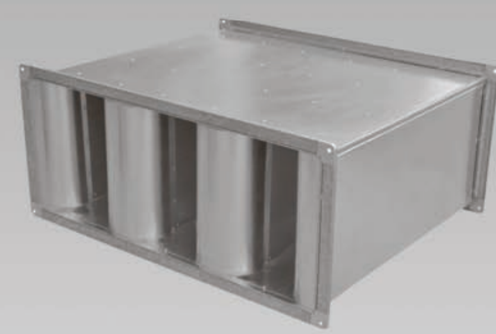
AIRODYNE

Sound Attenuators



Supply & Marketed By:

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AIRODYNE

INTRODUCTION

AIRODYNE Sound Attenuators are designed and manufactured using authentic computer selection software complying with **ASHRAE** standards, under technical guidelines of **'METRICO (UK)'.** Casings are formed with Pittsburgh longitudinal joints conforming to DW142 Class B ductwork code. Splitters are in compliance with Class 'O' building regulations. The infill material is inert, non-hygroscopic, non-combustible, vermin and rot proof, and does not support bacteriological growth. The AIRODYNE make attenuators have been successfully tested and certified by an **independent test laboratory**. The laboratory test certificate is available for review on demand.

AIRODYNE Sound Attenuators have Following Specifications and Options:

Pre-galvanized sheet steel casing.
SAL metal flanges standard. Metz optional.
Advance design with asymmetrical splitters.
Aerodynamically designed bull-nosed inlet.
Bull-nosed trailing edge (optional).
High acoustic performance.
High performance infill material covered with black glass tissue and having perforated pre-galvanized sheet metal facing.

Key Features

Increased low frequency attenuation.
More uniform attenuation over the acoustic spectrum.
Modular design for size flexibility.

Test Methods

Test methods used are in accordance with BS4718, ISO7235 and ASTM Standard E477-80 (Standard Method of Testing Duct Liner Materials and Prefabricated Silencers for Acoustical and Airflow Performance).
The following tests are performed on attenuator:

- **Static Insertion Loss in dB**
- **Dynamic Insertion Loss in dB**
- **Self-generated Airflow Noise in dB**
- **Pressure Loss with Airflow**

The laboratory test technique consists of feeding monitored noise and air from a source plenum down a matching rectangular duct through the attenuator, and into a 200 cubic meter acoustic reverberation chamber. Employing octave bands of noise from to 63Hz to 8,000Hz the insertion loss evaluations are obtained from a substitution technique, the attenuator being replaced by an exactly equal length of matching ductwork. The Static Insertion Loss is measured without airflow through the attenuator For the Dynamic Insertion Loss, monitored airflow passes through the attenuator both with (supply) and against (extract) the noise flow during the noise measurements. The Self-generated Air Flow Noise is measured in the reverberation chamber, octave band sound power levels are recorded in the bands from 63Hz to 8,000Hz. Aerodynamic Pressure Losses are recorded during the airflow experiments and related to the corresponding monitored uniform airflow in the supply duct and attenuator airways.
The measurement tolerances during these tests are held within the limits laid down in ASTM, E477-80, where stated.

Standard Construction

Sound attenuator casing is constructed with 1mm pre-galvanized sheet steel with mastic filled Pittsburgh longitudinal joints. The splitter are also fabricated with 1mm pre-galvanized sheet steel. The infill material used is fibreglass slabs of 48 kg/m3 density covered with Black Glass Tissue (BGT) to prevent the erosion of fibres into air stream. Perforated pre-galvanized sheet steel, 0.7mm thick, is provided over the BGT to further enhance the protection of fibres from erosion. The material used is 'Prime galvanized mild steel to BS 2989 Z2 G275 quality, lock forming and working up quality, normal spangle finish (N) coating type C'. Flanges are ready made flanges, and would generally be fabricated from pre-galvanized sheet as follows:

Where the width or height dimensions exceed 2500mm the flanges would be manufactured from hot dip galvanized rolled steel angle. Arranged within the casing would be attenuating splitter sections of sheet steel, fixed with self tapping screws. This type of construction has been tested in accordance with HVCA.

NOISE CONTROL PRINCIPLE

There are three distinct stages to the noise control process:

i Source
ii Transmission
iii Reception

It is correct, though impracticable, to propose that noise can be controlled at any of these stages. In the case of the fan, for example, the manufacturer has already produced a quiet design within the constraints of commercial prudence and the office worker is unlikely to take too kindly to the suggestion that the wearing of ear protectors is a satisfactory means of combating the air-conditioning noise! This leaves us with having to control the noise during transmission.

Noise control engineers have two weapons with which to combat noise - mass and absorption - usually applied in a combination. The term mass, for example, meaning the plantroom built of heavyweight materials and absorption being the splitter attenuators strategically located to acoustically seal **the ducts where they penetrate the mass barrier.**

Good Acoustic Design

It is commonly believed that the ventilation engineer having selected the quietest fan for the required duty need play no further role in noise control except perhaps to call in the noise control specialists at a later date. Frequently when this happens the acoustics engineer demands vast amount of valuable plantroom space for the attenuators or suggests dramatic changes in design. Both clearly can cost considerable time and money.

The obvious approach, even at the very early stages is to take the acoustical requirements into consideration. Certainly the ventilation engineer should seek advice regarding the following:

1. What noise criteria need to be achieved in the ventilated areas?
2. Is the criteria thus established likely to be achievable without the application of noise control techniques?
3. If noise control is required, ductwork design must leave sufficient space, preferably in straight duct runs. Plantrooms and plants should be located away from the noise sensitive area.
   Are plantroom walls substantial enough?
   Is sufficient pressure development available on the fans for attenuators?
4. Are neighbours likely to be attected by noise ?
   What, if any, atmospheric noise control is required ?
5. If plant has to be located close to noise sensitive areas or in false ceiling spaces what additional care should be taken in the initial selection of noisy items ?
6. Is the client aware that space restrictions imposed by him could result in noise problems: has the client, in applying for planning permission, had any requirements related to noise imposed upon him?

During the design stage, the common pitfalls should be avoided. These include:

a. Right angle bends and take-offs.
b. Ineffective expansions and contractions.
c. Incorrectly located dampers, heater batteries and cooling coils.
d. Fans located above lightweight ceilings or immediately above or below the most sensitive rooms.

CONSTRUCTIONAL DETAILS

AIRODYNE sound attenuators Type ADS are manufactured from galvanized sheet metal steel 1mm thick galvanized to BS 2989 Grade Z2 G275. Casings conform to DW142 Class B ductwork code.

Casings are formed with either stand-up or lock formed seams with mastic sealants. Casings are provided with slide on flanges on either side. The splitters, acoustic element arranged inside the casing, are in compliance with Class O building regulations. The infill material has a Black Glass Tissue (BGT) facing to withstand air velocities up to 20 m/s (3,935 fpm) without erosion of fibres into air stream. Additionally, a perforated sheet manufactured from galvanized sheet metal steel 0.7mm thick (standard) is provided over the BGT where the air velocities are greater than 15 m/s (2,950 fpm). This perforation can withstand air velocities up to 30 m/s (5,900 fpm) without erosion and damage to infill fibres.
The splitters would be arranged inside the casing and fixed with sealed pop rivets. Self tapping screws would be used to fix the splitters where the casing dimensions exceed 2500mm. The splitters are arranged so that the attenuator will have half a splitter on the sides, while the rest whole splitters are arranged in between, to provide extra rigidity to the attenuator and to prevent flanking of the casing under fluctuating pressures.

Acoustic Infill

Incorporated within the splitter frames would be our acoustic media consisting of semi-rigid fiberglass slabs of 48 kg/m3 density (standard) packed under compression so as to avoid formation of voids inside the splitter.

The material is inert, non-hygroscopic, non-combustible, vermin proof, rot proof and does not support any bacteriological growth. The material has Class 1 rating for surface spread of flame as measured to BS 476 Part 7, 1971.

Robust Construction

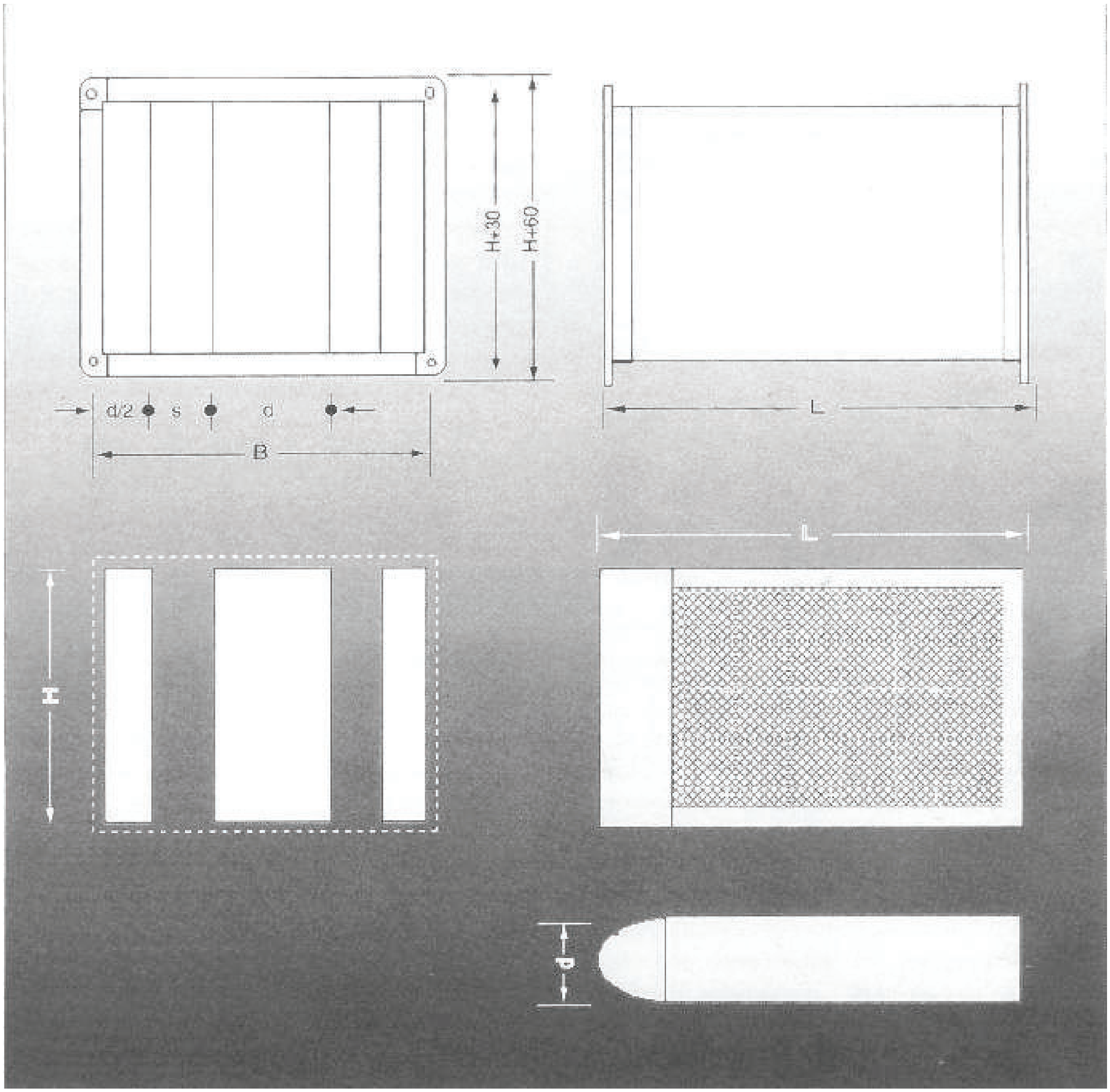
Casings are formed using mastic filled Pittsburgh longitudinal joints with flange type connection on either side. Casings would be turned back 12.5mm over the face of each end flanges. A 35mm readymade flange fabricated from pre-galvanized steel is used. Where the dimensions of the casing exceed 2500mm, end flanges would be manufactured from 5mm hot dip galvanized rolled steel angles and welded to the casing. This type of construction has been tested in accordance with HVCA specifications DW142 at a pressure of 2500 N/m2 and a leakage class of 'D' was obtained.

Paint Finish (Optional)
Electrostatic Polyester Powder Paint finish is available in range of RAL colours. This is a very durable finish now accepted within the industry as offering the best option for pre-galvanized sheet steel.

NOMENCLATURE:

B	In mm	:	Width inside duct
H	in mm	:	Height inside duct
L	in mm	:	Length
d	in mm	:	Splitter thickness
s	in mm	:	Airway width
V	in CMH	:	Volume Flow Rate
Vt	in m/s	:	Face Velocity based on [BxH]
Vs	in m/s	:	Face velocity in the airway gap
Dp	in Pa	:	Pressure Loss
NC		:	Noise Criteria

DIMENSIONAL DETAILS



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TERMINOLOGY

The following terms are commonly used in the field of accoustics and an understanding of their practical (rather than academic) meaning and importance might be of use to the ventilation engineer.

Sound Power Level (SWL)

A theoretical assessment of sound produced at source calculated from the measured sound pressure levels at known distances from the source under known acoustic conditions.

A level which depends only on the source and is independent of the environment or location.

The sound power level of a fan is therefore very useful information since any level quoted can be compared directly with data from any other manufacturer

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Sound Pressure Level (SPL)

A measured sound level which is an indication only of the noise produced at source since environmental factors such as distance from the source have affected the measurement. The sound pressure level of a fan is not very useful since environmental factors apparent when the unit was measured may or may not be present in the actual location of the plant.

Decibel (dB)

Commonly, the unit used to measure sound. It is a logarithmic ratio of two sound pressures or sound powers where one is a reference level. Care must be exercised when mathematically manipulating decibels.

Criteria

Noise levels which are subjectively or objectively acceptable in a given environment. The most commonly used criteria are "Noise Criteria Curves (NC Levels), Noise Rating Curves (NR Levels) and dB (A)".

Ductborne Noise

Noise which is transmitted along ductwork, both upstream and downstream of a fan.

Flanking Noise (Breakout)

Noise transmitted through a barrier, often a fan casing or ductwork. Any indirect noise path which tends to devalue noise control measures used to reduce transmission along the more obvious paths.

Noise Outlet

Any opening acting as a terminal element on either extract or supply system; usually a grille or a diffuser.

Insertion Loss

A measure of the noise reduction capability of an attenuator (sometimes of a partition) so named after the method of testing where a section of ductwork in replaced by an attenuator between two test rooms. One room contains the noise source and the other the sound level measuring equipment. The difference in recorded noise level is said to be the insertion loss due to the insertion of the attenuator in the system.

Regenerated Noise

Noise in addition to that produced by the fan, caused by air passing over fixed duct elements such as blades on grilles, dampers, air turns, splitters in attenuators, etc., is not normally a problem on low velocity system and is not dealt in this booklet.

Octave Bands

Subdivisions of the frequency range each identified by its mid (or center) frequency. By international agreements these comprise 63, 125, 250, 500, 1k, 2k, 4k, and 8k Hz.

Frequency (Hz)

The pitch of sound. The number of sound pressure waves arriving at a fixed point per second.

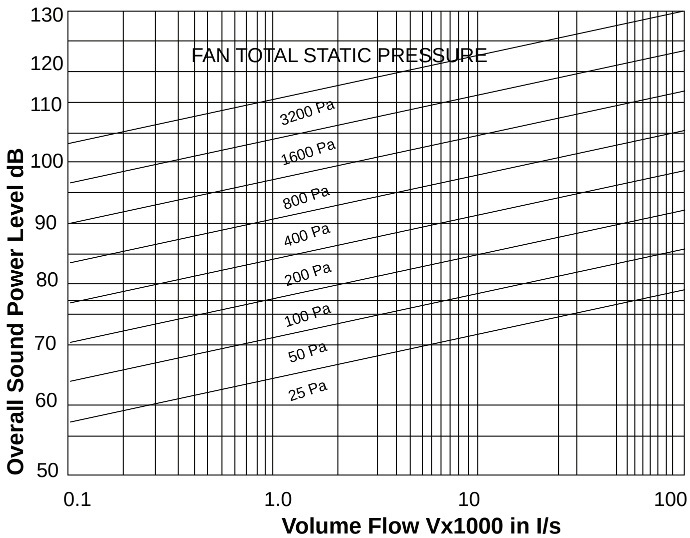
SYSTEM ANALYSIS

A system analysis should be carried out on all fan systems having ducted connections to the area under consideration. We recommend that requirements for NC30 or below be checked before final design.

SECTION 1
METHOD TO FIND THE IN-DUCT SWL OF THE FAN

A- Using the fan manufacture's catalogue information, obtain the In-duct Sound Power Level at the mid-frequency Octave Bands of interest, or calculate the approximate In-duct Sound Power Level from Table 1. In both cases the approximate duty of the fan needs to be known.
These figures are inserted in line a.
Some manufactures present noise data as a Sound Pressure Level which needs to be converted by applying the relevant correction factor.

Table 1: In-duct SWL of the fan



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	-5	-5	-6	-7	-8	-11	-14	-17

SECTION 2
METHOD TO FIND THE DUCT SYSTEM BETWEEN THE FAN AND THE CRITICAL NOISE OUTLET

The "critical" noise outlet in the duct system is usually the noise outlet closest to the fan.
Using the following information assess the total duct attenuation.

B- Straight unlined ducts provide a degree of attenuation. This is frequency dependent and Varies with the minium duct dimension and duct length.
Approximate attenuation per metre run is shown in Table 2. Bends provide attenuation as shown in Table 3a and 3b.
Duct and bend attenuation figures should be entered against lines b.
Note : For most practical purposes the attenuation produced by cylindrical ducts can be ignored.

Table 2: The Attenuation of Straight Unlined Rectangular Duct - dB per meter

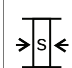
	Minimum dust dim S mm	Octave center frequency, fm in Hz							
		63	125	250	500	1k	2k	4k	8k
	-200	0.6	0.6	0.45	0.3	0.3	0.3	0.3	0.3
	201-400	0.6	0.6	0.45	0.3	0.2	0.2	0.2	0.2
	401-800	0.6	0.6	0.3	0.15	0.15	0.15	0.15	0.15
	801-1600	0.3	0.15	0.15	0.1	0.06	0.06	0.06	0.06

Table 3a: The Attenuation Of Mitred Bends With Short Chord Turning Vanes Or No Turing Vanes

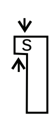
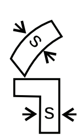
	Dimension S mm	Octave center frequency, fm in Hz							
		63	125	250	500	1k	2k	4k	8k
	-200	0	0.6	0	0	6	8	4	3
	201-400	0	0.6	0	6	8	4	3	3
	401-800	0	0.6	0	8	4	3	3	3
	801-2000	0	0.15	6	4	3	3	3	3

Table 3b: The Attenuation Of Mitred Bends With Log Chord Turning Vanes Or Radiussed Bends (circular Or Rectangular Duct)

	Dimension S mm	Octave center frequency, fm in Hz							
		63	125	250	500	1k	2k	4k	8k
	-250	0	0	0	0	1	2	3	3
	201-400	0	0	0	1	2	3	3	3
	401-800	0	0	1	2	3	3	3	3
	801-2000	0	1	2	3	3	3	3	3

C - At low frequencies some of the sound power on reaching the critical noise outlet is reflected back along the duct. The degree of attenuation due to this phenomenon is dependent of frequency and the total area of the outlet.

D - The total duct attenuation is obtained from lines b and c and is inserted in line d.

E - The Sound Power Level leaving the critical outlet is obtained from: e=a-d

F - By examining Table 4, select the location type (A or B or C) which is closest to matching the position of the critical outlet in the room. Using the charts for the chosen location type and outlet area, insert the factors obtained in line h.

Note: these figures are positive and to avoid possible confusion the positive sign should also be inserted in line h.

G - The factors tabulated at each Octave Band in lines f, g and h are now added together in line i, to give the total Direct Factors, remembering that the factors in line h are positive.

H - The Direct sound Pressure Level in the room is equal to the sum of the Sound Power Level leaving the Critical Outlet in line e and the Total Direct Factors shown in line i.

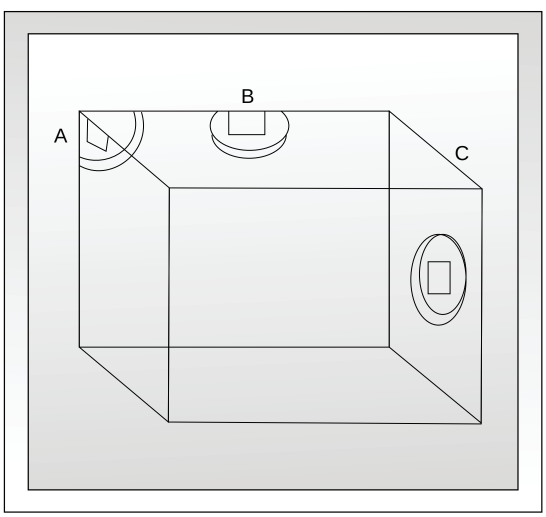
Alternative To estimate the ***Reverberant Sound Pressure Level.***

I - For the fan system in question, calculate the percentage of the sound emerging from all the noise outlets in the room served by the fan.

This approximates to the percentage of the fan air volume serving the room under investigation. Using Table 5 insert the factor in line k.

Table 4 : Directivity Factor, dB

Type A	Junction of three room surfaces = + 9 throughout



Type B	Junction of two room surfaces		
Outlet area, cm^2 (10 – 100 – 1000 – 10000)			
+6	+7	+8	
+6	+7	+8	
+6	+7	+8	+9
+6	+7	+8	+9
	+7	+8	+9
+7	+8	+9	
+7	+8	+9	
+8	+9		

Type C	Center of one room surface					
Outlet area, cm^2 (10 – 100 – 1000 – 10000)						
+3	+4	+5	+6	+7		
+3	+4	+5	+6	+7	+8	
+3	+4	+5	+6	+7	+8	+9
+3	+4	+5	+6	+7	+8	+9
+4	+5	+6	+7	+8	+9	
+5	+6	+7	+8	+9		
+7	+8	+9				
+8	+9					

Octave Center frequency, in Hz	63	120	250	500	1k	2k	4k	8k

Table 5: Percentage of Total Sound-factors, dB

-20	-19	-18	-17	-16	-15	-14	-13	-12	-11	-10	-9	-8	-7	-6	-5	-4	-3	-2	-1	-0

1 2 3 4 5 10 20 50 100

Percentage

Note: Since "Ashrea" Chapter -7 does not recommend Reverberant SPL, it is ignored in our selections

J - The amount of reflection or absorption of the sound emerging from the noise outlets depends upon the volume and the reverberation time (which is a function of amount of absorption) of the room. Table 6 and 7 give the factors related to these which are inserted in lines **l** and m respectively.

K - The factors tabulated at each Octave Band in lines k, I and m are now added together in line n, to give the Total Reverberant Factors.

L - The Reverberant Sound Pressure Level (line o) in the room is equal to the sum of the Sound Power Level leaving the Critical Outlet (line e) and the Total Reverberant Factors (line n).

M -To arrive at the Combined Sound Pressure Level, it is necessary to logarithmically sum the Reverberant Sound Pressure Level and the Direct Sound Pressure Level. This can be simplified by using Table 8. The combined pressure level can then be entered in line p.

Table 6: Room Volume Factor, dB

+10	
+9	3
+8	
+7	5
+6	
+5	
+4	10
+3	
+2	
+1	20
+0	
-1	
-2	
-3	50
-4	
-5	
-6	100
-7	
-8	
-9	200
-10	
-11	
-12	
-13	500
-14	
-15	
-16	1000
-17	
-18	
-19	2000
-20	
-21	
-22	
-23	5000
-24	
-25	
-26	10000
-27	
-28	

Table 7: Reverberation Time Factor, dB

-11	
-10	
-9	
-8	
-7	
-6	
-5	
-4	Average furnishing
-3	Average furnishing
-2	Average furnishing
-1	Limited furnishing
0	Limited furnishing
+1	Limited furnishing
+2	No furnishing
+3	No furnishing
+4	No furnishing
+5	Very hard surfaces, high ceilings
+6	Very hard surfaces, high ceilings
+7	Very hard surfaces, high ceilings
+8	
+9	
+10	
+11	

Table 8: Addition Of Sound Pressure Levels, dB

Differences in SPLs	Add to Larger SPL
0,1	+3
2,3	+2
4,5,6,7,8,9	+1
10+	+0

SECTION 3

METHOD TO FIND REQUIRED INSERTION LOSS

N - The specification will usually give a criterion; where one is not given, Table 9 can be used.

The required or selected criterion is inserted in line q.

O - If the Combined Sound Pressure Level exceeds the Criterion in any Octave Band, then the deference is the Insertion Loss required from the attenuator (line r).

To allow for the possible addition of noise from other sources a safety margin of typically 3dB may be added.

P - The attenuator can now be selected to meet the parameters of Insertion Loss, physical size and the pressure loss. The Insertion Loss figures are placed in line s as a final check.

The above analysis method takes no account of regenerated noise from attenuators or ductwork elements.

Similarly, it is not possible to deal with the method of selecting attenuators for high pressure systems which commonly have terminal devices that generate noise and often have some attenuation capability.

Table 9: Recommended Design Criteria of Various Area Functions (according to ASHRAE).

Situation	NC
Concert halls, opera halls, studios for sound reproduction, live theaters (>500 seats)	20
Bedrooms in private homes, live theaters (<500 seats) cathedrals and large churches, television studios, large conference and lecture rooms (>50 people)	25
Living rooms in private homes, board rooms, top management offices, conference and lecture rooms (20-50 people), multi-purpose, halls, churches (medium and small), libraries, bedrooms in hotels, etc., banqueting rooms, operating theaters, cinemas, hospital private rooms, large courtrooms	30
Public rooms in hotels, etc., ballrooms, hospital open wards, middle management and small offices, small conference and lecture rooms (<20 people), school classrooms, small courtrooms, museums, libraries, banking halls, small restaurants, cocktail bars, quality shops	35
Toilets and washrooms, large open offices drawing offices, reception areas (offices), halls, corridors, lobbies in hotels hospital etc., laboratories, recreation rooms, post offices. large restaurants, bars and night clubs, department stores, shop gymnasia	40
Kitchens in hotels, hospitals, etc., laundry rooms, computer rooms, accounting machine rooms, cafeteria, canteens, supermarkets, swimming pools, covered garages in hotels, offices etc., bowling alleys	45

ATTENUATOR QUICK SELECTION TABLE

Type of Ventilated Area Being Served by Low Velocity System Utilizing DW 142 Classes A or B Ductwork

		Rooms with average furnishings: Floor carpeted			Rooms with limited furnishings: mainly hard surfaces			Rooms with soft furnishings			
		Offices, Banks, Libraries, Lecture Rooms, Restaurants, Departmental-stores			Hospital areas, Supermarkets, Computer rooms Laboratories, Cafes Dance Halls, Museums, Canteens, Toilets			Dance Halls, Museums, Canteens, Toilets			High Velocity CV/VAV Systems incorporating Terminal units, and utilizing DW 142 Class C ductwork.
Fan Static Pressure		**250Pa**	**500Pa**	**1000Pa**	**250Pa**	**500Pa**	**1000Pa**	**250Pa**	**500Pa**	**1000Pa**	**2000Pa**
Criterion	Model	Attenuator Length in mm			Attenuator Length in mm			Attenuator Length in mm			Attenuator Length in mm
NC 40	ADS20-100	900	900	900	900	900	1200	900	1200	1500	1200
	ADS20-150	900	1200	1200	1200	1500	1800	1500	1800	2100	1800
NC 40	ADS20-100	900	900	1200	1200	1200	1500	1200	1500	1500	1500
	ADS20-150	1200	1500	1800	1500	1800	2100	1800	2100	2100	2100
NC 30	ADS20-100	1200	1200	1500	1500	1500	1800	1500	1800	1800	1800
	ADS20-150	1500	1800	2100	1800	2100	2400	1800	2100	2400	2400

ATTENUATOR WEIGHT TABLE

Width B in mm	ADS20 -75	275	550	825	1100	1375	1650	1925
	ADS20-100	300	600	900	1200	1500	1800	2100
	ADS20-150	350	700	1050	1400	1750	2100	-
Number of modules		1	2	3	4	5	6	7
Length L in mm	Height H in mm							
600	300	16	26	36	46	56	64	70
	600	23	36	49	62	75	87	95
	900	30	46	62	78	94	110	120
	1200	37	56	75	93	113	132	145
	1500	-	66	82	110	131	153	169
	1800	-	-	106	132	159	185	205
900	300	22	36	49	63	77	90	98
	600	31	49	66	84	102	119	130
	900	41	63	84	106	126	150	164
	1200	50	76	101	127	153	179	197
	1500	-	90	116	148	178	207	229
	1800	-	-	144	180	216	252	280
1200	300	26	44	61	79	97	115	123
	600	38	60	82	104	127	149	162
	900	50	78	106	133	161	189	207
	1200	63	95	127	160	192	225	248
	1500	-	113	149	186	224	261	289
	1800	-	-	182	227	273	319	355
1500	300	30	51	72	92	113	134	144
	600	44	70	96	121	147	173	188
	900	58	90	122	154	186	218	239
	1200	72	110	147	185	222	259	286
	1500	-	130	172	215	258	301	333
	1800	-	-	210	262	315	368	409
1800	300	42	70	95	122	150	176	193
	600	60	96	130	165	201	235	256
	900	80	124	166	208	252	279	325
	1200	98	150	199	250	301	355	390
	1500	-	178	230	293	351	411	454
	1800	-	-	284	355	427	500	554
2100	300	46	78	108	140	172	203	219
	600	67	107	146	186	227	265	290
	900	89	138	187	236	286	335	365
	1200	110	167	225	284	340	400	440
	1500	-	200	261	330	398	464	513
	1800	-	-	322	401	485	565	692

Width in Modules		One Module	Each additional Module
Length L in mm	Height H in mm	Weight Kg + 10 %	
600	300	6	5
	600	10	8
	900	14	10
	1200	17	13
	1500	20	15
	1800	27	17
900	300	9	7
	600	14	10
	900	20	14
	1200	25	18
	1500	30	21
	1800	39	25
1200	300	11	8
	600	17	13
	900	25	18
	1200	34	23
	1500	42	27
	1800	55	31
1500	300	13	10
	600	21	16
	900	30	22
	1200	34	28
	1500	51	32
	1800	66	38
1800	300	17	11
	600	28	19
	900	39	25
	1200	55	32
	1500	66	37
	1800	78	45
2100	300	19	13
	600	30	19
	900	44	28
	1200	61	35
	1500	75	44
	1800	88	52

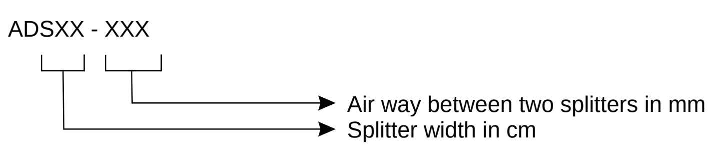
Note : Total weights for larger units can be obtained by summation of above information.

Note that if any of the following dimensions are exceeded the units would normally be supplied in sections:
B = 2100 mm   H = 1800mm   L = 2100mm

INSERTION LOSS TABLE

Attenuator		Octave Center Frequency, fm in Hz							
Type	**Length L in mm**	63	125	250	500	1k	2k	4k	8k
ADS20-75	**600**	7	11	19	31	45	36	29	20
ADS20-75	**900**	9	14	26	49	50	50	37	29
ADS20-75	**1200**	10	18	33	50	50	50	47	38
ADS20-75	**1500**	12	21	40	50	50	50	50	45
ADS20-75	**1800**	13	24	47	50	50	50	50	50
ADS20-75	**2100**	15	28	50	50	50	50	50	50
ADS20-75	**2400**	17	31	50	50	50	50	50	50
ADS20-100	**600**	6	9	14	22	36	28	21	15
ADS20-100	**900**	8	11	19	31	48	37	28	21
ADS20-100	**1200**	9	14	25	41	50	48	34	27
ADS20-100	**1500**	11	17	30	50	50	50	42	33
ADS20-100	**1800**	12	20	34	50	50	50	49	39
ADS20-100	**2100**	14	23	39	50	50	50	50	45
ADS20-100	**2400**	15	26	44	50	50	50	50	50
ADS20-150	**600**	5	7	11	17	24	20	13	11
ADS20-150	**900**	6	9	14	24	33	25	18	15
ADS20-150	**1200**	7	11	18	31	42	33	23	19
ADS20-150	**1500**	8	12	22	39	50	40	28	23
ADS20-150	**1800**	9	14	25	45	50	47	34	27
ADS20-150	**2100**	10	16	29	50	50	50	39	31
ADS20-150	**2400**	11	19	32	50	50	50	44	35
ADS20-200	**600**	5	6	9	13	18	14	10	9
ADS20-200	**900**	6	7	12	20	25	20	14	12
ADS20-200	**1200**	6	9	14	25	33	25	18	15
ADS20-200	**1500**	7	10	18	30	40	31	22	18
ADS20-200	**1800**	8	11	20	35	48	37	26	21
ADS20-200	**2100**	8	13	24	40	50	42	30	24
ADS20-200	**2400**	9	15	26	45	50	48	34	27

For Air way less than 75mm please refer to computer selection or contact factory for further details.



PRESSURE LOSS DATA Model: ADS20 -75

Pressure Loss, Δp		15	25	35	50	60	75	85	100
Face velocity, V_t (m/s)		1.6	2.1	2.4	2.9	3.2	3.5	3.8	4
Face velocity, V_S (m/s)		5.9	7.7	8.8	10.6	11.7	12.9	14.0	14.7
Attenuator self noise		NC 25			NC 30		NC 35		
Width B (mm)	Height H (mm)	Volume Flow Rate, V (CMH)							
275	150	235	308	360	434	469	524	559	595
	300	469	614	721	865	937	1046	1117	1188
One	450	721	937	1081	1297	1442	1549	1693	1800
Module	600	937	1261	1442	1729	1909	2089	2270	2377
	750	1188	1549	1800	2161	2377	2593	2810	2989
	900	1442	1873	2125	2593	2846	3133	3385	3565
550	300	937	1261	1442	1729	1909	2089	2270	2377
	450	1442	1873	2125	2593	2846	3133	3385	3565
Two	600	1909	2485	2846	3458	3818	4177	4502	4753
Modules	750	2377	3133	3565	4321	4753	5185	5654	5942
	900	2846	3745	4286	5185	5690	6231	6769	7130
	1050	3313	4357	5007	6015	6662	7274	7886	8318
825	450	2125	2810	3206	3890	4286	4682	5078	5365
	600	2846	3745	4286	5185	5690	6231	6769	7130
Three	750	3556	4682	5365	6446	7130	7815	8463	8930
Modules	900	4286	5619	6411	7742	8570	9362	10154	10695
	1050	5007	6554	7490	9039	9974	10911	11847	12495
	1200	5690	7490	8570	10334	11416	12495	13539	14260
1100	600	3818	5007	5690	6878	7597	8318	9039	9506
	750	4753	6231	7130	8607	9506	10407	11307	11883
Four	900	5690	7490	8570	10334	11416	12459	13539	14260
Modules	1050	6662	8750	9974	12063	13323	14547	15808	16636
	1200	7597	9947	11416	13790	15195	16636	18076	19013
	1350	8570	11235	12820	15519	17104	18724	20308	21388
1375	750	5942	7815	8930	10766	11883	12998	14115	14872
	900	7130	9362	10695	12927	14260	15591	16924	17825
Five	1050	8318	10911	12459	15088	16636	18183	19768	20813
Modules	1200	9506	12495	14260	17248	19013	20813	22576	23764
	1350	10695	14044	16060	19372	21388	23404	25384	26753
	1500	11883	15591	17825	21532	23764	25996	28230	29706
1650	900	8570	11235	12820	15519	17104	18724	20308	21388
	1050	9974	13107	14979	18076	19948	21821	23729	24953
Six	1200	11416	14979	17104	20669	22829	24953	27078	28518
Modules	1350	12820	16852	19264	23261	25673	28086	30462	32082
	1500	14260	18724	21388	25854	28518	31181	33847	35647
	1650	15700	20596	23513	28446	31362	34315	37267	39212
	1800	17104	22469	25673	31001	34206	37448	40652	42775

The pressure loss data is for 1200 mm length. Use correction factor for other lengths as follows:

Length L in mm	600	900	1200	1500	1800	2100	2400
p factor	x 0.90	x 0.95	x 1.00	x 1.05	x 1.10	x 1.15	x 1.20

PRESSURE LOSS DATA Model: ADS20-100

Pressure Loss, Δp		15	25	35	50	60	75	85	100
Face Velocity, V_t (m/s)		2.1	2.7	3.2	3.8	4.2	4.7	5	5.4
Face Velocity, V_S (m/s)		6.3	8.1	9.6	11.4	12.6	14.1	15.0	16.2
Attenuator Self noise		NC 25			NC 30		NC 35		
Width B(mm)	Height H(mm)	Volume Flow Rate, V (CMH)							
300	150	343	434	524	614	685	757	811	822
	300	685	865	1046	1226	1369	1513	1622	1765
One	450	1010	1297	1549	1838	2054	2270	2450	2630
Module	600	1369	1765	2089	2450	2737	3062	3242	3494
	750	1693	2196	2593	3097	3422	3810	4070	4393
	900	2054	2630	3097	3709	4070	4573	4862	5258
600	300	1396	1765	2089	2450	2737	3062	3242	3494
	450	2054	2630	3097	3709	4070	4573	4862	5258
Two	600	2737	3494	4141	4933	5438	6086	6482	6985
Modules	750	3422	4393	5185	6157	6807	7635	8102	8750
	900	4070	5258	6231	7381	8174	9146	9717	10515
	1050	4753	6122	7274	8607	9542	10659	11342	12243
	1200	5438	6985	8282	9867	10875	12170	12963	13790
900	450	3062	3925	4682	5545	6122	6843	7310	7886
	600	4070	5258	6231	7381	8174	9146	9722	10515
Three	750	5114	6554	7778	9255	10227	11416	12170	13143
Modules	900	6122	7886	9326	11091	12243	13719	14583	15735
	1050	6122	7886	9326	11091	12243	13719	14583	15735
	1200	8174	10515	12459	14763	16347	18292	19945	20992
	1350	9182	11812	14008	16636	18363	20560	21893	23622
1200	600	5438	6985	8282	9867	10875	12170	12963	13790
	750	6807	8750	10370	12315	13612	15232	16203	17500
Four	900	8174	10515	12459	14763	16347	18292	19445	20992
Modules	1050	9542	12243	14511	17248	19049	21316	22685	24485
	1200	9542	12243	14511	17248	19049	21316	22685	24485
	350	12243	15735	18652	22180	24485	27401	29165	31506
	1500	13612	17500	20740	24630	27222	30823	32405	34998
1500	750	8498	10946	12963	15412	17032	19049	20273	21893
	900	10277	13143	15555	18472	20417	22865	24305	26250
Five	1050	11919	15303	18148	21568	23837	26646	28373	30643
Modules	1200	13612	17500	20740	24630	27222	30462	32405	34998
	1350	13612	17500	20740	24630	27222	30462	32105	34998
	1500	13612	17500	20740	24630	27222	30462	32405	34998
	1650	18724	24053	28518	33883	37448	41876	44576	48141
	1800	20417	26250	31110	36943	40832	45693	48608	52498
1800	900	12243	15735	18652	22180	24485	27401	29165	31506
	1050	14295	18363	21784	25854	28589	31974	34027	36763
Six	1200	16347	20992	24881	29561	32659	36547	38888	41983
Modules	1350	18363	23622	28014	33235	36763	41120	43748	47241
	1500	20417	26250	31110	36943	40832	45693	48608	52498
	1650	20417	26250	31110	36943	40832	45693	48608	52498
	1800	24485	31506	37339	44324	49004	54839	58330	63011
	1950	26537	34134	40436	48034	53074	59410	63191	68233

The pressure loss data is for 1200 mm length. Use correction factor for other lengths as follows:

Length L in mm	600	900	1200	1500	1800	2100	2400
p factor	x 0.90	x 0.95	x 1.00	x 1.05	x 1.10	x 1.15	x 1.20

PRESSURE LOSS DATA Model: ADS20-150

Pressure Loss, ∆p		15	25	35	50	60	75	85	100
Face Velocity, V_t (m/s)		3	3.9	4.6	5.5	6	6.7	7.1	7.7
Face Velocity, V_S (m/s)		7.0	9.1	10.7	12.9	14.0	15.6	16.6	18.0
Attenuator Self noise		NC 25			NC 30		NC 35		
Width B(mm)	Height H(mm)	Volume Flow Rate, V (CMH)							
350	150	576	740	965	1046	1136	1261	1352	1459
	300	1153	1477	1729	2089	2270	2521	2701	2917
One	450	1693	2196	2593	3133	3422	3818	4034	4357
Module	600	2270	2953	3494	4177	4537	5078	5365	5834
	750	2846	3674	4367	5185	5690	6338	6698	7274
	900	3422	4430	5222	6231	6807	7597	8067	8750
700	450	3422	4430	5222	6231	6807	7597	8067	8750
	600	4537	5906	6950	8318	9075	10118	10730	11631
Two	750	5690	7381	8714	10407	11342	12675	13394	14547
Modules	900	6807	8859	10443	12495	13612	15195	16096	17464
	1050	7958	10334	1270	14547	15880	17716	18795	20380
	1200	9075	11812	13899	16636	18148	20273	21461	23397
1050	600	6807	8859	10441	12495	13612	15195	16096	17464
	750	8498	11055	13036	15591	17032	19013	20128	21821
Three	900	1027	13287	15224	18724	20417	22792	24160	26214
Modules	1050	11919	15484	18256	21821	23837	26610	28193	30569
	1200	13612	17680	20885	24953	27222	30389	32227	34927
	1350	15303	18812	23477	28086	30643	34206	36224	39284
	1500	17032	22109	26070	31181	34027	37987	40256	43676
1400	750	11342	14727	17391	20813	22685	25349	26862	29130
	900	13612	17680	20886	24953	27222	30389	32227	34927
Four	1050	15880	20633	24341	29130	31758	35467	37590	40759
Modules	1200	18148	23584	27834	33271	36295	40543	42956	46592
	1350	20417	26537	31290	37448	40832	45584	48321	52389
	1500	22685	29490	34782	41587	45368	50662	53686	58223
	1650	24953	32443	38276	45764	49905	55738	59051	6456
	1800	27222	35394	41732	49905	54443	60778	64416	69853
1750	900	17032	22109	26070	31181	34027	37987	40256	46376
	1050	19841	25818	30427	36402	39715	44324	46988	50949
Five	1200	22685	29490	34782	41587	45368	50662	53686	58223
Modules	1350	25529	33451	39139	46772	51058	56998	60382	65496
	1500	28373	36871	43496	51993	56710	63335	67116	72769
	1650	31181	40543	47818	57178	62399	69673	73812	80043
	1800	34027	44253	52173	62399	68053	76009	80546	87351
	1950	36871	47925	56530	67332	73741	82311	87244	94625
	2100	39715	51597	60887	72769	79393	88648	93940	101898
2100	1050	23837	30966	36511	43676	47637	53181	56386	61139
	1200	27222	35394	41732	49905	54443	60778	64416	69853
Six	1350	30643	39824	46952	56134	61248	68411	72481	78601
Modules	1500	34027	44253	67473	62399	68053	76009	80546	87351
	1650	37448	48646	57394	68629	74858	83606	88575	96065
	1800	40832	53074	62616	74858	81663	91203	96642	104814
	1950	44253	57503	67837	81087	88252	98801	104671	113528

The pressure loss data is for 1200 mm length. Use correction factor for other lengths as follows:

Length L in mm	600	900	1200	1500	1800	2100	2400
p factor	x 0.90	x 0.95	x 1.00	x 1.05	x 1.10	x 1.15	x 1.20

QUICK SELECTION METHOD - 250Hz

Selecting the Attenuator

After having calculated the required insertion loss through System Analysis, a suitable size of the sound attenuator can be selected, to achieve the estimated required insertion loss, based on the information on acceptable pressure drop, air flow rate, flow regenerated noise, dimensions etc., provided by the customer for the attenuator in an air conditioning system (e.g. to VDI 2081 of VDI 2714).

The calculation requirements for the sound attenuator are used to optimize the selection – in particular, taking price into account – as suitable and reliable selection aids.

Nomenclature

B	in mm	: Width inside duct
H	in mm	: Height inside duct
L	in mm	: Length of the attenuator
d	in mm	: Splitter thickness
s	in mm	: Airway gap
n		: Number of splitters (Modules)
V	in CMH	: Volume flow rate
V_t	in m/s	: Face velocity based on [B x H]
V_s	in m/s	: Face velocity in the airway gap

$$V_t = V_s \cdot \frac{s}{d+s}$$

$$V_s = V_t \cdot \frac{d+s}{s}$$

$\triangle p$	in Pa	: Pressure loss
NC		: Noise Criteria
f_m	Hz	: Octave centre frequency
D_e	in dB	: Insertion loss
L_W	in dB	: Flow regenerated sound power level
L_W	in dB(A)	: A-weighted sound power level of flow regenerated noise
L	in dB(A)	: A-weighted sound pressure level of flow regenerated noise
L_S	in dB	: Correction for BxH = 1m^2

Use of Diagrams

By combining the various performance parameters, AIRODYNE has been able to provide a monograph system for selection. In addition, the A-weighted sound pressure level L [in dB(A)] for flow regenerated noise base on outlet size (BxH).

The pressure drop graphs apply to an attenuator length of one metre with duct connections at either end. Refer relevant pages for correction values.

Rule of Thumb

Small airway	=	Short length, large attenuator cross section
Large airway	=	Long length, small attenuator cross section

Example

Data given:

Required insertion loss at f_m 250 Hz	D_e = 17 dB
Max. specified length of attenuator	L = 1000 mm
Max. specified pressure drop	Δp = 60 Pa
Volume flow rate	V = 10800 CMH

Results:

Length	L = 1000 mm
Airway gap	s = 100 mm
Splitter thickness	d = 200 mm
Pressure drop	Δp = 40 Pa
Air velocity in the airway	V_s = 6.3 m/s
Flow regenerated noise	L = 40 dB(A)
Height	H = 900 mm
Width	B = 1200 mm
No. of splitters	n = 4

Order Information

ADS20-100 | 1200 x 900 x 1000

Alternate selections - with other data unchanged:

	a)	b)
Height, H mm	450mm	1800mm
Width, B mm	2400 mm	600 mm
No. of splitters, n	8	2

SELECTION TABLE (1,000...22,000 m^3/h)

Selection Table ADS20

The volume flow rate given in the table is calculated for the given sound attenuator at a pressure drop of Δp of 50 Pa. L is the sound pressure level (to VDI 2081) of the flow regenerated noise at the attenuator discharge.

V_S = Airway velocity in m/s

n = number of splitters in the sound attenuator

The A-weighted sound power level of the flow regenerated noise corresponds to $L_W = L + L_S$ [in dB(A)].

Volume Flow Rate, V at Δp of 50Pa (Part 1)

Splitter Attenuator			Insertion loss at 250 Hz in dB						
			11	19	28	36	45	50	
			Length of attenuator, L in mm						
			500	1000	1500	2000	2500	3000	
L in dB (A)			45	44	43	42	40	39	
V_S in m/s			10.1	9.6	9.3	9.0	8.6	8.3	
n	Width mm	Height mm	Volume Flow Rate, V (CMH)						L_S
1	300	300	1091	1037	1000	968	930	896	-10
		450	1636	1155	1500	1452	1395	1344	-9
		600	2182	2074	2000	1935	1860	1793	-7
		900	3272	3110	3000	2903	2796	2689	-9
2	600	300	2182	2074	2000	1935	1860	1793	-7
		450	3272	3110	3000	2903	2790	2689	-6
		600	4363	4147	4000	3871	3720	3586	-4
		900	6545	6221	6000	5806	5579	5378	-3
		1200	8726	8294	8000	7741	7439	7171	-1
		1500	10908	10368	10000	9677	9299	8994	±0
		1800	13090	12442	12000	11612	11159	10757	±0
3	900	300	3272	3110	3000	2903	2790	2689	-6
		450	4909	4666	4500	4355	4184	4034	-4
		600	6545	6221	6000	5806	5579	5378	-3
		900	9817	9331	9000	8709	8369	8068	-1
		1200	13090	12442	12000	11612	11159	10757	±0
		1500	16362	15552	15000	14515	13948	13446	+1
		1800	19634	18662	18000	17418	16738	16135	+2
4	1200	300	4363	1447	4000	3871	3720	3566	-4
		450	6545	6221	6000	5806	5579	5378	-3
		600	8726	8294	8000	7741	7439	7171	-1
		900	13090	12442	12000	11612	11159	10757	±0
		1200	17453	16589	16000	15483	14878	14342	+2
		1500	21861	20736	20000	19354	19859	17928	+3
		1800	26189	24883	24000	23224	22317	21514	+3

SELECTION TABLE (5,000...45,000 m^3/h)

Selection Table ADS20

The volume flow rate given in the table is calculated for the given sound attenuator at a pressure drop of Δp of 50 Pa. L is the sound pressure level (to VDI 2081) of the flow regenerated noise at the attenuator discharge.

V_S = Airway velocity in m/s

n = number of splitters in the sound attenuator

The A-weighted sound power level of the flow regenerated noise corresponds to $L_W = L + L_S$ [in dB(A)].

Volume Flow Rate, V at Δp of 50Pa (Part 2)

Splitter Attenuator			Insertion loss at 250 Hz in dB						
			11	19	28	36	45	50	
			Length of attenuator, L in mm						
			500	1000	1500	2000	2500	3000	
L in dB (A)			45	44	43	42	40	39	
V_1 in m/s			10.1	9.6	9.3	9.0	8.6	8.3	
n	Width mm	Height mm	Volume Flow Rate, V (CMH)						L_S
5	1500	300	5454	5184	5000	4838	4649	4482	- 3
		450	8181	7776	7500	7258	6974	6723	- 2
		600	10908	10368	10000	9677	9299	8964	+ 0
		900	16362	15552	50000	14515	13949	13446	± 1
		1200	21816	20736	20000	19354	18598	17928	± 3
		1500	27270	25920	25000	24192	23247	22410	+ 4
		1800	32924	31104	30000	29030	27896	26892	+ 4
6	1800	300	6545	6221	6000	5806	5579	5378	- 3
		450	9817	9331	9000	8709	8369	8068	- 1
		600	13090	12442	12000	11612	11159	10757	± 0
		900	19634	18662	18000	17418	16768	16135	+ 2
		1200	26197	24883	24000	23224	22317	21514	+ 3
		1500	32724	31104	30000	29030	27896	26892	+ 4
		1800	39269	37315	36000	34836	33476	32270	+ 5
7	2100	300	7636	7258	7000	6774	6509	6275	- 2
		450	11453	10886	10500	10161	9764	9412	± 0
		600	45271	14515	14000	13548	13018	12550	+ 1
		900	22907	21773	21000	20321	19527	18824	+ 3
		1200	30542	29030	28000	27095	26037	25099	+ 4
		1500	38178	36288	35000	33869	32546	31374	+ 5
		1800	45814	43546	42000	40643	39055	37649	+ 6
8	2400	300	8726	8294	8000	7741	7439	7171	- 1
		450	13090	12442	12000	11612	11159	10757	+ 0
		600	17453	16589	16000	15483	14878	14342	± 2
		900	26179	24883	24000	23224	22317	21514	+ 3
		1200	34905	33178	32000	30966	29756	28685	+ 5
		1500	43632	41472	40000	38702	37195	35856	+ 6
		1800	52358	49766	48000	46449	44634	43027	+ 6

Flow Regenerated Noise Sound Power Level, L_W in dB

Measured in accordance with DIN EN ISO 7235 at 10 and 20 m/s. Readings for 5 m/s were interpolated from the basic data. The data in brackets in the flow regenerated noise of the measurement duct; the flow regenerated noise of the attenuator is only marginally below this. The values in brackets are included in the calculation of the A-weighted sound power level L_W.

Data for the sound attenuator lengths of 1m and cross section B x H = 1 m^2.

	Air velocity V_S in m/s					
	5		10		20	
f_m in Hz	Airway gap in mm 100	200	100	200	100	200
63	40	43	55	58	65	74
125	24	30	39	45	56	64
250	26	24	41	39	58	60
500	25	22	40	37	55	56
1k	22	18	37	33	54	54
2k	19	12	34	27	51	51
4k	12	10	27	25	56	47
8k	16	15	31	30	43	35
L_W in dB(A)	27	25	42	40	59	60

Corrections:

B x H in m2	0.1	0.25	0.5	1.0	2.0	4.0	10.0
Corr, Ls in dB	- 10	- 6	- 3	± 0	+ 3	+ 6	+ 10

Corresponds to Apt in DIN EN ISO 7255

Total Presure Drop Dp in Pa

Length L = 500 mm

Vs in m/s	Airway gap, S, in mm 80	100	120	140	160	180	200
4	9	8	7	7	6	6	5
6	21	18	17	16	14	13	12
8	37	32	30	28	26	24	22
10	57	49	46	43	40	36	34
12	83	71	67	62	58	54	49
14	113	97	91	85	79	73	67
16	147	126	119	111	103	95	87
18	186	160	150	140	130	121	111
20	230	198	185	173	161	149	137

Length L = 1000 mm

Vs in m/s	Airway gap, S, in mm 80	100	120	140	160	180	200
4	11	9	8	8	7	7	6
6	24	20	19	18	16	15	14
8	43	36	34	31	29	27	25
10	67	56	53	49	46	42	38
12	97	81	76	71	66	60	55
14	132	110	103	96	87	82	75
16	172	144	135	126	116	106	98
18	218	182	170	159	147	136	125
20	269	224	210	196	182	168	154

Length L = 1500 mm

Vs in m/s	Airway gap, S, in mm 80	100	120	140	160	180	200
4	12	10	9	9	8	7	6
6	28	22	21	19	18	16	15
8	50	39	37	34	31	29	26
10	77	62	57	53	49	45	41
12	112	89	83	77	71	64	58
14	152	121	113	104	96	88	80
16	198	158	147	136	125	115	104
18	125	200	185	172	159	145	131
20	310	246	230	213	196	179	162

Length L = 2000 mm

Vs in m/s	Airway gap, S, in mm 80	100	120	140	160	180	200
4	14	11	10	9	8	8	7
6	32	24	22	21	19	17	15
8	56	43	40	37	34	30	27
10	88	67	62	57	52	48	43
12	126	97	90	83	76	69	61
10	172	132	122	112	103	93	84
16	224	172	159	147	137	122	109
18	284	217	202	186	170	154	138
20	350	268	249	229	210	190	171

Length L = 2500 mm

Vs in m/s	Airway gap, S, in mm 80	100	120	140	160	180	200
4	15	12	11	10	9	8	7
6	35	26	24	22	20	19	16
8	62	45	43	40	36	33	29
10	97	73	67	62	56	51	45
12	139	105	97	89	81	74	65
14	189	142	132	121	110	101	89
16	247	186	172	158	144	132	116
18	313	235	218	200	182	167	147
20	386	290	269	247	225	206	182

The data applies to fully ducted configuration.

Length L = 3000 mm

Vs in m/s	Airway gap, S, in mm 80	100	120	140	160	180	200
4	17	12	12	11	10	9	8
6	38	28	26	24	22	20	17
8	67	50	46	42	38	35	31
10	105	78	72	66	60	54	48
12	152	112	104	95	87	78	69
14	207	153	141	130	118	106	94
16	270	200	185	169	154	139	123
18	342	253	234	214	196	154	156
20	422	312	288	264	241	217	193

Duct connection on side a) Plerum entry + 10% b) Plenum discharge + 30%

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