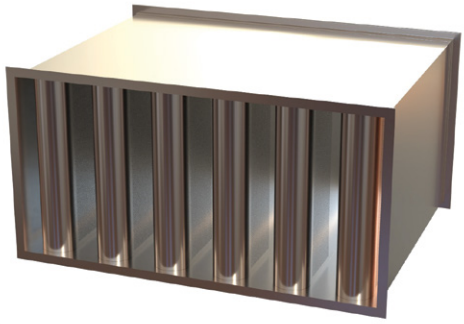
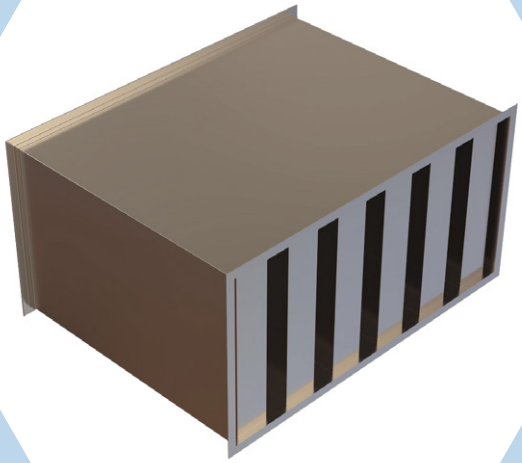
FMC
METAL FACTORY

شركة محمد عبدالرحمن فرحات للصناعة
Mohammad A. Farhat Co. For Industry





Sound Attenuator

SISTEMA Certifications and Inspections ISO 9001:2015
IAS ACCREDITED Management Systems Certification Body
INTERNATIONAL ACCREDITATION FORUM IAF
International - Affiliate MEMBER SMACNA

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ABOUT US

FMC Metal Factory, founded in 2021 in the city of Jeddah, for its Excellence, Engineering, Professionalism, and Experience in the field of fabrication of HVAC duct and its Accessories. The company has been a forerunner in the Construction field with his vast experience, commitment, adoption of new technologies and challenges by emerging as one of a key player. It offers a wide range of services for Supply, Installation, Testing and Commissioning in HVAC field. The group is leading under the supreme guidance of Mr. Mohamed Abdul Rahman Farhat, who has a long life experience in the Saudi market.

Vision

Our ambition is to amplify the presence of FMC as a recognized company in the field of construction. We aspire to extent our professional services abroad in the coming years.

Mission

Form valuable long-term relationships with our clients and partners.

Manage large and complex projects.
Be a reliable company.

Compete successfully in the Construction market of the region with high efficiency, professionalism and honesty in order to maintain, our outstanding reputation.

Objective

Our aim is to enhance the lifestyle of the communities we serve through consistent, timely, efficient and added value delivery of engineered, innovative, and tailor-made technology solutions that never fails to exceed expectations

Commitment

Constantly strive to ensure that amidst all the projects exists a great deal of passion and commitment to provide quality services and to deliver clients satisfaction.

Maintain leadership in project management capability.

Provide an open and flexible approach towards the needs of our clients by listening and respecting their views and by being ahead of emerging trends.

Deliver superior value through our consistent implementation of advanced methods and state of the art solutions.

Our Team

FMC's work force is the main asset which represent and implement all projects in professional manors due to the on going training programs that we provide to our, head office employees, engineers, supervisors, technicians, drivers, labors and all of our working force whom reflect their professions on sites.

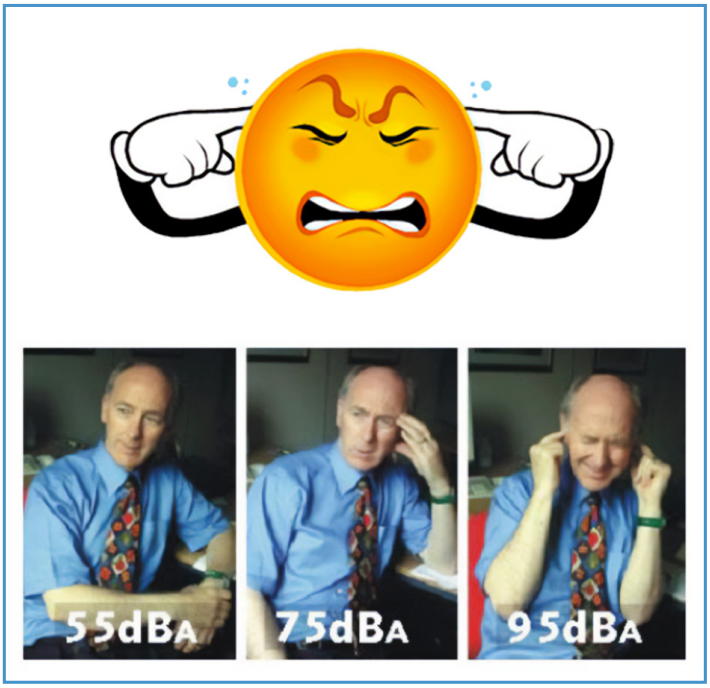
OUR PRODUCTS MAINTAINING THE HIGHEST INTERNATIONAL STANDARDS.

SOUND AND NOISE

Sound is an energy that travels in waves through mediums like air, liquids, or solids. It is a fundamental part of our daily lives, allowing communication and adding to our sensory experience. However, not all sounds are welcome, this is where the noise comes in. Noise is unwanted or disturbing sound. Whether it's the humming of machinery, the drone of HVAC systems, or the rumble of generators, noise disrupts comfort, reduces productivity, and can even harm health.

Why is Noise Control Important?

- **Health and Well-being:** Prolonged exposure to high noise levels can lead to stress, hearing loss, and fatigue.
- **Productivity and Focus:** Excessive noise in workplaces or living spaces can hinder concentration and efficiency.
- **Regulatory Compliance:** Many industries must adhere to strict noise regulations to ensure safety and comfort for employees and residents.



Picture 1- *Visual representation of noise-induced discomfort progression.*

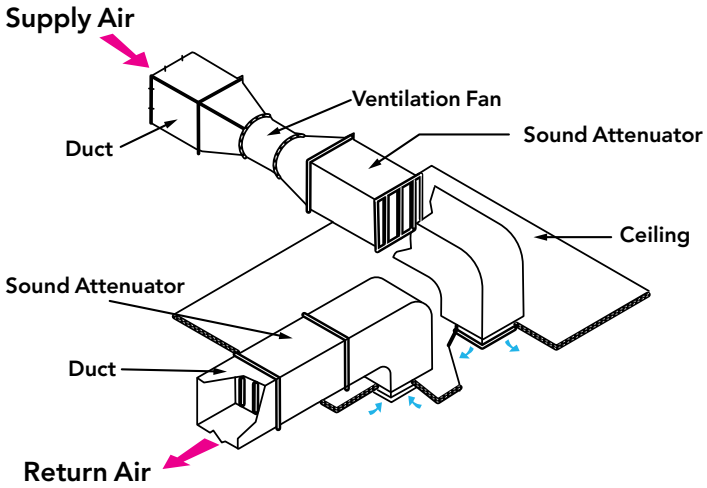
THE IMPORTANCE OF SOUND ATTENUATORS

Sound attenuators play a critical role in managing noise in HVAC systems and industrial environments. These devices are engineered to reduce unwanted sound while maintaining optimal system performance.

Benefits of Using Sound Attenuators:

- **Noise Reduction:** Minimizes the transmission of equipment noise, creating quieter and more comfortable environments.
- System Efficiency: Enhances the performance of HVAC systems by reducing noise-related pressure drops.
- **Customizable Solutions:** Designed to meet specific requirements for noise levels, airflow, and space constraints.
- **Improved Compliance:** Helps meet noise regulations and standards for residential, commercial, and industrial projects.

Sound attenuators are not just accessories, they are essential for creating environments that prioritize comfort, health, and efficiency.



Picture 2- *Standard HVAC Airflow System with Sound Attenuators at Supply and Return.*

DESIGN

The sound attenuator consists of two main parts:

1. **Casing** – The outer shell functions as a duct, built to SMACNA standards for proper thickness and secure connections.
2. **Baffles** – The inner section features rectangular silencers with baffles available in 100mm or 200mm widths.

Casing

The outer casing is strong and durable, designed to meet SMACNA standards for optimal airflow and reliable duct connections.

Baffles

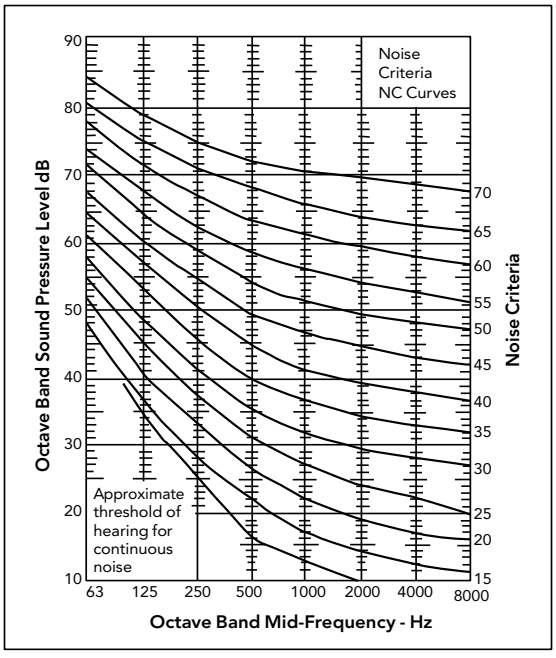
Inside the duct, rectangular silencers contain sturdy sheet metal baffles. These are wrapped in perforated sheets and packed with high-density Acoustic liner for superior noise reduction. The perforations ensure smooth airflow while keeping the insulation securely in place with minimal pressure drop.

CONSTRUCTION MATERIALS

Casing	Galvanized Steel, Stainless Steel, minimum thickness 22-gauge. Material grade as per requirement.
Connection	We can provide all kind of connections as per SMACNA standards and client requirements
Acoustic liner	Rockwool, Minimum density 40Kg/m3 (other Acoustic insulations types available upon request).
Casing Seam	Lock-formed or welded as per SMACNA standards, depending on size and thickness.
Baffle	Galvanized steel or stainless steel with a minimum thickness of 24-gauge. material grade as per requirement. The baffles containing the acoustic liner which is covered by a perforated sheet.

NOISE CRITERIA CURVES (NC)

Noise Criteria curves are a set of American standards that measure broadband noise based on human ear sensitivity. They provide a single noise rating and are commonly used in indoor design assessments.



Picture 3- *Noise Criteria Curves (NC)*

SOFTWARE USED FOR CALCULATING NOISE IN THE HVAC SYSTEM

FMC use NEC ACOSTIX® software by Najah Engineering Consultants LLC which is very famous software being used by many respectful companies in the field or Acoustic solutions.

We use NEC ACOSTIX ® for designing sound attenuators and performing detailed sound calculations to meet customers acoustic requirements.

Example of Sound attenuator selection from NEC ACOSTIX® software.

FMC METAL FACTORY

ROOM SIDE CALCULATIONS

Page # 1 of 1

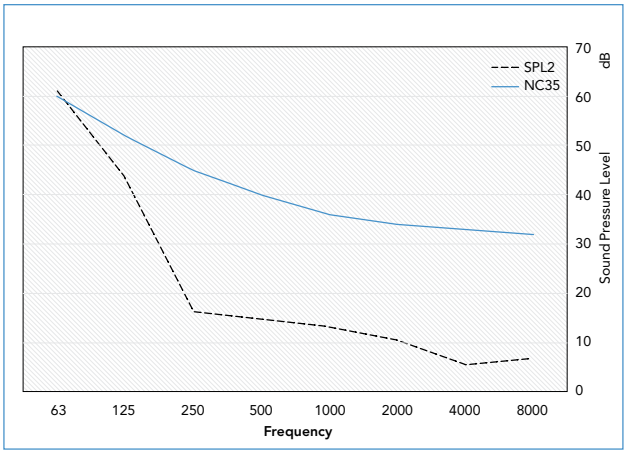
Customer :	FMC CONSTRUCTION	Report Date :	29-Oct-20
Project :	SAMPLE SELECTION	Report No :	SA - 001
Building / Room :	HEAD OFFICE	Title :	SOUND ATTENUATOR
Unit Ref :	AHU - 03 - 01	Checked by :	Date :
		Approved by :	Date :

Section	Item	Lining	W / Diameter (mm)	H (mm)	Length (m) / QTY	Air %	63	125	250	500	1000	2000	4000	8000	Hz
Source Details	AHU / Fan Air Flow	1.50 m³/sec				SWL :	106.0	98.0	90.0	87.0	86.0	83.0	78.0	70.0	dB
Straight Rectangular Ducts Attenuation	Duct Type	Lining	Dimensions (mm) W	H	Length (m)	Air %	Attenuations and corrections								
	Rectangular Duct (wrapped with external fiberglass blankets)	Unlined	900	600	2.5	100%	1.8	1.2	0.8	0.2	0.2	0.2	0.2	0.2	dB
		Unlined	900	600	3	100%	2.1	1.4	1.0	0.3	0.3	0.3	0.3	0.3	dB
		Unlined	300	300	4.3	27%	5.0	2.8	1.5	0.9	0.9	0.9	0.9	0.9	dB
			0	0	0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	dB
			0	0	0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	dB
			0	0	0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	dB
			0	0	0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	dB
			0	0	0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	dB
Round Ducts Attenuation	Duct Type	Lining	Diameter (mm)		Length (m)	Air %									
	Straight Round Duct		0		0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	dB
			0		0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	dB
			0		0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	dB
			0		0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	dB
	Round Duct Elbows Radiussed 90°	Lining	Diameter (mm)		QTY	Air%									
		Unlined	0		0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	dB
		Unlined	0		0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	dB
Flex Round Ducts with 25mm Fiberglass	Duct Type	Lining	Diameter (mm)		Length (m)	Air %									
	Flex Round Duct	Lined 25mm	0		0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	dB
			0		0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	dB
			0		0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	dB
			0		0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	dB
90° Elbows Attenuation	Type	Lining	Dimension (mm) W	H	QTY	Air %									
	Round Elbow	Unlined	900	600	1	100%	0	2	3	3	3	3	3	3	dB
	Round Elbow	Unlined	900	600	1	100%	1	2	3	3	3	3	3	3	dB
	Round Elbow	Unlined	900	600	1	100%	1	2	3	3	3	3	3	3	dB
	Round Elbow	Unlined	300	300	1	27%	0	0	1	2	3	3	3	3	dB
			0	0	0		0	0	0	0	0	0	0	0	dB
			0	0	0		0	0	0	0	0	0	0	0	dB
Outlet Loss, Additional Losses, SWL_{out} and Direct SPL	Outlet Reflection Loss	Rectangular Outlet W X H	595		560	Flush	7	3	1	0	0	0	0	0	dB
	Additional duct components sound data				ΔP (Pa):		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	dB
					ΔP (Pa):		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	dB
					ΔP (Pa):		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	dB
					ΔP (Pa):		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	dB
	Duct Totals >>>		Total Duct ΔP = 16.5		Total Duct Attenuation		18	15	14	13	13	13	13	13	dB
	SWL Leaving the system				Duct SWL outlet		88	83	76	74	73	70	65	57	dB
	Percentage leaving outlet		10.0%	= 0.15 m3/sec			-10	-10	-10	-10	-10	-10	-10	-10	dB
	Distance from Outlet			2.0	m	0.15	-17	-17	-17	-17	-17	-17	-17	-17	dB
	Directivity >>>	Center of one room surface		Outlet Area : 3340 cm2		Type C	5	6	7	7	8	9	9	9	dB
	Direct SPL						66	62	56	54	53	52	47	39	dB
Room and Terminal Effects (reverberant)	Room Aborption Type >>>		Soft			Room Rev Time	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	Sec
	Room Reverberation Time Correction						-2	-2	-2	-2	-2	-2	-2	-2	dB
	Percentage Reaching Room >>>		27.0%	0.41 m³/s			-6	-6	-6	-6	-6	-6	-6	-6	dB
	Room Volume W x H x L		5.00	5.00	2.80	70 m3	-5	-5	-5	-5	-5	-5	-5	-5	dB
	Reverberant SPL						76	72	64	63	61	58	53	45	dB
Room SPL and Required Attenuation	Total SPL at designated point						76	72	64	63	61	59	54	46	dB
	Sound Criteria		NC35	Temp °C	50		60	52	45	40	36	34	33	32	dB
	Required Insertion Loss (Optimal)				Add safety dB's	1	17	21	20	24	26	26	22	15	dB
Primray Attenuator	Customized Design														
	Attenuator (W) : 900	Airways # : 3													
	Attenuator (H) : 600	Airway (W) : 100	Airway (L) : 3000	Temp : 30											
	Attenuator W x H x L : 600 mm X 900 mm X 3000 mm		FA = 33 %	DP = 45 Pa	45										
Secondary Attenuator	No Selection					0									
Final Resultant dBA and Pressure drop	Primary Attenuator Insertion Loss						15	29	48	48	48	48	48	39	dB
	Total Selected Attenuator(s) Insertion Loss (Total)						15	29	48	48	48	48	48	39	dB
	Actual SPL using the selected insertion loss		SPL = 36 dBA		ΔP = 61 Pa		61	43	16	15	13	10	5	7	dB
	Attenuator Self Noise SWL @ 8.33 m/s						43	40	37	37	36	34	31	26	dB

Complis to ASHARE HVAC Applications 2001, Chapter 48 (SI Edition)and ASHARE Fundamentals 2013, Chapter 8 (SI Edition) Version 3.3.3 09-24

Picture 4- *Example of Sound attenuator selection from NEC ACOSTIX ® software.*

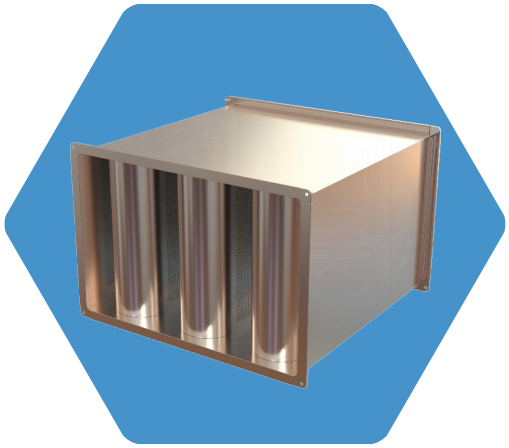
Noise Criteria VS Resultant Sound Level



Picture 5- *Noise Criteria of 35 NC against Resultant Sound Level*

In designing our sound attenuators for HVAC systems, we prioritize optimal acoustic comfort by adhering to established Noise Criteria (NC) standards. NC curves serve as benchmarks that define acceptable background noise levels across octave bands from 63 Hz to 8,000 Hz, reflecting the human ear's increased sensitivity to higher frequencies. Notably, the 63 Hz band is generally considered less critical in occupied spaces because the ear is less sensitive to very low-frequency sounds, permitting slightly higher levels without significant perceptual impact. In contrast, the mid-range frequencies, particularly 125 Hz, 250 Hz, and 500 Hz are the most critical for maintaining acoustic quality, as even small exceedances in these bands can noticeably affect speech intelligibility and overall comfort. The 1000 Hz band, while not as sensitive as the lower mid-range bands, still plays a crucial role in ensuring clear speech perception and overall sound clarity; therefore, its levels must be carefully managed to avoid masking effects. By meticulously controlling each of these frequency bands within the NC curves, our sound attenuators ensure that HVAC systems operate quietly and efficiently, thereby enhancing occupant satisfaction.

RECTANGULAR STRAIGHT SOUND ATTENUATOR



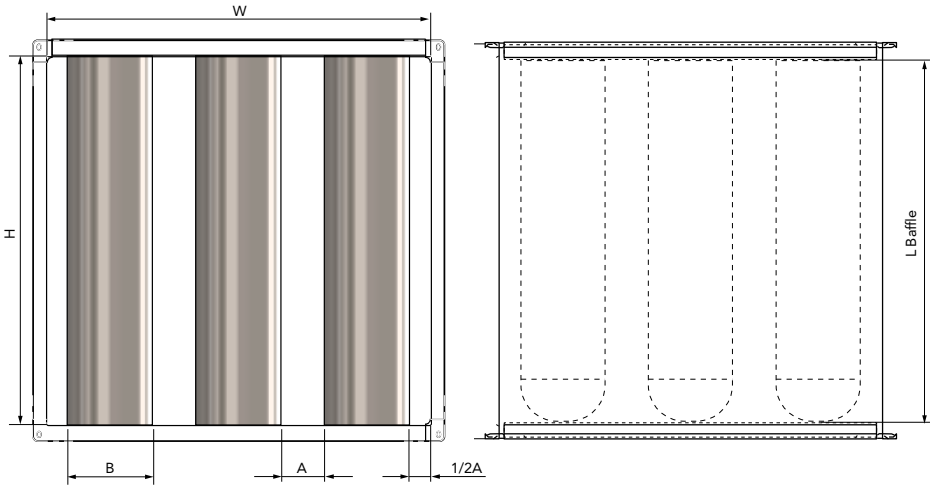
Description

Our Rectangular straight Sound Attenuator offers a conventional design with dimensions that do not exceed the corresponding connection sizes, making it an ideal solution for all standard duct installations.

Our product is engineered as a rectangular straight sound attenuator. It is constructed with a robust galvanized-steel or stainless-steel frame and filled with premium rock wool absorption material for effective noise reduction. Featuring an integrated splitter unit, our attenuator is available with splitter widths of 100 and 200 mm. This design element optimizes the acoustic performance across the unit. Also, it's equipped with a custom joining profile, and ensures straightforward installation and reliable connection with your ductwork.

The acoustic performance is determined using our NEC ACOSTIX® software. By leveraging both rigorous theoretical models and comprehensive experimental validations, this advanced software delivers highly accurate results.

Dimensions



L Baffle = L – 30mm*

L Baffle = Baffle Length

L = Duct Length

H = Baffle Height or Duct Height

W = Duct Width

B = Baffle Width

A = Airway Width

** This value can be 30mm or less based on connection type.*

Technical Data

Sound Attenuator Size = 900 W x 600 H - Baffle Width (B) = 100 - Airway Width (A) = 200

Airway Length (mm)	63 Hz	125 Hz	250 Hz	500 Hz	1K Hz	2K Hz	4K Hz	8K Hz	Pressure Drop (Pa)
500	9	7	8	17	19	13	8	6	2
1000	10	9	13	28	33	22	11	7	2
1500	10	11	18	40	47	30	14	8	3
2000	10	13	23	49	49	38	17	8	3
2500	11	15	28	49	49	46	19	9	4

Sound Attenuator Size = 900 W x 600 H - Baffle Width (B) = 100 - Airway Width (A) = 125

Airway Length (mm)	63 Hz	125 Hz	250 Hz	500 Hz	1K Hz	2K Hz	4K Hz	8K Hz	Pressure Drop (Pa)
500	11	7	7	14	28	23	16	8	5
1000	11	9	11	24	49	42	27	12	6
1500	12	10	16	35	49	49	38	15	7
2000	12	12	20	45	49	49	49	18	8
2500	12	13	24	49	49	49	49	22	9

Sound Attenuator Size = 900 W x 600 H - Baffle Width (B) = 100 - Airway Width (A) = 80

Airway Length (mm)	63 Hz	125 Hz	250 Hz	500 Hz	1K Hz	2K Hz	4K Hz	8K Hz	Pressure Drop (Pa)
500	13	8	7	11	28	43	28	17	11
1000	13	9	10	19	49	49	49	28	14
1500	13	11	12	27	49	49	49	39	17
2000	13	12	15	35	49	49	49	49	20
2500	14	13	18	43	49	49	49	49	23

Sound Attenuator Size = 900 W x 600 H - Baffle Width (B) = 200 - Airway Width (A) = 300

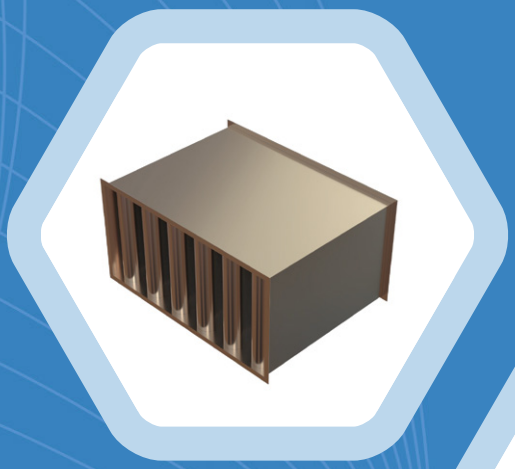
Airway Length (mm)	63 Hz	125 Hz	250 Hz	500 Hz	1K Hz	2K Hz	4K Hz	8K Hz	Pressure Drop (Pa)
500	8	7	10	13	13	9	6	6	2
1000	9	10	16	21	21	13	7	6	2
1500	9	13	22	29	29	17	8	6	2
2000	10	16	28	36	36	21	9	7	3
2500	10	19	34	44	44	25	10	7	3

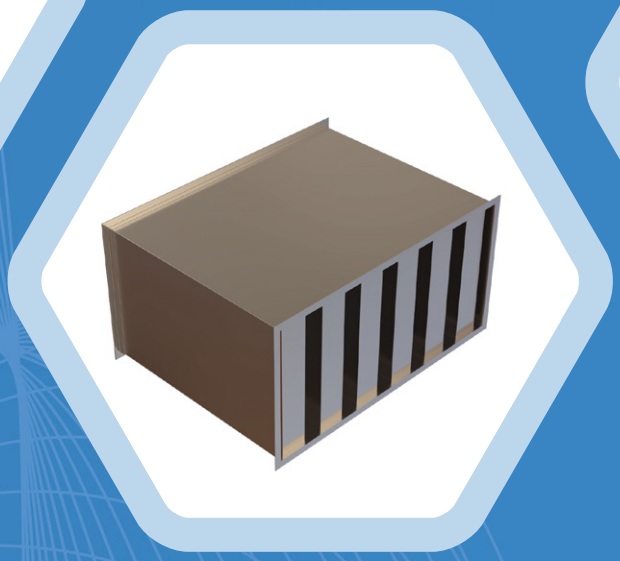
Sound Attenuator Size = 900 W x 600 H - Baffle Width (B) = 200 - Airway Width (A) = 100

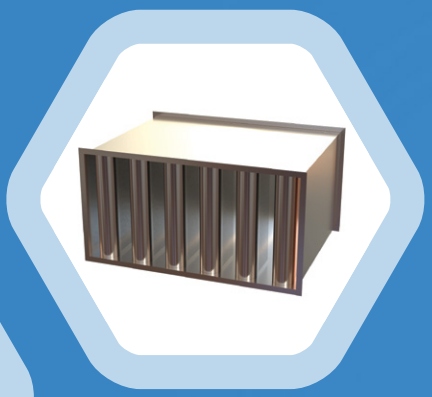
Airway Length (mm)	63 Hz	125 Hz	250 Hz	500 Hz	1K Hz	2K Hz	4K Hz	8K Hz	Pressure Drop (Pa)
500	12	10	12	19	27	30	22	11	23
1000	13	14	21	35	48	48	39	16	28
1500	13	18	30	48	48	48	48	22	32
2000	14	21	39	48	48	48	48	28	36
2500	15	25	48	48	48	48	48	33	41

The examples above show multiple sound attenuator options for the same duct size, each varying in baffle width, baffle length, and airway width. The selection of a sound attenuator is based on pressure drop values and noise criteria.

For Example: if the maximum allowable pressure drop in the duct line from the noise source to the room is 80 Pa, and the existing duct line pressure drop is already 60 Pa, we should select a sound attenuator with a pressure drop of 20 Pa or less while still meeting the noise criteria.







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