» FESI Ductwork Acoustic Lining Calculator (India)

Who is FESI

FESI is the federation of European insulation contractor associations. Amongst the interests of FESI is the formulation of scientifically based solutions to acoustic problems which can be consistently and practically implemented.

The calculation methodology used within this PDF is based on equations and methods developed in FESI Document A6.

Introduction

Ductwork carries air around buildings, be it heated air, conditioned air or extract air. Unfortunately ductwork also has the unwanted side effect of simultaneously carrying noise around buildings. This noise can include not only noise from fans and other mechanical systems but also voices carried from elsewhere in a building.

Various pieces of legislation mean building engineers must now take steps to reduce the impact of noise on those using their buildings. One of the simplest ways of doing this is to internally line ductwork using an acoustic foam such as ArmaSound 240 or ArmaSound Punched Sheet.

Break-out noise vs. propagation noise

Noise can leave ductwork in a number of distinctly different ways.

One way in which noise can travel is by propagating through the air within the duct. At grilles and openings this noise then leaves the duct as propagation noise. The level of noise which leaves the duct at these points can be directly influenced by internally lining the duct.

Internal Lining of Ductwork

For acoustic purposes it is preferable to line the inside of ductwork using an acoustic lining material. When doing so the primary objective is not to introduce health hazards into the air stream. All ArmaSound products are fibre free and as such will have no negative impact on the indoor air quality.

The secondary objective when lining ductwork internally must be to guard against any unnecessary reduction in the duct cross section which would reduce the air flow rate. When compared to other acoustic absorbing materials ArmaSound 240 can achieve comparable absorption coefficients at any given frequency with thicknesses significantly less. This enables an acoustic reduction to be met with a reduced impact on air flow rates.

» Frequency of Noise

When it comes to acoustic absorbers the thickest product is not always the best. The same material will perform differently at different frequencies depending on the thickness. If the nuisance noise frequency is known the required thickness of insulation can often be reduced.

Unfortunately it is impossible to know in advance exactly what the frequency of noise travelling down ductwork will be. This can only be accurately known by the process of site testing, by which time it may be impractical to acoustically line the ductwork internally.

However, since in most cases the fan is the primary source of nuisance noise, it is often possible to roughly predict the frequency most likely to become a problem. Simply take the

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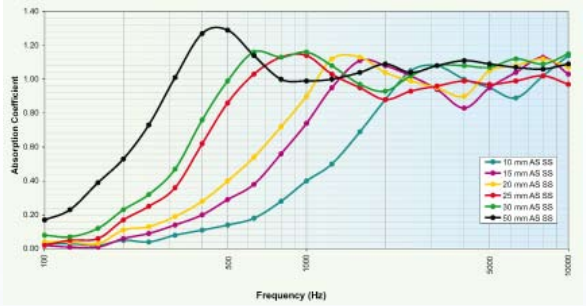
fan speed (in rotations per second) and multiply this by the number of fan blades. This will give you a frequency in Hz. (see as an example graph below)

RISAC of ArmaSound Super Silence Ductliner



This chart shows the acoustic absorption coefficient for ArmaSound Super Silence measured at different thickness'. Measured in acc. with the ISO 354 measurement standard at the School of Acoustics and Electronic Engineering, Salford University, UK
Measured in acc. with the ISO 10534 (pt2) measurement standard at the Acoustic Group, Bradford University, UK

The manufacturer of your air handling unit may be able to provide you with a more detailed break down of the expected noise levels emitted by the entire system which takes into account more than just the noise emitted by the fan. If possible this information should be obtained.

It is important to select the appropriate thickness of ArmaSound Super Silence most well suited to absorbing noise in the particular frequencies likely to be experienced so as to achieve the most economical solution.

High Frequency Noise in Ductwork

Higher frequency noise may propagate down through a duct as a "beam" without ever touching the sides of the duct. The result of this is that, for a perfectly straight length of ductwork, it is impossible to accurately predict the impact of acoustic insulation on noise at higher frequencies.

The exact nature of ductwork acoustics is exceedingly complicated but for most practical purposes it is reasonable to assume that most higher frequency noise will be dealt with as the duct goes around bends. In cases where further reductions are necessary it is possible to design a system incorporating additional silencers which split the air stream and prevent the "beam" effect from occurring.

Breakout noise versus propagation noise

Noise can leave ductwork in a number of distinctly different ways.

One way in which noise can travel is by propagating through the air within the duct. At grilles and openings this noise then leaves the duct as propagation noise. The level of noise which leaves the duct at these points can be directly influenced by internally lining the duct.

Products recommendations

ArmaSound Super Silence is a unique, high performance, dust and fibre free, elastomeric acoustic absorber. Its complex pore geometry allows for effective absorption of air borne noise across a broad frequency range. The result is a versatile acoustic absorber which can achieve significant noise reductions with reduced wall thicknesses.

Microban® anti-microbial protection is built into ArmaSound Super Silence Ductliner during the manufacturing process, giving continuous active protection against microbial growth

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and provides the basis for a continuous system hygiene.

Calculation tool (see overleaf)

The calculation tool on the following page allows for the calculation of the length to be insulated given a set of existing and target noise levels and also for the calculation of decibel reductions by frequency given existing noise levels and the length of duct to be insulated.

Attenuation mechanisms associated with directional changes, branching, cross-sectional area variation, losses in and through walls, airflow speeds and temperatures are not covered by this calculation tool. Calculating true insertion losses for ducting is a complex subject and this tool serves only as an engineering guide.

The formula is reliable up to the frequency at which the wavelength is equal to the diameter or shortest dimension of the duct, beyond which the sound acts like a beam flowing along the centre of the duct and attentuation decreases. The tool allows for calculations to be performed above this point but one should be aware that the margin of error will increase as the frequency rises further.

Nevertheless, an estimation of the total noise reduction performance can be made with this tool if the octave band noise levels above the cut-off frequency are substantially lower than the octave band noise levels below it.

Note also that the calculated low frequency insertion loss is generally lower than is observed in practise.

»Start Calculation Tool

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Cylindrical	**Internal diameter of duct**	**0.25**	m
Length of duct to line to be calculated			
ArmaSound Super Silencer (25mm)			

	125	250	500	1000	2000	4000	8000	Hz			Are these noise levels A-weighted
Current noise level	**57**	**63**	**57**	**52**	**40**	**36**	**30**	dB	**65.01**	dB	**No**
	41	**54**	**54**	**52**	**41**	**37**	**29**	dB(A)	**58.40**	dB(A)	

Individual octave bands known

	125	250	500	1000	2000	4000	8000				Are these noise levels A-weighted
Required noise level	**55**	**55**	**55**	**55**	**55**	**55**	**55**	dB	**63.45**	dB	**No**
	39	**46**	**52**	**55**	**56**	**56**	**54**	dB(A)	**61.96**	dB(A)	

Calculate

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