INSERTION LOSS MEASUREMENT TEST REPORT

Acoustically & Thermally Insulated Aluminium Flexible Air Duct
[SONOAFS-ALU SHINE]

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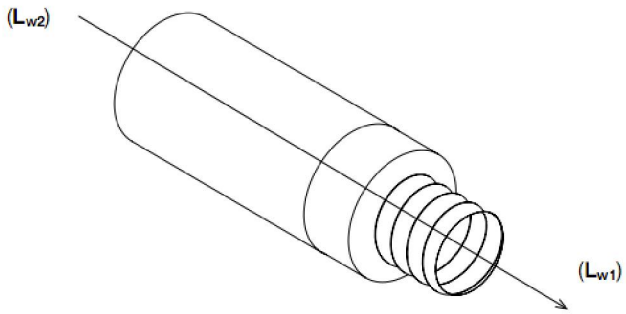
INSERTION LOSS MEASUREMENT
Product: SONOAFS-ALU.F

1. Introduction

HVAC equipment is a significant source for background noise for indoor environments hence noise level is one significant topic that design engineer cannot ignore. Source, path and receiver, at each part of the system, there might be alternative solutions if the desired noise level is not reached in the room.

AFS develops noise reducing solutions fitting to the path. We produce variety of flexible air ducts and silencers. Variety is necessary to propose solutions for different cases. Insertion loss is a key parameter in selecting the right variety for the case in concern.

Insertion Loss is the difference between the sound pressure level at the inlet (L_{W2}) and at the outlet (L_{W1}) of the acoustically insulated flexible air duct/silencer (Figure 1).



Insertion Loss = $L_{W2} - L_{W1}$

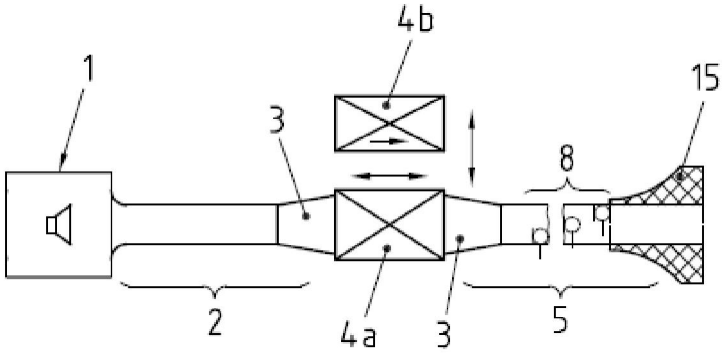
Figure 1.

In this document, insertion loss measurements performed on **SONOAFS-ALU SHINE** were tabulated for the ducts in 82 mm to 508 mm diameter.

2. The semi-anechoic test chamber and test setup

Insertion loss measurements performed in AFS Lab are in accordance with **EN ISO 7235** (Acoustics – Laboratory measurement procedures for ducted silencers and air terminal units – Insertion loss, flow noise and total pressure loss) standard. This Standard specifies the substitution method for determining the insertion loss of ducted silencers.

Related Parts of the Standard:
In the substitution method, the sound pressure level of the transmitted wave is first determined for the AFS Silencer (L_{w1}) and then when the Silencer has been replaced by substitution duct (L_{w2}). The sound pressure level of the transmitted wave is measured in a test duct after the Silencer (Figure 2).



1: loudspeaker unit in the source chamber

2: test duct in front of the AFS Silencer (including modal filter)

3: transitions

4a: AFS Silencer

4b: substitution duct

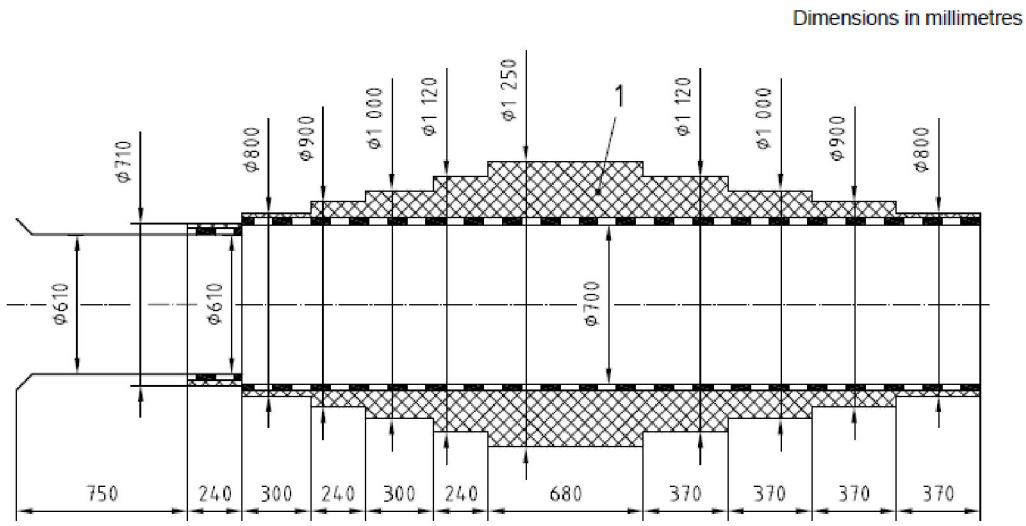
5: test duct behind the AFS Silencer

8: microphone positions behind the AFS Silencer

15: anechoic termination

Figure 2. Test facility for the measurement of insertion loss (EN ISO 7235)

The primary feature of an anechoic termination (Figure 3) is a sufficiently gradual change in duct area to suppress the reflection of the sound waves back into the duct where they would interfere with the sound level measurements.



Key

1 porous sound-absorbing material

Figure 3. Example of an anechoic termination (EN ISO 7235)

The insertion loss is expressed in decibels (dB). Measurements for determining the insertion loss of AFS Silencers are recorded in 1/1-octave bands of random noise excited by the sound source equipment in the frequency range of 63 Hz to 8000 Hz.

AFS acoustic test facility (Figure 4) is suitable for the measurement of insertion loss in 82 mm to 508 mm diameter acoustically insulated flexible air ducts/silencers.

(a)

(b)

Figure 4. AFS test facility a) substitution duct is installed b) AFS Silencer is installed

3. Specification of the Product

Below please find the technical properties of the product tested.

AFS Code: SONOAFS-ALU SHINE

	SONOAFS-ALU SHINE
INNER DUCT	
Number of Layer	3 layer
Construction	1 ply Al + 2 ply Poly
Layer Thickness	Al: 9 μ - Poly: 12 μ
Thickness	45 μ
Diameter Range	82 mm - 800 mm
Wire Pitch	25 mm (Ø 82 mm) 30mm (Ø 102mm) 40 mm (∅ ≥ 127 mm)
Wire Type	Coated steel wire
Color	Aluminium
Temperature Range	-30 °C / +120 °C
Maximum Air Velocity	30 m/s
Maximum Operating Pressure	3000 Pa
INSULATION	
Insulation Material	Glass wool
Thickness	25 mm
Density	14 kg/m^3
Color	Yellow
CEKET / JACKET	
Number of Layer	3 layer
Construction	1 ply Al + 2 ply Poly

4. RESULTS

4.1) Straight Duct in 1 meter Length

The results for all diameters are tabulated in Table 1.

Table 1. Insertion Loss (length = 1 m)

INSERTION LOSS (dB)								
Diameter (mm)	**Frequency (Hz)**							
	63	**125**	**250**	**500**	**1000**	**2000**	**4000**	**8000**
Ø 82	7,6	25,4	26,7	24,0	24,2	22,8	17,6	15,1
Ø 102	6,2	21,3	30,7	28,9	28,8	26,9	13,5	10,4
Ø 127	0,3	12,7	22,1	26,2	30,0	26,1	12,8	11,5
Ø 152	0,6	21,6	24,3	20,7	20,9	20,3	14,8	9,7
Ø 160	6,6	21,5	29,1	24,3	21,6	21,9	11,3	7,9
Ø 203	4,1	11,2	21,7	22,1	22,9	21,4	8,4	7,0
Ø 254	6,2	14,5	18,9	17,3	16,2	13,5	5,1	4,5
Ø 305	8,4	15,8	17,6	14,6	13,3	11,8	3,9	3,9
Ø 315	8,3	13,8	14,0	13,2	13,4	10,6	4,1	4,6
Ø 356	6,2	11,3	13,5	11,7	10,8	8,0	2,9	4,0
Ø 406	2,3	4,9	12,8	13,2	11,6	7,3	2,5	4,6
Ø 457	9,7	11,2	10,8	8,1	7,5	5,3	2,2	3,3
Ø 508	3,2	5,7	6,0	4,7	4,7	5,0	1,0	2,1

4.2) Straight Duct in 2 meters Length

The results for all diameters are tabulated in Table 2.

Table 2. Insertion Loss (length = 2 m)

INSERTION LOSS (dB)								
Diameter (mm)	**Frequency (Hz)**							
	63	**125**	**250**	**500**	**1000**	**2000**	**4000**	**8000**
Ø 82	20,2	40,5	50,1	44,2	43,2	40,3	28,3	24,8
Ø 102	17,7	33,5	42,3	37,9	38,8	35,1	23,0	18,6
Ø 127	7,4	24,0	39,0	41,1	40,5	39,0	24,5	20,5
Ø 152	23,8	41,9	39,3	35,6	33,3	34,7	25,7	20,3
Ø 160	14,8	35,1	40,0	35,1	33,0	34,7	20,1	14,3
Ø 203	8,2	19,5	35,2	31,5	31,7	28,8	14,1	8,5
Ø 254	11,0	23,9	31,5	26,6	27,8	22,0	9,3	7,4
Ø 305	16,6	30,5	28,8	23,1	24,4	21,4	9,1	7,6
Ø 315	14,0	26,5	26,6	22,9	25,8	19,5	8,6	8,0
Ø 356	10,8	18,5	26,6	21,7	22,3	16,2	4,7	3,6
Ø 406	8,3	14,3	27,2	21,4	21,5	13,2	4,2	4,1

4.3) Straight Duct in 3 meters Length

The results for all diameters are tabulated in Table 3.

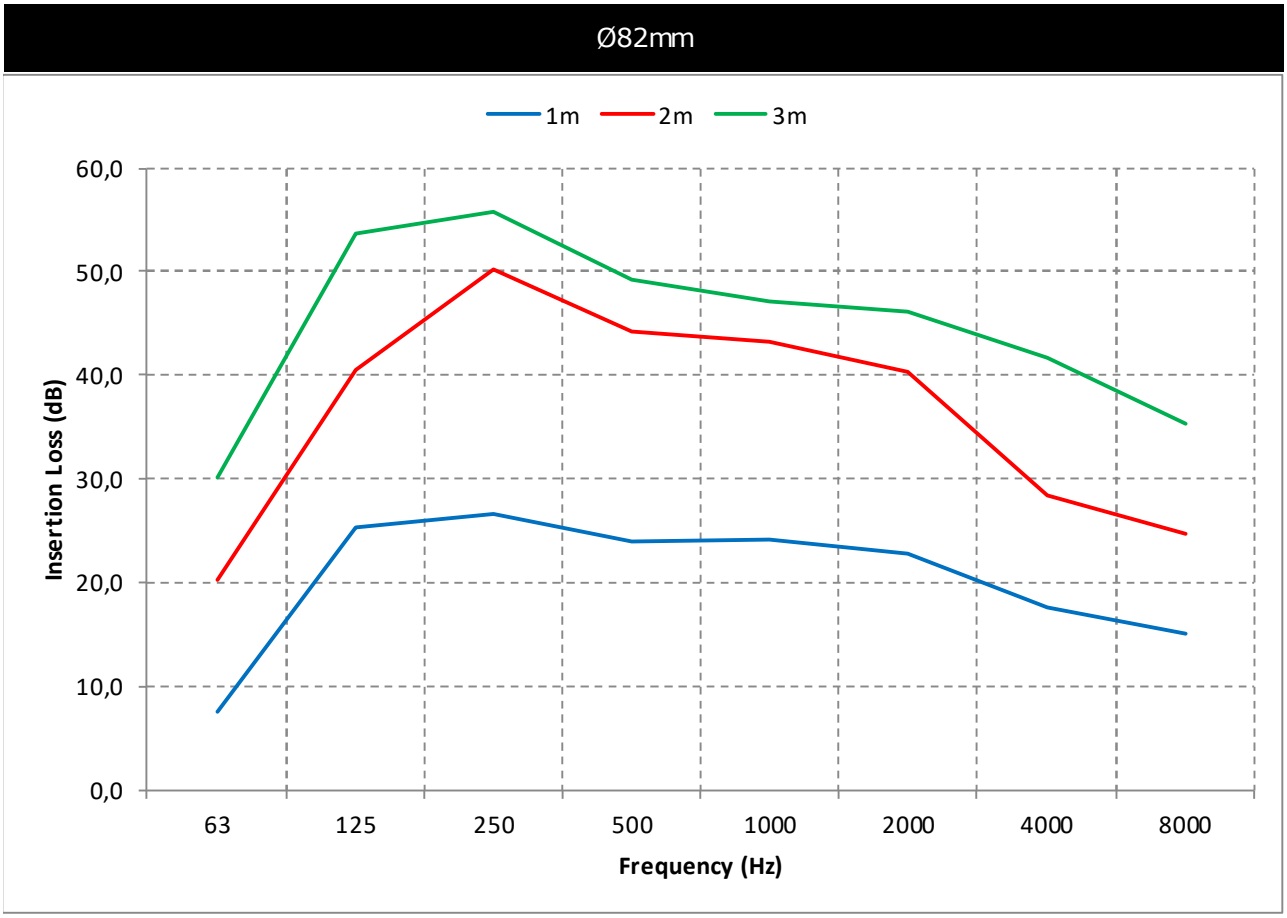
Table 3. Insertion Loss (length = 3 m)

INSERTION LOSS (dB)								
Diameter (mm)	**Frequency (Hz)**							
	63	**125**	**250**	**500**	**1000**	**2000**	**4000**	**8000**
Ø 82	30,1	53,7	55,8	49,3	47,1	46,1	41,7	35,3
Ø 102	25,6	48,5	47,4	46,0	47,4	44,5	31,8	26,1
Ø 127	10,7	29,4	45,1	44,4	42,7	42,1	30,7	25,2
Ø 152	31,9	43,8	49,5	40,9	41,7	42,5	33,9	25,6
Ø 160	21,2	43,3	46,1	40,2	37,4	39,2	28,0	19,6
Ø 203	12,2	27,8	43,1	38,7	37,1	36,2	20,3	11,8
Ø 254	14,6	31,2	39,3	33,1	33,3	27,8	14,0	11,1
Ø 305	19,8	38,5	35,1	28,7	28,9	25,3	11,6	9,4
Ø 315	22,1	40,0	33,0	27,9	29,6	22,9	10,3	8,9
Ø 356	11,3	24,0	33,8	27,6	28,9	22,1	8,5	6,8

5. GRAPHS

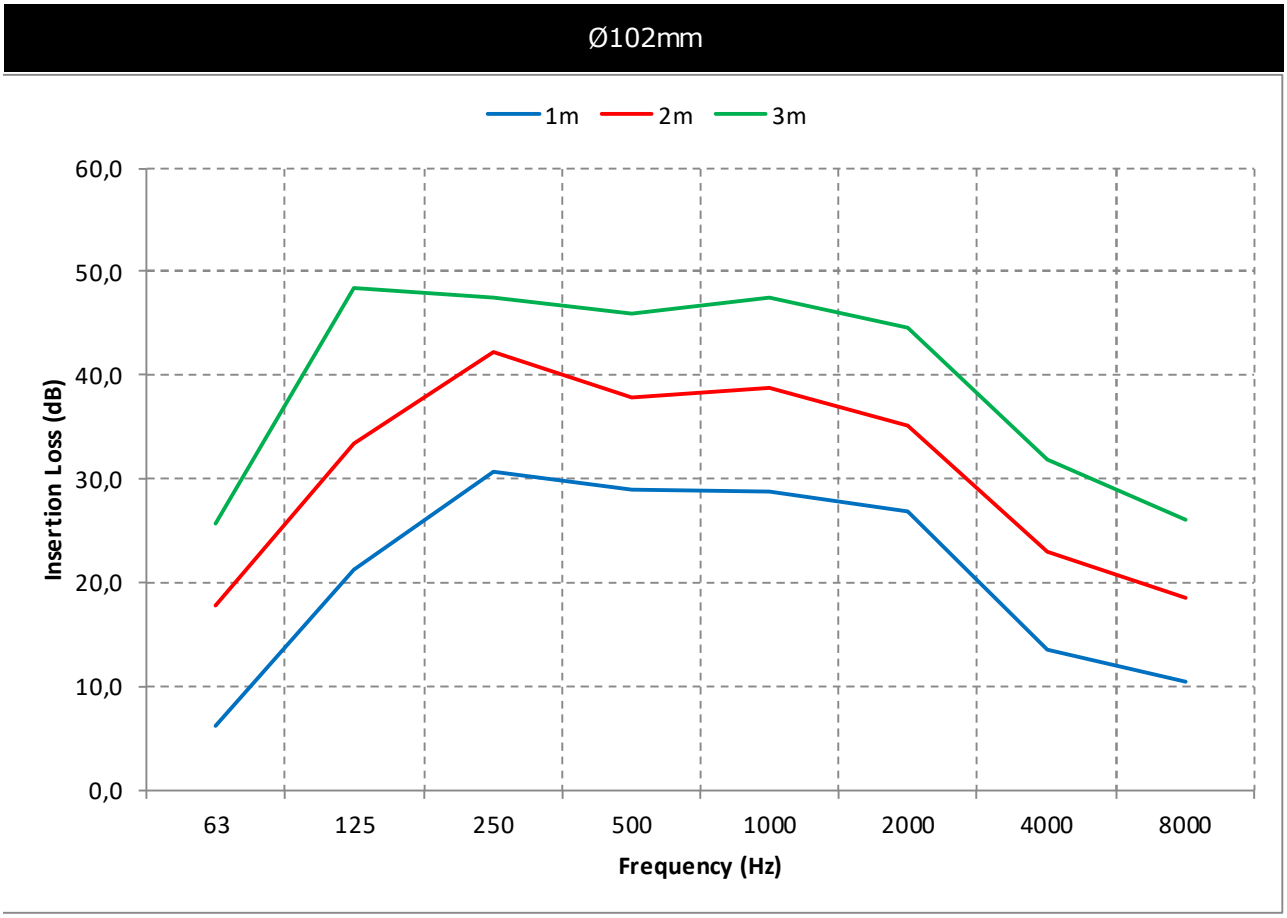
The insertion loss values are drawn at each frequency for each diameter in the following Graphs.

Graph 1. Insertion loss [∅ 82 mm in diameter – 1 m, 2 m, 3 m in length]
Graph 2. Insertion loss [∅ 102 mm in diameter – 1 m, 2 m, 3 m in length]
Graph 3. Insertion loss [∅ 127 mm in diameter – 1 m, 2 m, 3 m in length]
Graph 4. Insertion loss [∅ 152 mm in diameter – 1 m, 2 m, 3 m in length]
Graph 5. Insertion loss [∅ 160 mm in diameter – 1 m, 2 m, 3 m in length]
Graph 6. Insertion loss [∅ 203 mm in diameter – 1 m, 2 m, 3 m in length]
Graph 7. Insertion loss [∅ 254 mm in diameter – 1 m, 2 m, 3 m in length]
Graph 8. Insertion loss [∅ 305 mm in diameter – 1 m, 2 m, 3 m in length]
Graph 9. Insertion loss [∅ 315 mm in diameter – 1 m, 2 m, 3 m in length]
Graph 10. Insertion loss [∅ 356 mm in diameter – 1 m, 2 m, 3 m in length]
Graph 11. Insertion loss [∅ 406 mm in diameter – 1 m, 2 m in length]
Graph 12. Insertion loss [∅ 457 mm in diameter – 1 m in length]
Graph 13. Insertion loss [∅ 508 mm in diameter – 1 m in length]



	Frequency (Hz)	63	125	250	500	1000	2000	4000	8000
Insertion Loss (dB)	1m	7,6	25,4	26,7	24,0	24,2	22,8	17,6	15,1
	2m	20,2	40,5	50,1	44,2	43,2	40,3	28,3	24,8
	3m	30,1	53,7	55,8	49,3	47,1	46,1	41,7	35,3

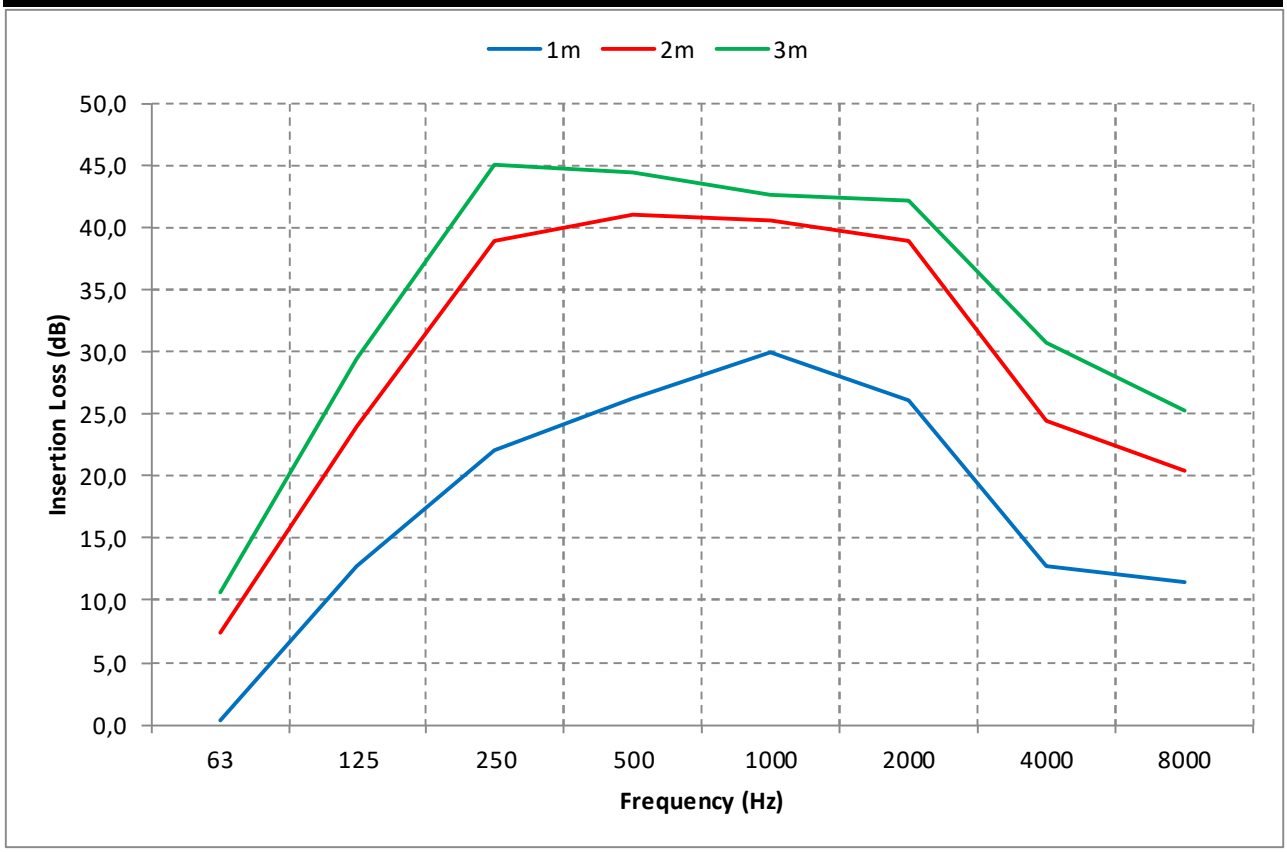
Graph 1. Insertion loss [Ø 82 mm in diameter – 1 m, 2 m, 3 m in length]



	Frequency (Hz)	63	125	250	500	1000	2000	4000	8000
Insertion Loss (dB)	1m	6,2	21,3	30,7	28,9	28,8	26,9	13,5	10,4
	2m	17,7	33,5	42,3	37,9	38,8	35,1	23,0	18,6
	3m	25,6	48,5	47,4	46,0	47,4	44,5	31,8	26,1

Graph 2. Insertion loss [∅ 102 mm in diameter – 1 m, 2 m, 3 m in length]

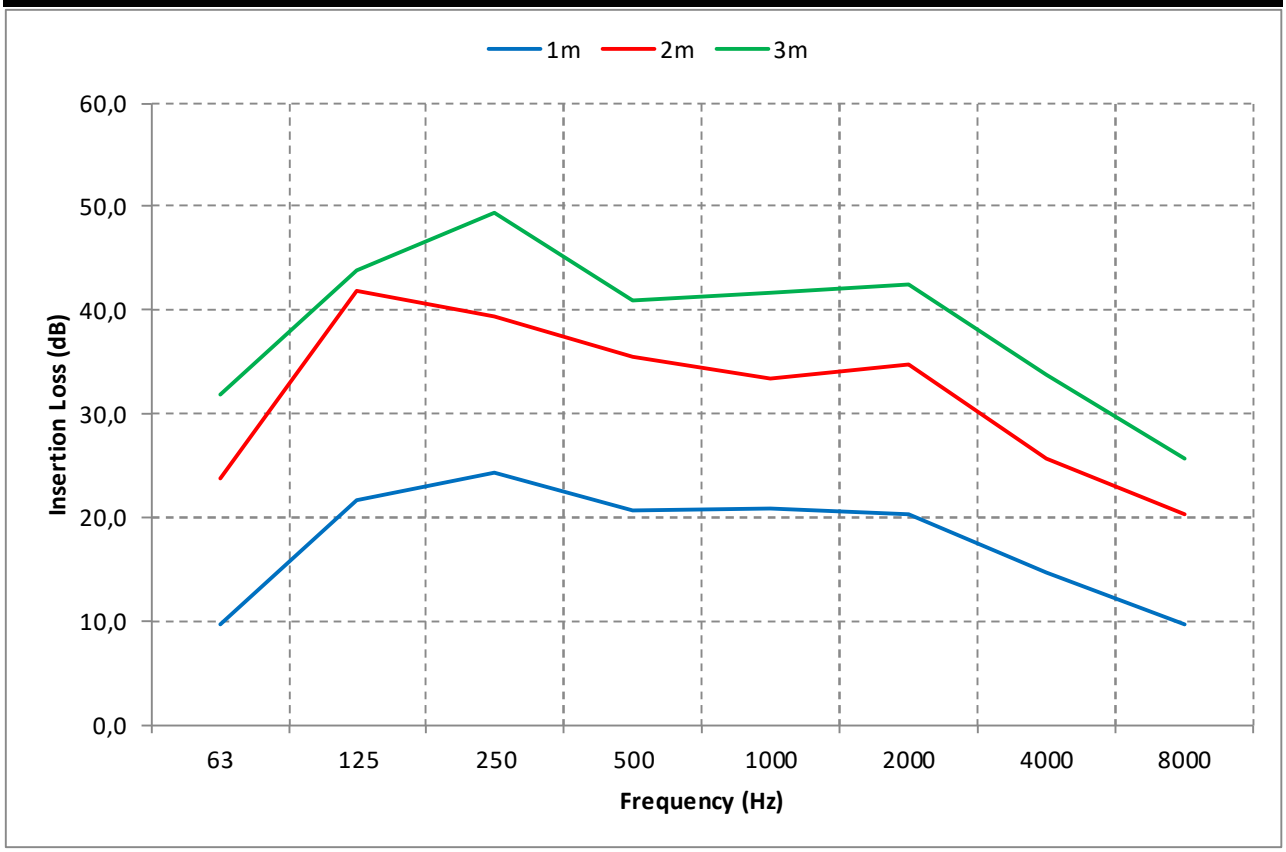
Ø127mm



	Frequency (Hz)	63	125	250	500	1000	2000	4000	8000
Insertion Loss (dB)	1m	0,3	12,7	22,1	26,2	30,0	26,1	12,8	11,5
	2m	7,4	24,0	39,0	41,1	40,5	39,0	24,5	20,5
	3m	10,7	29,4	45,1	44,4	42,7	42,1	30,7	25,2

Graph 3. Insertion loss [∅ 127 mm in diameter – 1 m, 2 m, 3 m in length]

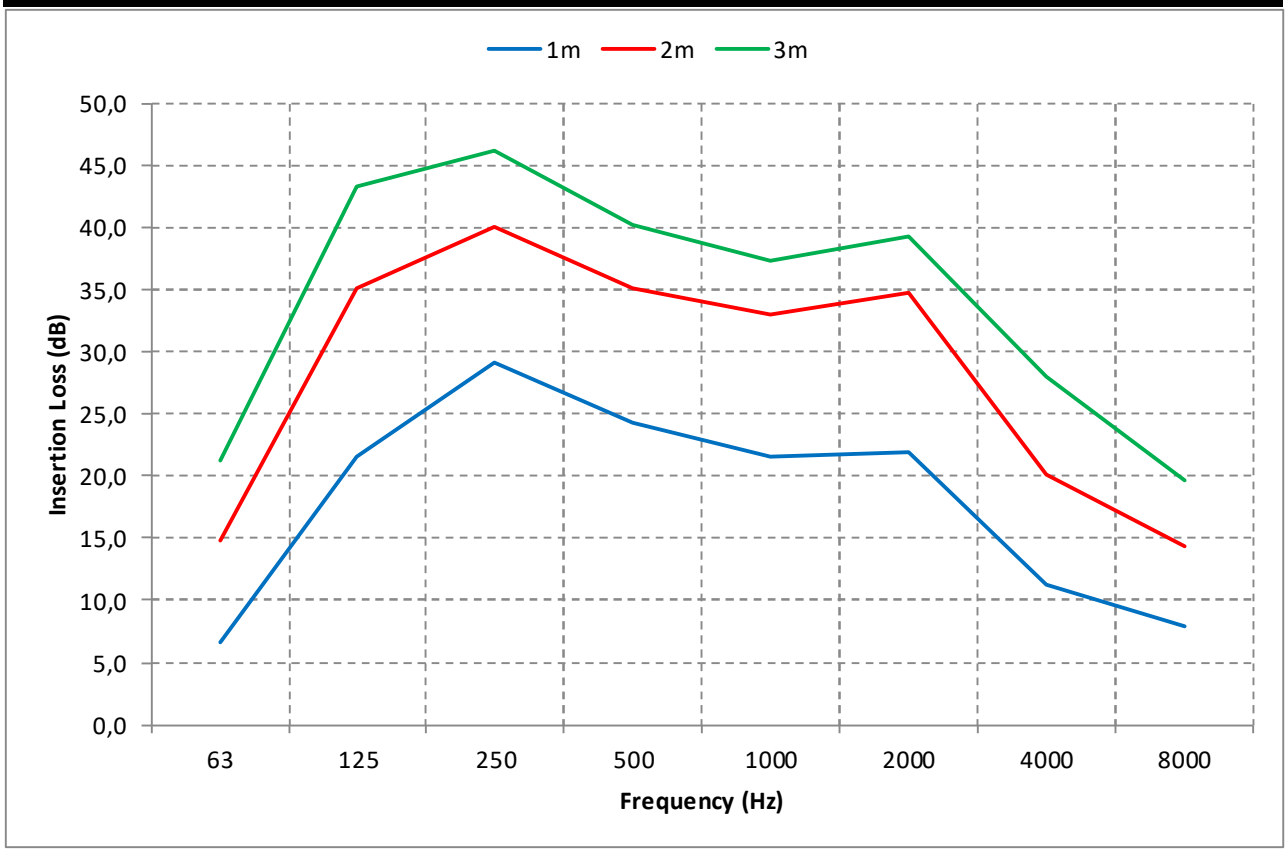
Ø152mm



	Frequency (Hz)	63	125	250	500	1000	2000	4000	8000
Insertion Loss (dB)	1m	9,6	21,6	24,3	20,7	20,9	20,3	14,8	9,7
	2m	23,8	41,9	39,3	35,6	33,3	34,7	25,7	20,3
	3m	31,9	43,8	49,5	40,9	41,7	42,5	33,9	25,6

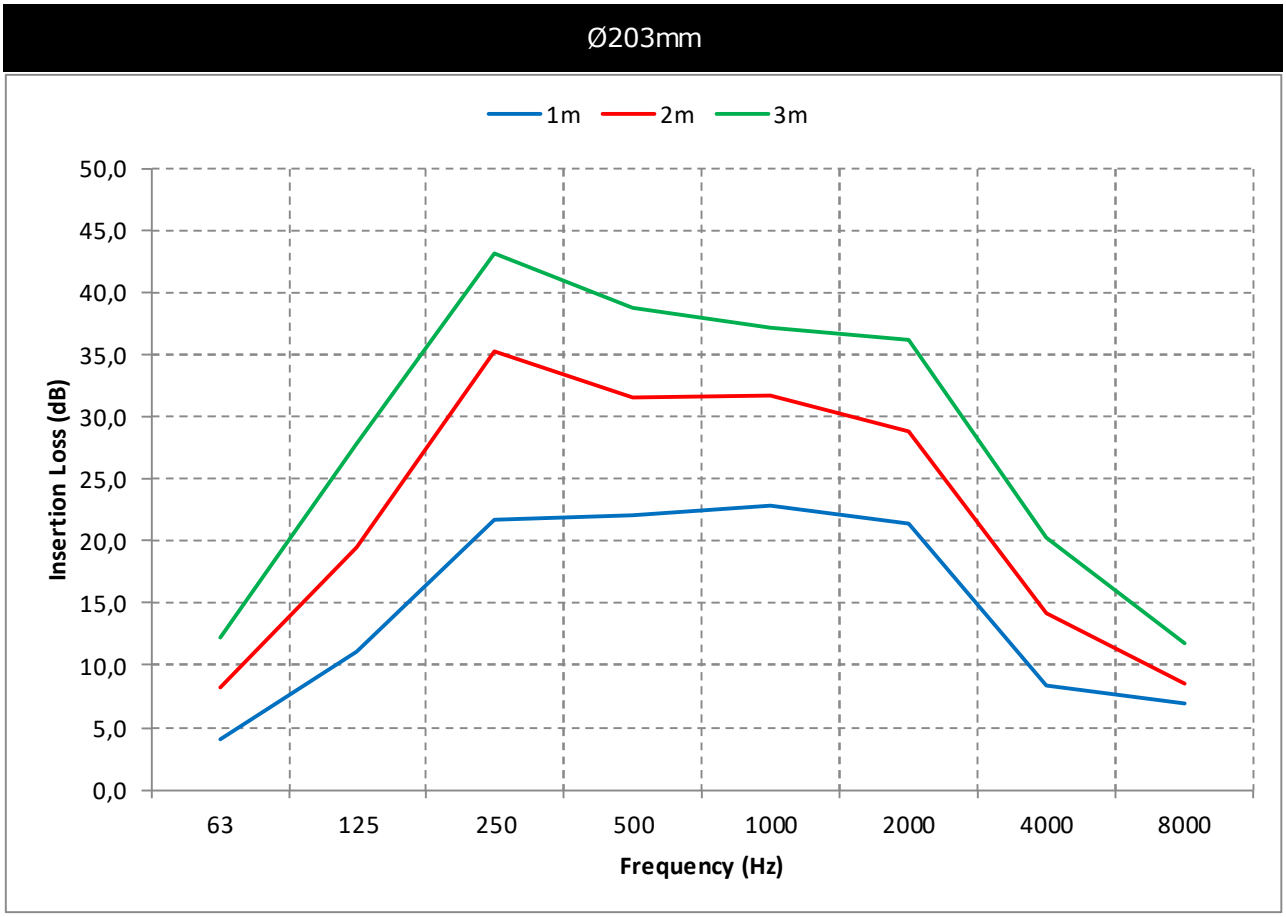
Graph 4. Insertion loss [∅ 152 mm in diameter – 1 m, 2 m, 3 m in length]

Ø160mm



	Frequency (Hz)	63	125	250	500	1000	2000	4000	8000
Insertion Loss (dB)	1m	6,6	21,5	29,1	24,3	21,6	21,9	11,3	7,9
	2m	14,8	35,1	40,0	35,1	33,0	34,7	20,1	14,3
	3m	21,2	43,3	46,1	40,2	37,4	39,2	28,0	19,6

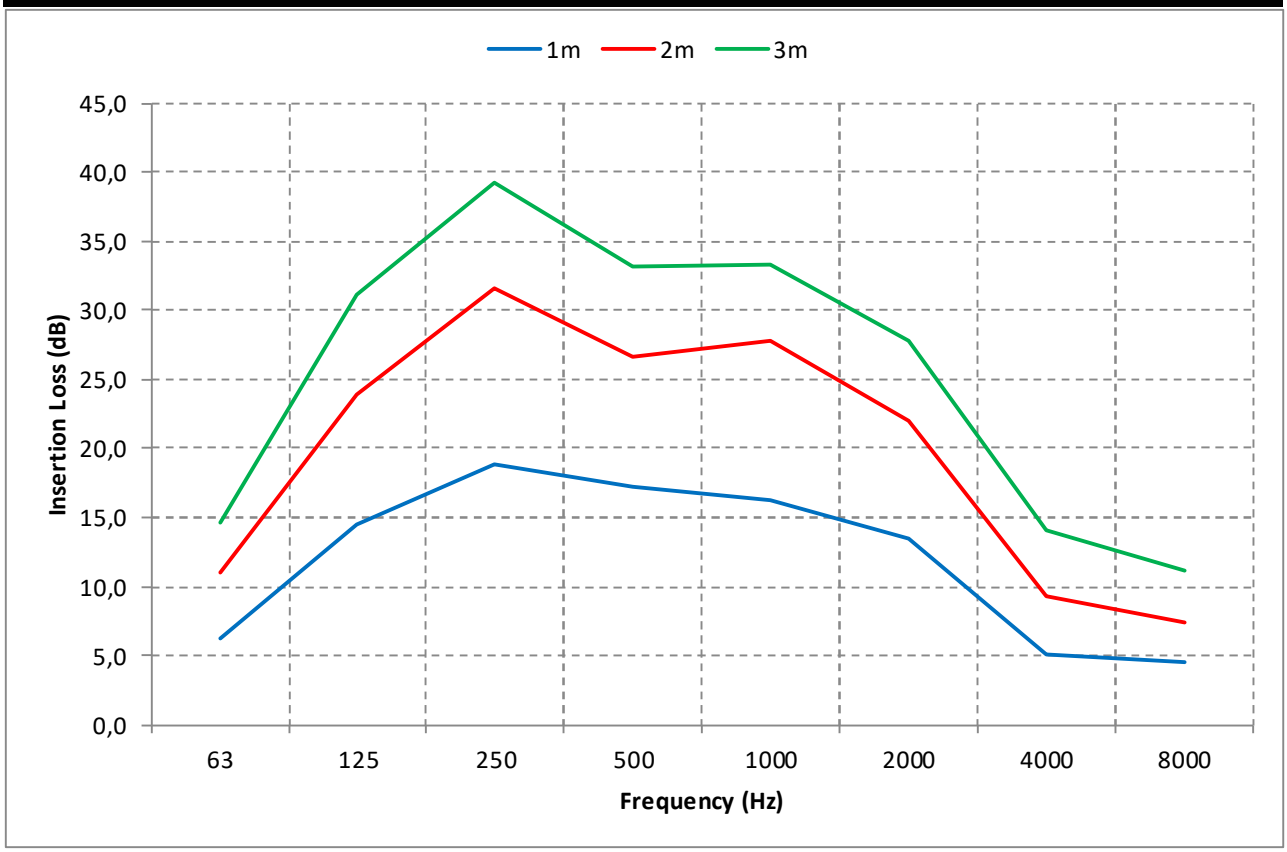
Graph 5. Insertion loss [∅ 160 mm in diameter – 1 m, 2 m, 3 m in length]



	Frequency (Hz)	63	125	250	500	1000	2000	4000	8000
Insertion Loss (dB)	1m	4,1	11,2	21,7	22,1	22,9	21,4	8,4	7,0
	2m	8,2	19,5	35,2	31,5	31,7	28,8	14,1	8,5
	3m	12,2	27,8	43,1	38,7	37,1	36,2	20,3	11,8

Graph 6. Insertion loss [∅ 203 mm in diameter – 1 m, 2 m, 3 m in length]

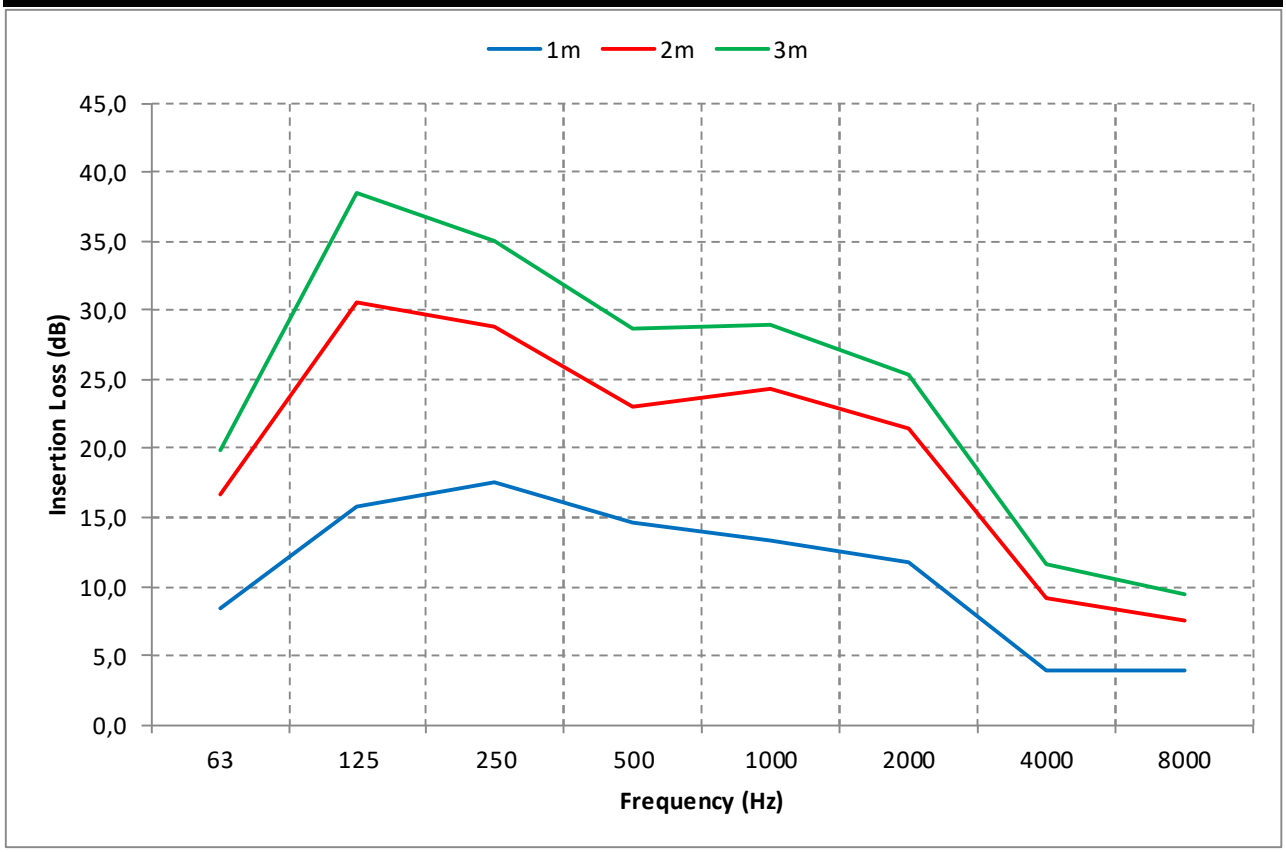
Ø254mm



	Frequency (Hz)	63	125	250	500	1000	2000	4000	8000
Insertion Loss (dB)	1m	6,2	14,5	18,9	17,3	16,2	13,5	5,1	4,5
	2m	11,0	23,9	31,5	26,6	27,8	22,0	9,3	7,4
	3m	14,6	31,2	39,3	33,1	33,3	27,8	14,0	11,1

Graph 7. Insertion loss [∅ 254 mm in diameter – 1 m, 2 m, 3 m in length]

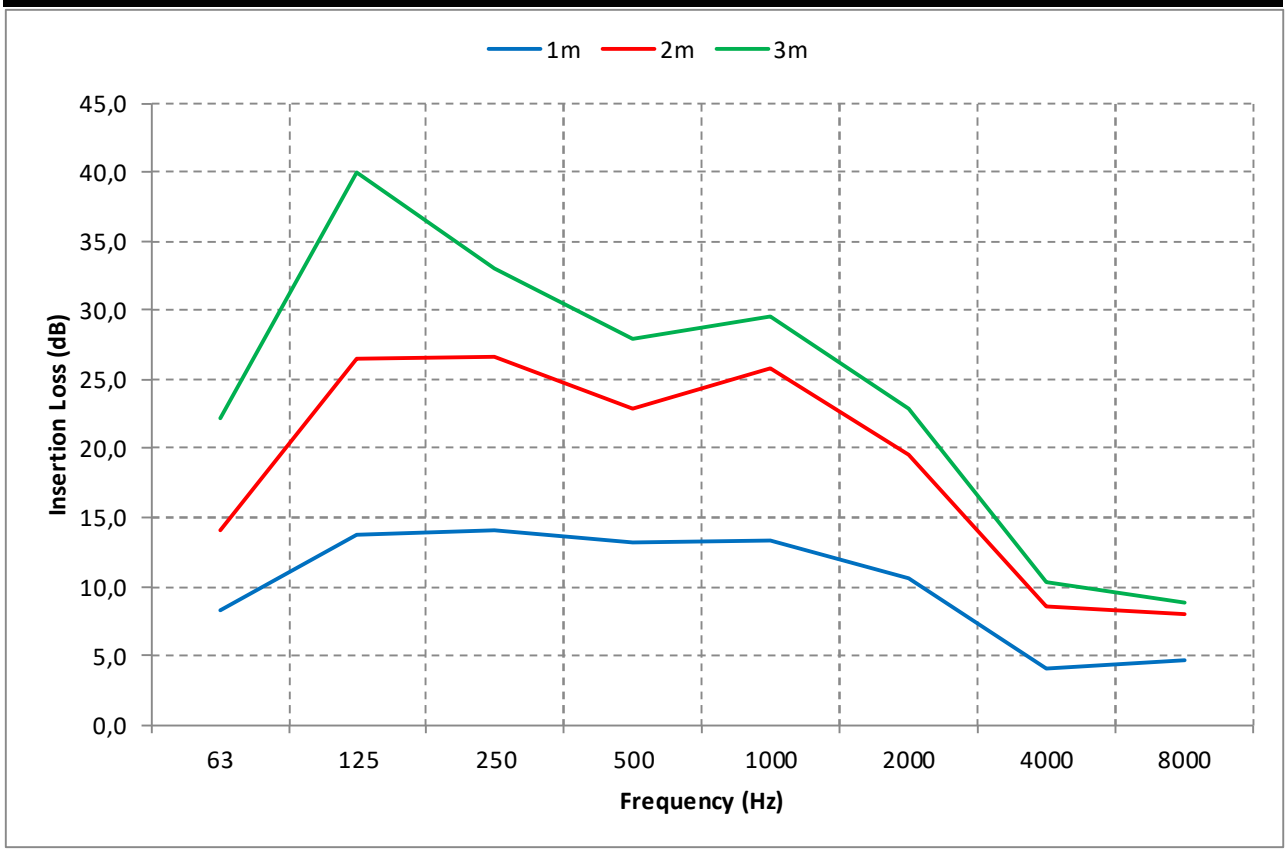
Ø305mm



	Frequency (Hz)	63	125	250	500	1000	2000	4000	8000
Insertion Loss (dB)	1m	8,4	15,8	17,6	14,6	13,3	11,8	3,9	3,9
	2m	16,6	30,5	28,8	23,1	24,4	21,4	9,1	7,6
	3m	19,8	38,5	35,1	28,7	28,9	25,3	11,6	9,4

Graph 8. Insertion loss [∅ 305 mm in diameter – 1 m, 2 m, 3 m in length]

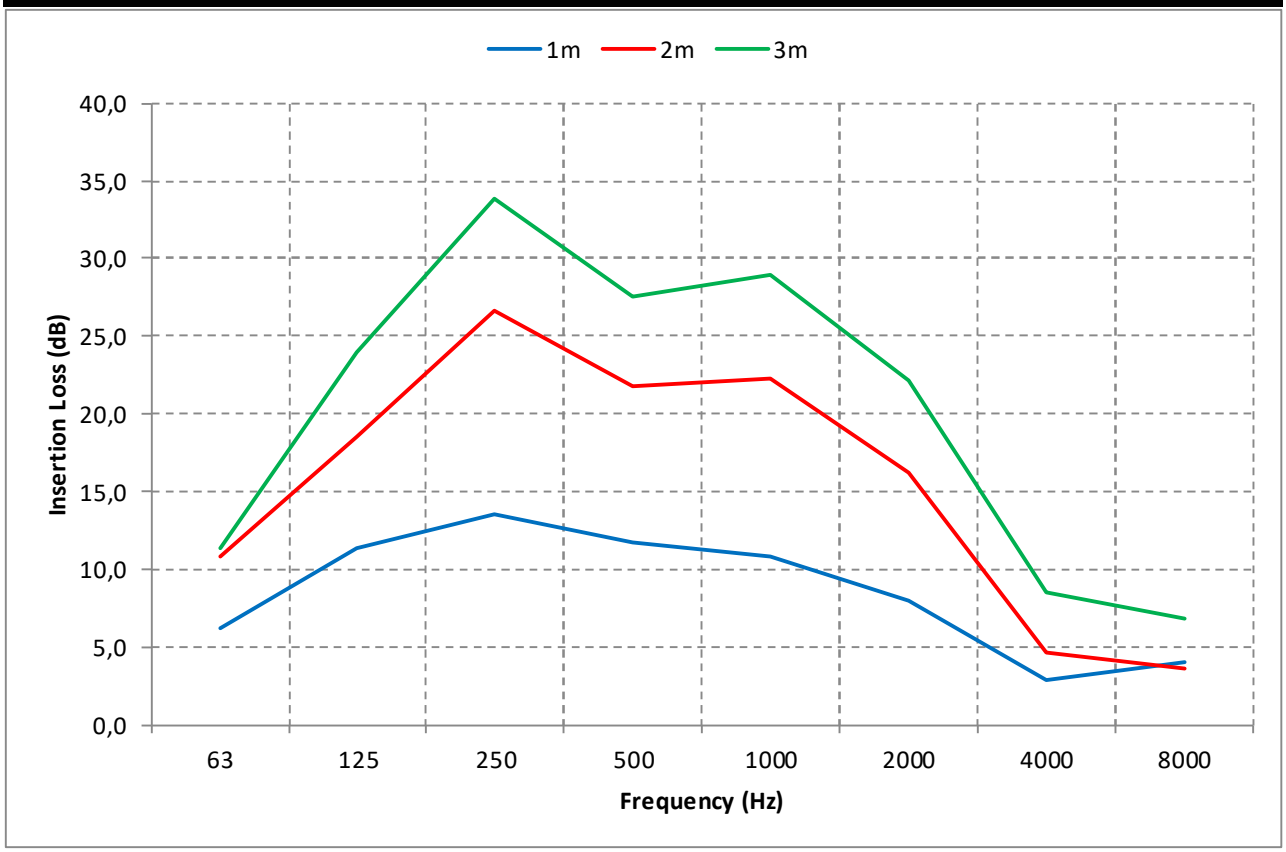
Ø315mm



	Frequency (Hz)	63	125	250	500	1000	2000	4000	8000
Insertion Loss (dB)	1m	8,3	13,8	14,0	13,2	13,4	10,6	4,1	4,6
	2m	14,0	26,5	26,6	22,9	25,8	19,5	8,6	8,0
	3m	22,1	40,0	33,0	27,9	29,6	22,9	10,3	8,9

Graph 9. Insertion loss [∅ 315 mm in diameter – 1 m, 2 m, 3 m in length]

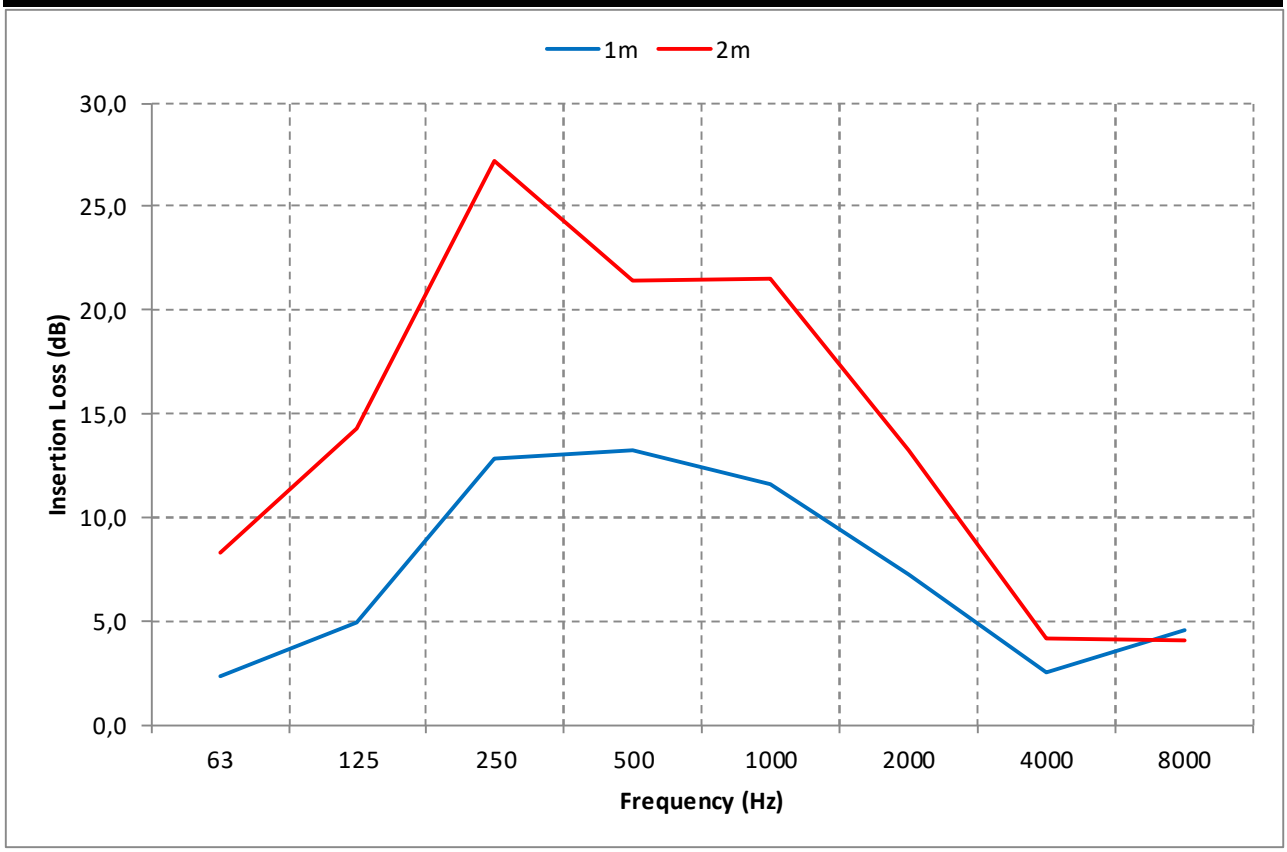
Ø356mm



	Frequency (Hz)	63	125	250	500	1000	2000	4000	8000
Insertion Loss (dB)	1m	6,2	11,3	13,5	11,7	10,8	8,0	2,9	4,0
	2m	10,8	18,5	26,6	21,7	22,3	16,2	4,7	3,6
	3m	11,3	24,0	33,8	27,6	28,9	22,1	8,5	6,8

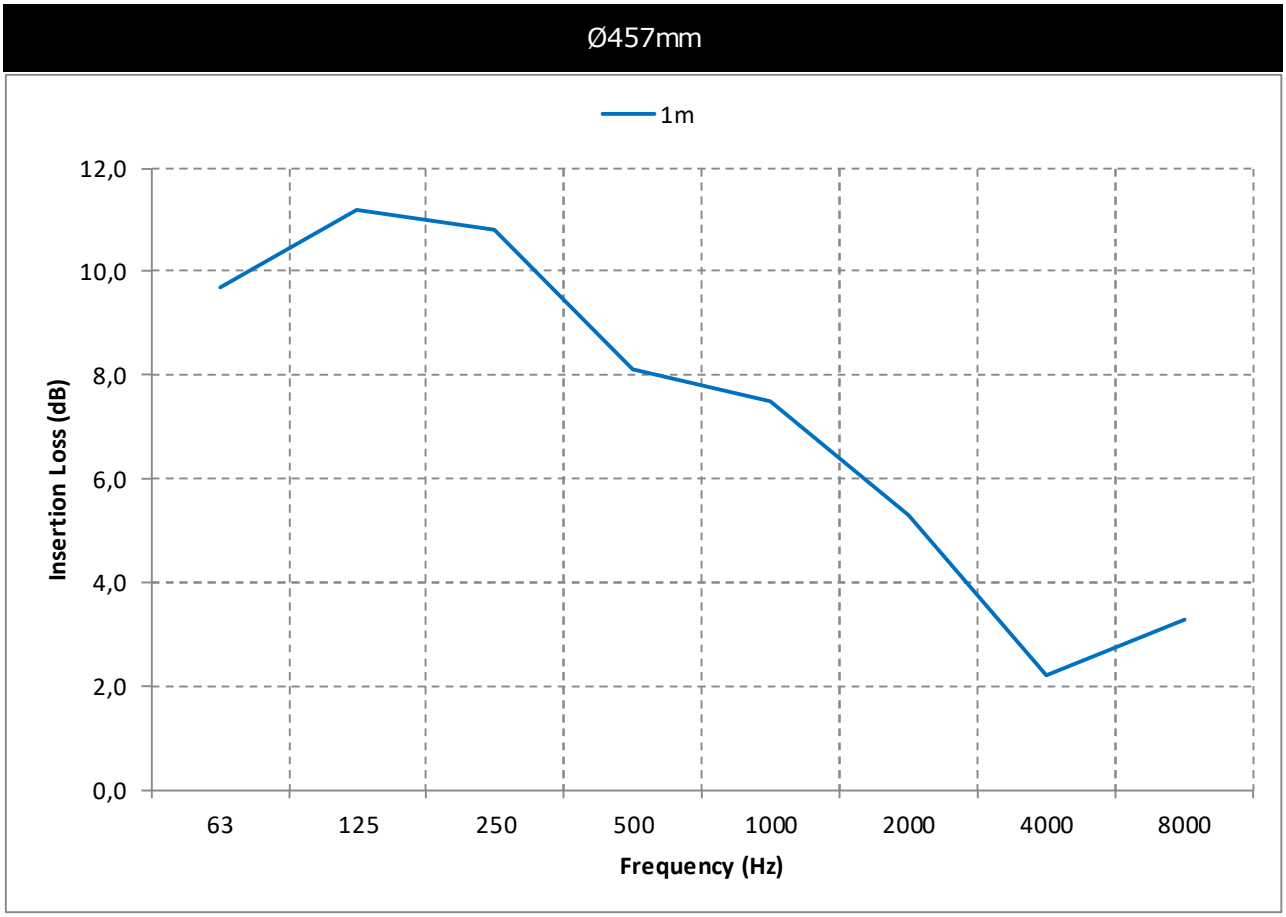
Graph 10. Insertion loss [∅ 356 mm in diameter – 1 m, 2 m, 3 m in length]

Ø406mm



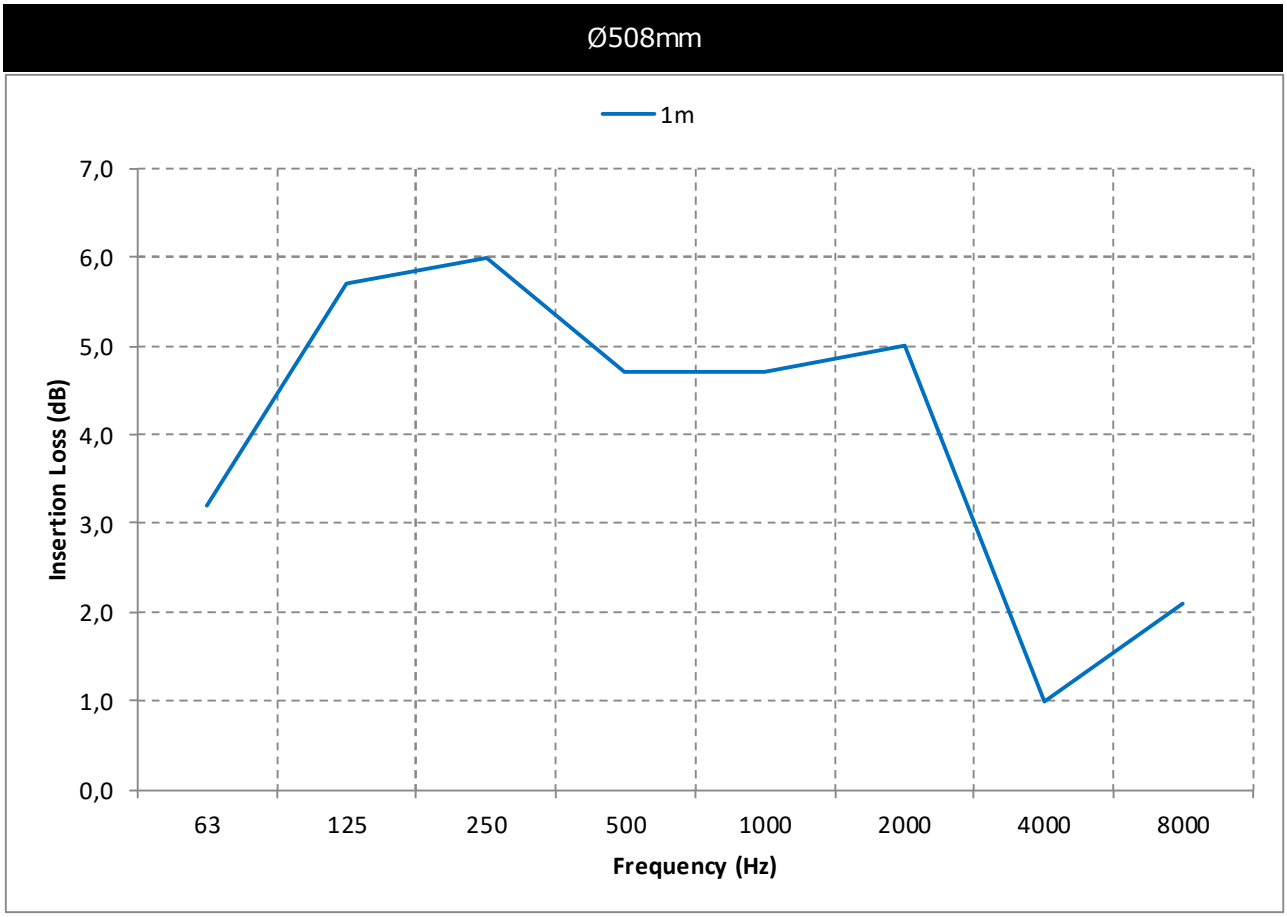
	Frequency (Hz)	63	125	250	500	1000	2000	4000	8000
Insertion Loss (dB)	1m	2,3	4,9	12,8	13,2	11,6	7,3	2,5	4,6
	2m	8,3	14,3	27,2	21,4	21,5	13,2	4,2	4,1
	3m	-	-	-	-	-	-	-	-

Graph 11. Insertion loss [∅ 406 mm in diameter – 1 m, 2 m in length]



	Frequency (Hz)	63	125	250	500	1000	2000	4000	8000
Insertion Loss (dB)	1m	9,7	11,2	10,8	8,1	7,5	5,3	2,2	3,3
	2m	-	-	-	-	-	-	-	-
	3m	-	-	-	-	-	-	-	-

Graph 12. Insertion loss [∅ 457 mm in diameter – 1 m in length]



	Frequency (Hz)	63	125	250	500	1000	2000	4000	8000
Insertion Loss (dB)	1m	3,2	5,7	6,0	4,7	4,7	5,0	1,0	2,1
	2m	-	-	-	-	-	-	-	-
	3m	-	-	-	-	-	-	-	-

Graph 13. Insertion loss [∅ 508 mm in diameter – 1 m in length]