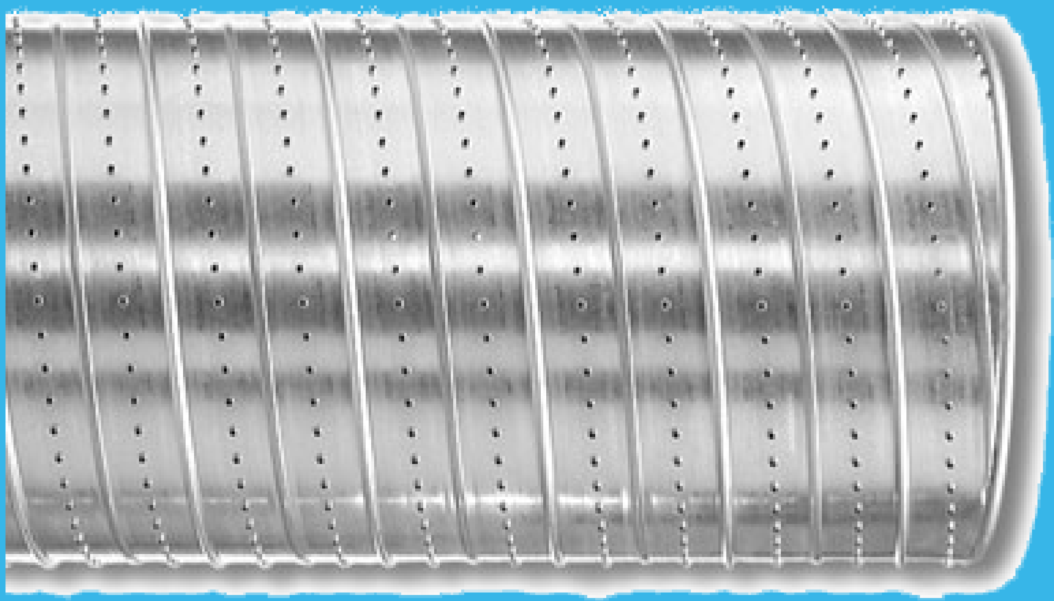
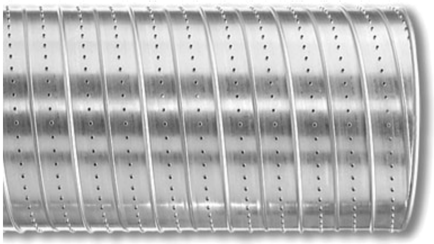


Lindab VSR

Ventiduct nozzle ducts

Ventiduct nozzle ducts VSR

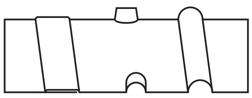


Description

Ventiduct is an air distribution system consisting of spiral seamed circular ducts that is equipped with a large number of small nozzles inserted into the duct wall. They are supplied in five sizes from Ø200 mm to Ø500 mm and with various nozzle patterns, which should be chosen according to the task in hand.
Maximum standard length is 3.000 mm. The ducts have a raised protective cover to prevent the nozzles becoming deformed during transport. Ventiduct ducts can be supplied in hot-galvanised or powder-coated versions, VSR and VSRPL.
The system should be primarily used for the supply of cooled air.

- Large cooling effect
- Large dynamic range
- Large induction rate
- Short throw
- Discrete diffuser design
- Easy to install

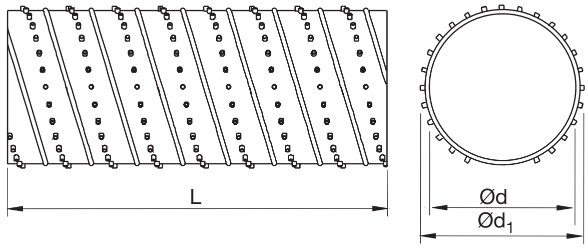
Cross-section of nozzle duct



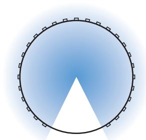
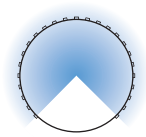
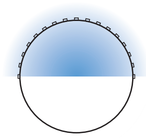
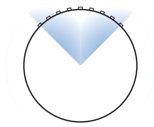
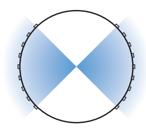
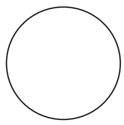
Order code

Product	VSR	aaa	bbb	cccc
Type	VSR			
Ød		aaa		
Nozzle pattern			bbb	
Length/no. of parts				cccc

Dimensions



Ød [mm]	$Ød_1$ [mm]	L [mm]	Weight [Kg/m]
200	212	3000	3.66
250	262	3000	4.57
315	327	3000	5.76
400	412	3000	7.31
500	512	3000	9.14

Nozzle pattern		Code
300°		300
270°		270
180°		180
90°		90
2 x 90°		2 x 90
Blind piece without nozzles: Spiral-seamed Long seamed		 000 001

The blind piece is a specially made spiral-seamed duct that resembles ventiduct in design, as it has no actual nozzles.
Available in the same length as ordinary nozzle ducts.
Alternatively long-seamed pipes can be used, which creates an attractive contrasting effect.

Ventiduct nozzle ducts VSR

Dispersal patterns

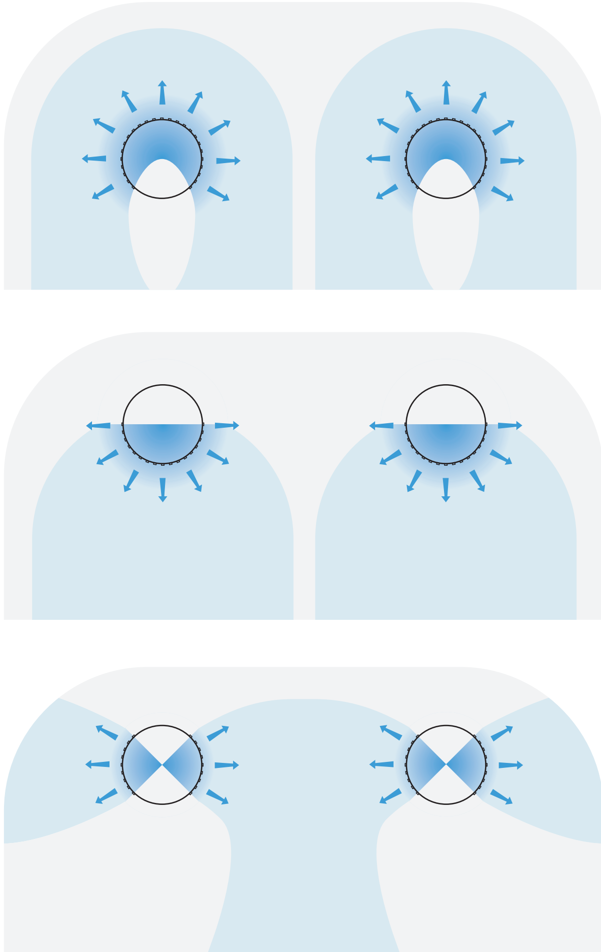
With Ventiduct nozzle ducts, various flow conditions can be achieved in the room. The downward supply of air always creates the greatest air velocities in the occupied zone and is therefore used mostly in industrial ventilation. The choice between air being supplied horizontally or upwards depends on the required form of flow.

Upward supply air
When cooled air is supplied upwards, the cool air mixes with the warmer room air close to the duct nozzles. The supplied air typically covers a vertical area of 2-4 metres below the ducts. At greater distances between the ducts, the supplied air flows behind in a displacement flow further out in the room.
Depending on the required volume flow, a nozzle pattern of between 90° and 300° is used.

Downward supply air
When air is supplied downwards, the air velocities in the occupied zone are increased by the thermal forces (by cooling) and by the dynamic forces (Supplied air velocity). This can result in quite high air velocities in the occupied zone, which is not acceptable for traditional comfort ventilation. However, high air velocities can be recommended if a stable downward flow of air is required, and if increased, air veloci-ties in the occupied zone are acceptable. This could, for example, be desirable for industrial assignments. A nozzle pattern between 90° and 300° is used, depending on the volume flow required.

Horizontal supply air
When air is supplied horizontally, air jets are formed, creating a mixed flow in the room. Depending on the various parameters, maximum air velocities occur in the occupied zone due to the thermal load, air jet velocities or a combination of both. When low supply air velocities are being used (low volume flow or large ducts/nozzle patterns) the form of the flow approximates a form of low impulse supply air, as with upwards supply air. Horizontal supply air can be used in locations where there is a deliberate demand for a flow of air throughout the room in accordance with the mixing principle, and therefore where an upward supply is not being used.

Dispersal patterns



Recommended working areas for Ventiduct
When air is supplied horizontally, air jets are formed, creating a mixed flow in the room. Depending on the various parameters, maximum air velocities occur in the occupied zone due to the thermal load, air jet velocities or a combination of both. When low supply air velocities are being used (low volume flow or large ducts/nozzle patterns) the form of the flow approximates a form of low impulse supply air, as with upwards supply air. Horizontal supply air can be used in locations where there is a deliberate demand for a flow of air throughout the room in accordance with the mixing principle, and therefore where an upward supply is not being used.

Air pattern	Up	Down	Horizontal
Installation height [m] *	2.5–5.0	3.0–8.0	2.5–5.0
Min. distance from ceiling [m] **	0.2	0.1–0.2	0.1
Δt (t_1 - t_r) [K]	-1..–10	-1..–6	-1..–8

* Distance from floor to lower edge of duct.
** Distance from upper edge of duct to ceiling must be maintained to avoid dirtying the ceiling.

Ventiduct nozzle ducts VSR

Technical data

Max. volume flow per metre of duct

Dim.	Nozzle pattern							
	90°		180°/2x90°		270°		300°	
Ød	[l/s]	[m³/h]	[l/s]	[m³/h]	[l/s]	[m³/h]	[l/s]	[m³/h]
200	13	45	26	95	39	140	43	155
250	17	60	32	115	49	175	54	195
315	21	75	42	150	61	220	68	245
400	26	95	53	190	78	280	88	315
500	32	115	65	235	97	350	108	390

Max. total duct length (m)

	Nozzle pattern			
Ød	90°	180°/2x90°	270°	300°
200	14	7	5	4
250	17	8	6	5
315	21	11	7	6
400	27	14	9	8
500	34	17	11	10

Sound effect level L_w (dB) = $L_{WA} + K_{ok}$

Ød	125	250	500	1K	2K	4K	8K
200	-7	0	1	-6	-15	-21	-27
250	-5	1	-1	-5	-11	-18	-22
315	1	2	-2	-4	-11	-16	-19
400	-1	-1	-3	-4	-9	-14	-17
500	4	0	-3	-4	-9	-16	-14

Technical data

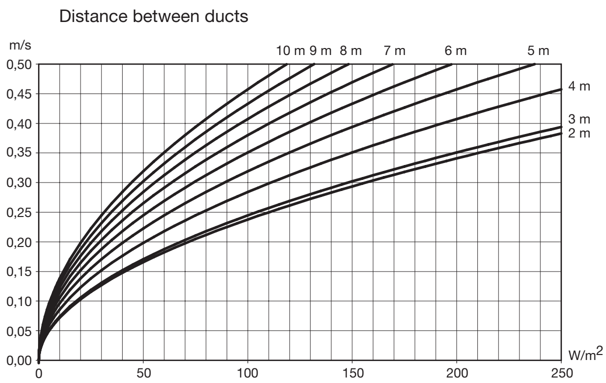
Air velocity in the occupied zone

The air velocity in the occupied zone is a result of air jet velocities and thermal air movements in the room. An exact calculation of the resulting air velocity in the occupied zone can be performed using a computer program. (Contact the lindab sales department for futher information).

For upward supply, the maximum air velocity in the occupied zone are dependent on the temperature difference t_i-t_r. The best results are achieved by using maximum supply air per duct metre, according to the table on the left.

Depending on the thermal load (W/m²) and the duct length, the maximum air velocity in the occupied zone is indicated as a rough estimate in the diagram below. Diagram only applies to upward dispersal pattern with maximum volume flow per duct metre:

(distance to ceiling > 4 × Ød).



Please contact Lindab's sales department for further information.

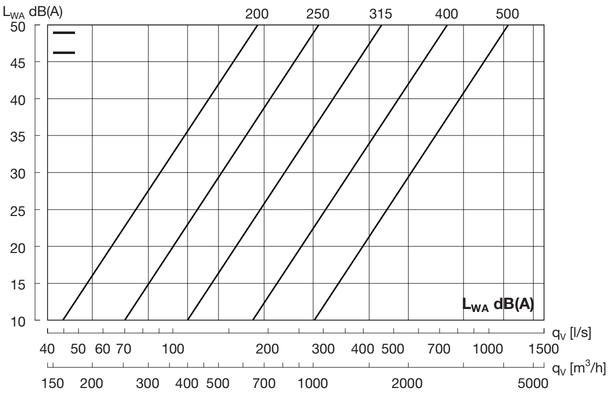
Ventiduct nozzle ducts VSR

Technical data

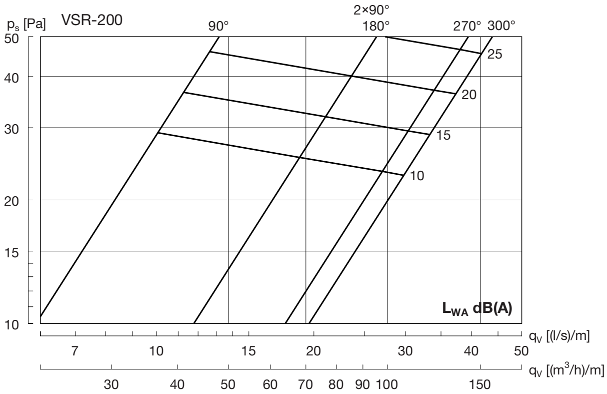
Pressure and sound

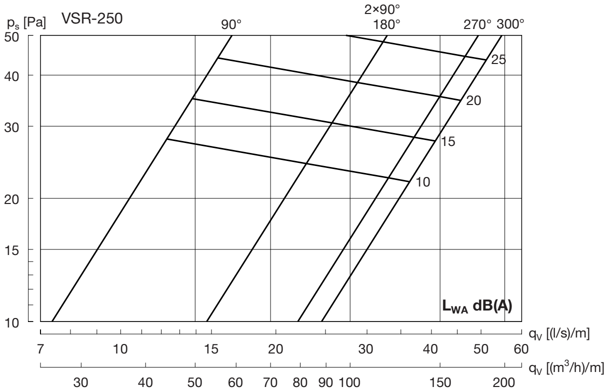
For calculation of the resulting sound power level from a ventiduct, add the sound power level from the nozzles ($L_{WA\ nozzles}$) and the sound power level from the flow noise in the ventiduct (L_{WA} duct) logarithmically.

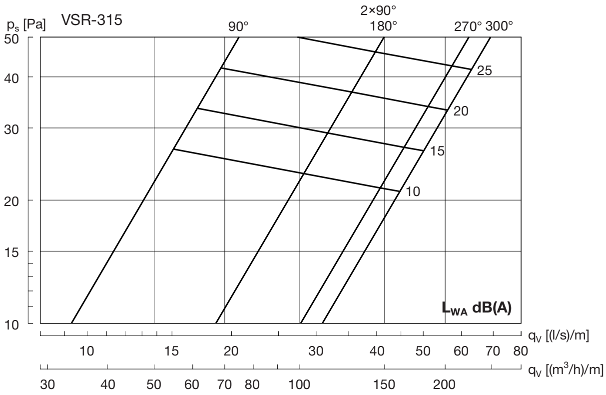
Flow noise in duct

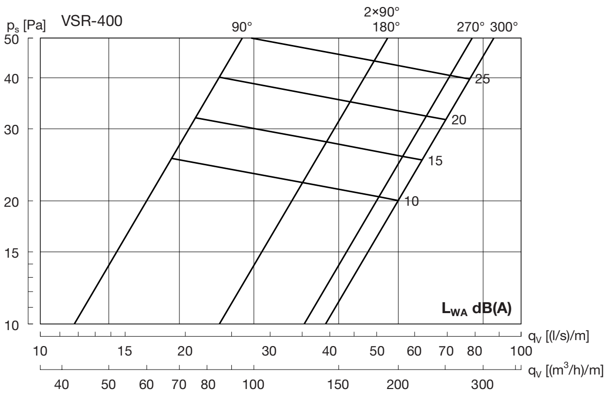


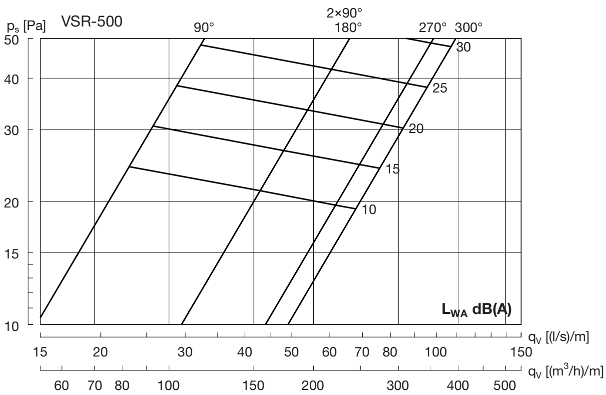
Sound effect level from nozzles









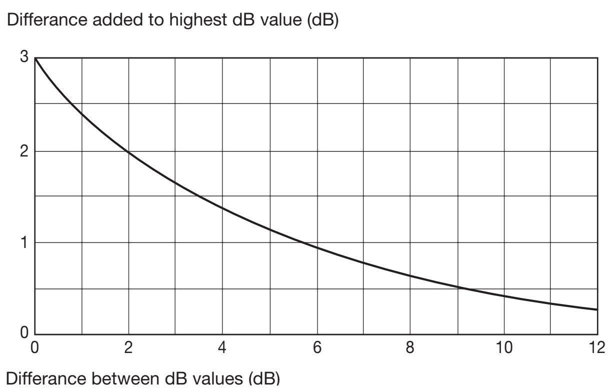


The sound levels from the nozzles apply for duct length 1 m.

Correction for other duct lengths:

Length m	1.0	1.5	2.0	2.5	3.0	4.0	5.0	6.0
Corrections	0	2	3	4	5	6	7	8

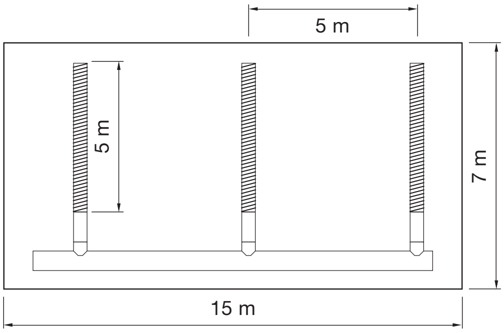
Addition of sound levels from nozzles and duct:



Ventiduct nozzle ducts VSR

Technical data

Calculation example



Required information:

Pressure loss:	p_t [pa]
Resulting sound level in the rooms:	L_p [dB(A)]
Max. velocity in the occupied zone:	v_{occ} [m/s]

Calculation based on catalogue values:

VSR-250, 270°	
Ceiling height	5.0 m
Installation height upper edge duct	4.5 m
Volume of the room:	525 m³
Hard room	(T_s~ 1.9 s)
Volume flow	2400 m³/h (667 l/s)

The following can be determined from the diagrams on the previous page:

Pressure loss:	40 Pa
Sound effect: $L_{WA\ duct}$:	41 dB(A)
Sound effect: $L_{WA\ nozzle}$:	22 dB(A)

Duct length of 5 m = > correction of + 7

Sound effect nozzles corrected: $L_{WA\ nozzles}$ = 22 + 7 = 29 dB(A)

Addition of sound levels from nozzles and duct:

Difference:	12 dB -> No addition
Three identical sound sources:	+ 4.8
(see figure 25 in the Theory section)	
Sound effect L_{WA} for three ducts:	41+ 5= 46 dB(A)

Resulting sound level:
The sound formula from *page 46 in the Theory* section is used.

The absorption area of the room is determined by :

$A = 0.16\ (V/T_s) = 0.16\ (525/1.9) =$ 44 m² Sabine

Based on *Figures 27 and 28 in the Theory section*, room attenuation D is determined:

Figure 27: $\sqrt{n}/\sqrt{Q}$ = 1.7 for direction factor Q = 1 and n = 3

1.5 m above the floor is distance to duct : r = 4.5-0.25-1.5 = **2.75 m**

Figure 28: $r\sqrt{(n/Q)}$ = 4.7 and A = 44 =>D = 10 dB
Resulting sound pressure in the room:
$L_P = L_{WA}$ (for three ducts) – D = 46–10 = **36 dB(A)**

Φ = 3.2 kW => ΔT = 3200/(667·1.2) = -4 K
3200 W/(15 m x 5 m)
=> 43 W/m² in the actively ventilated area
Speed in the occupied zone according to the diagram:
43 W/m² and 5 m distance => v_{occ} = **0.21 m/s**

Dimensioning of Ventiduct

Project :

Room

Length	m	7	A_{total} m²	105.0
Width	m	15	V m³	525
Height	m	5	Free distance	
Occupied zone (height)	m o. floor	1.8	Ventiduct/Ceiling in m	
Installation height (top)	m	4.5	ok	0.50
Reverberation time Ts	s	1.9	Room attenuation	
Absorptioncoefficient	α_m	0.10	hard	

		A	B	C
Dimension		ø D 250	ø D 250	ø D 250
Nozzle pattern		270°	270°	270°
Air flow pattern		upwards	upwards	upwards
Air flow rate (total)	m³/h	2400	2400	2400
Temperature difference	K	2	4	6
Number Ventiduct	pcs.	3	3	3
Length Ventiduct	m	5	5	5
Distance between ventiduct	m	5	5	5

		A	B	C
Active room area	m²	75	75	75
area		ok	ok	ok
width		ok	ok	ok
length		ok	ok	ok
Max.flow pr. m Ventiduct	m³/(hm)	175	175	175
Air flow pr. m Ventiduct	m³/(hm)	160	160	160
Check maximum-flow pr. m		ok	ok	ok
Total Length Ventiduct	m	15.0	15.0	15.0
Check (Length)		ok	ok	ok
Distance floor/duct	m	4.25	4.25	4.25
Thermal parameters				
Cooling effekt	W	1632	3264	4896
Q/A_{total}	W/m²	16	31	47
Air change rate	1/h	4.6	4.6	4.6
Flow pr A_{aktiv}	m3/(hm2)	32	32	32
Airflow pr. length	W/m	109	218	326
Q/A_{aktiv}	W/m²	22	44	65
Acustic				
Air flow rate pr. duct	m3/h	800	800	800
Max. velocity duct	m/s	4.5	4.5	4.5
Nozzle	dB(A)	30	30	30
Duct	dB(A)	41	41	41
Sound power level pr. duct	dB(A)	42	42	42

Result

Max. velocity	m/s	0.15	0.21	0.25
Total sound pressure level	dB(A)	36	36	36
Total pressure drop	Pa	53	53	53

Comments

(Printout from the program)

Lindab is able to offer complete calculations for an actual installation using our internal dimensioning program (see printout above from the program). Based on the specification of a large number of variables, detailed information can be obtained on maximum a velocities in the occupied zone, pressure loss and resulting sound levels in the rooms for the overall installation. Variables that it is not possible to include in calculations based on the catalogue values.

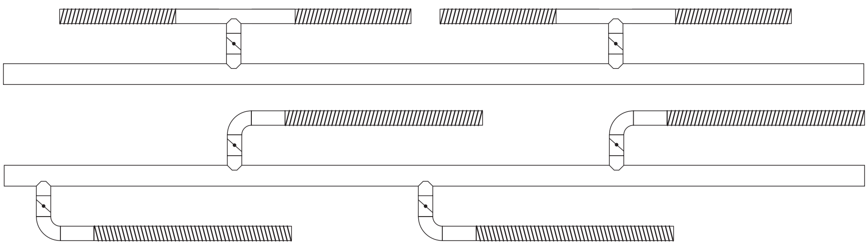
Contact Lindab for further information.

Ventiduct nozzle ducts VSR

Technical data
Examples of duct design

Ventiduct nozzle ducts can be installed in various ways. In highceilinged rooms it is generally an advantage to install Ventiduct nozzle ducts as low down as possible (min. height above floor 2.5 m). This provides the greatest efficiency.

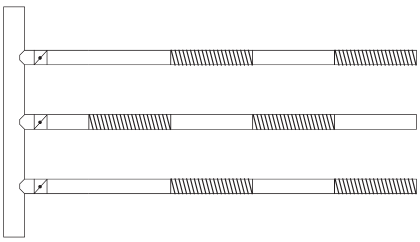
Cactus model
This solution is used for long, narrow rooms.

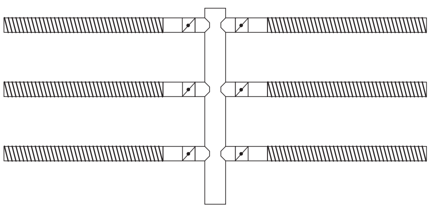


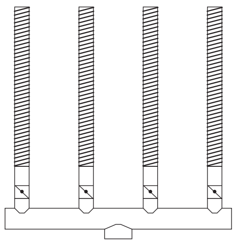
Exchange model
An ideal solution for long, narrow rooms. This model provides an even distribution of supplied air.

Fishbone model
Ventiduct nozzle ducts stretch out from both sides of the main duct. It is recommended that an adjustment damper be used for accurate regulation of the air volume.

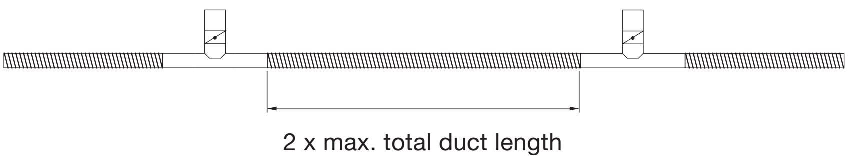
Fork model
Here the Ventiduct nozzle ducts are positioned on one side of a main or branch duct.
It is recommended that an adjustment damper be installed on the duct joints in order to ensure consistent air distribution in the duct system.





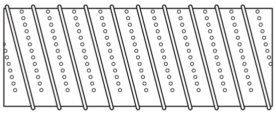


Line model
A simple solution that makes duct installation easier and minimises the number of adjustment dampers. The distance between the connection ducts is equivalent to twice Ventiduct's maximum length plus the two blind pieces.

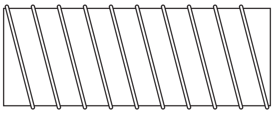


Ventiduct nozzle ducts VSR

Components



VSR nozzle duct - Nozzle pattern 90 - 300
Ventiduct nozzle ducts over 3 m are supplied in multiple sections, e.g. one 4 m long duct is supplied in two 2 m lengths.



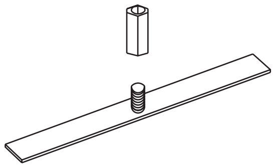
VSR 000
Blind piece without nozzles, spiral-seamed.

VSR 001
Blind piece without nozzles, long-seamed (smooth).

Ordering example

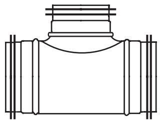
Product	INV	aaa
Type		
Dimension Ød		

Accessories

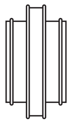


INV
Mounting bracket for Ventiduct

OSB10
VSR_OSB10

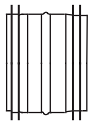


TCPU
T-piece

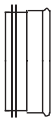


DIRU
Iris damper

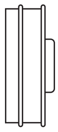
DRU
Balancing damper



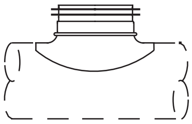
NPU
Spigot



ESU
End cap



ESUH
End cap with handle



PSU
Saddle

All accessories are supplied in the same material as the Ventiducts, and can also be supplied with a powder-coated finish.

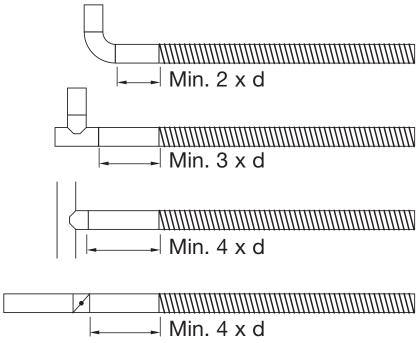
Other components
Motorised shut-off and adjustment damper DTBU and volume flow regulator VRU incl. accompanying silencer SLU.

Ventiduct nozzle ducts VSR

Technical data

Building-in distance

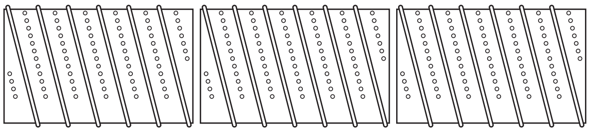
Ventiducts should not be positioned too close to dampers, bends, T-pieces or other elements that may create turbulence and hence noise.
Straight duct sections should be installed between the Ventiducts and potentially disruptive components, as shown in the illustration below. Suitable duct sections are available.



Installation

Assembly

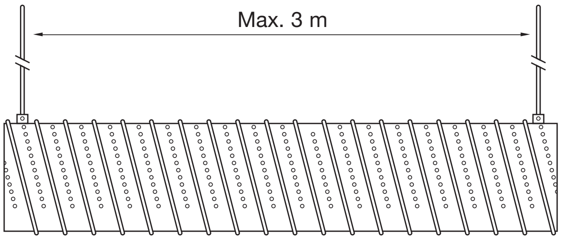
The Ventiducts are individually packed in cardboard boxes at the factory, to minimise the risk of transport damage. The packaging is numbered to ensure that the ducts are mounted in the correct order, so that the spiral seam is continuous.



Suspension

If it is necessary to be able to dismantle the Ventiducts, e.g. for cleaning, we recommend using Lindab Transfer connections (see Lindab's Duct Systems catalogue).

IMPORTANT: In order to maintain the number sequence, the Ventiducts should be left in their packaging until mounting commences.

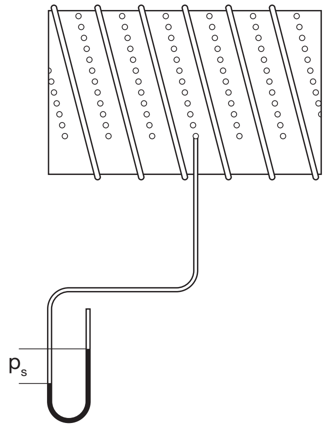


Maximum distance between suspension loops is 3 metres.

Balancing

Measuring of the airflow

The easiest way to measure the volume flow is to measure the nozzle pressure in the middle of the Ventiduct (see sketch).
To do this, attach the hose from the manometer to one of the nozzles. The static pressure (P_s) in the duct can then be read.
Once you know the static pressure, you can read the volume flow per m/duct from the "Sound and pressure" diagram for the relevant duct dimension and nozzle pattern.
The total volume flow can thus be calculated by multiplying the relevant diagram value by the total active length of the Ventiduct.



Most of us spend the majority of our time indoors. Indoor climate is crucial to how we feel, how productive we are and if we stay healthy.

We at Lindab have therefore made it our most important objective to contribute to an indoor climate that improves people's lives. We do this by developing energy-efficient ventilation solutions and durable building products. We also aim to contribute to a better climate for our planet by working in a way that is sustainable for both people and the environment.

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