





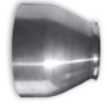



Nozzles



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Nozzles

Nozzles

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Nozzles



GD nozzles, painted white, Bauhaus A/S, Glostrup

Nozzles

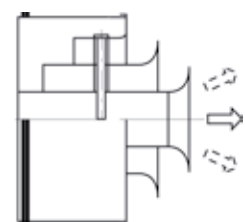
Nozzles can be used with great advantage in rooms where long air throws are desirable, even at small air flows/volumes. Nozzles are suitable for both heating and cooling. Depending on the chosen nozzle the supplied air pattern can be adapted to the job at hand.

Consequently, nozzles can be used to solve very different problems, but excell especially at ventilation of larger rooms with high ceilings. The nozzles can also be used as a “help-system” to lead heated air from units placed high up, down into the occupied zone.

Calculation

In the back of this chapter is a number of examples of calculations to be used in connection with planning. Lindab can offer specific calculations on a definite installation due to our internal dimensioning-programme.

Please contact Lindab for further information.



Example of supply air pattern and direction

Nozzle diffuser

GTI



Description

GTI is a flexible supply air nozzle that is suitable for ventilation of large areas. The nozzle can be used for both heated and cooled air and can be adjusted from diffused to concentrated supply air patterns. The supply air pattern can be adjusted by turning the insert in relation to the central line of the nozzle. The nozzle is equipped with Lindab Safe and can be installed directly into a circular duct, fitting, wall or duct side.

- Flexible nozzle for cooling and heating
- Adjustable dispersal pattern
- Simple installation

Maintenance

The visible parts of the diffuser can be wiped with a damp cloth.

Materials and finish

Insert: Steel
 Connection: Galvanised steel
 Standard finish: Powder-coated
 Standard colour: RAL 9003, 9010, gloss 30

The diffuser is available in other colours. Please contact Lindab's sales department for further information.

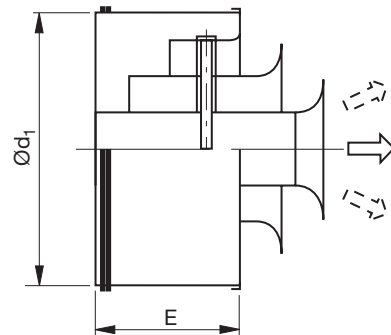
Order code

Product	GTI	aaa	A
Type			
GTI			
Size			
200 - 400			
Version			
A			

Example: GTI - 250 - A

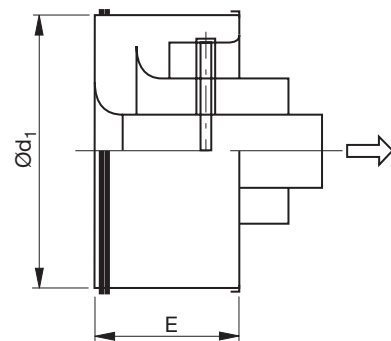
Dimensions

Installation 0



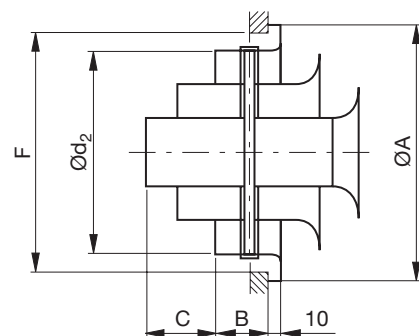
Diffused supply air – for installation in a circular duct or fitting. Supplied adapted to this form of installation as standard.

Installation 1



Concentrated supply air – for installation in a circular duct or fitting. The insert is turned 180 degrees.

Installation 2



Diffused supply air – for installation in a wall or duct side. Remove the external pipe.

Size	ØA mm	B mm	C mm	Ød ₁ mm	E mm	F mm	Ød ₂ mm	Weight kg
200	203	40	55	198	109	170	158	0,8
250	253	50	75	248	139	210	198	1,3
315	318	60	95	313	169	260	248	2,0
400	403	70	115	398	199	321	313	2,8

Free area for GTI nozzle – see pages *Nozzle calculations*.

Nozzle diffuser

GTI

Technical data

Capacity

Volume flow q_v [l/s] and [m³/h], total pressure Δp_t [Pa], throw $l_{0,3}$ and sound level L_{WA} [dB(A)] can be seen in the diagrams.

Throw $l_{0,3}$

Throw $l_{0,3}$ can be seen in the diagrams for isothermal air at a terminal velocity of 0.3 m/s

Resulting sound effect level

The sound effect level from the nozzles must be added logarithmically to the sound effect level from the flow noise in the duct. See sample calculation, pages *Nozzle calculations*.

Frequency-related sound effect level

The sound effect level in the frequency band is defined as $L_{wOK} = L_{WA} + K_{OK}$. K_{OK} values can be seen in the table below.

Table 1 - diffused supply air

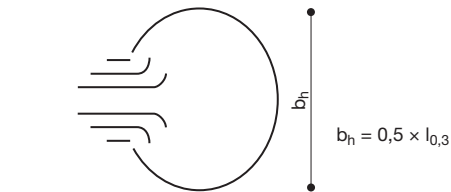
Size	Centre frequency Hz							
	63	125	250	500	1K	2K	4K	8K
200	15	0	-5	-6	-2	-10	-22	-32
250	13	-3	-6	-6	-1	-14	-14	-33
315	16	-1	-6	-2	-3	-15	-26	-35
400	14	-1	-3	0	-5	-16	-27	-32

Table 2 - concentrated supply air

Size	Centre frequency Hz							
	63	125	250	500	1K	2K	4K	8K
200	14	0	-3	-4	-2	-13	-27	-37
250	16	-3	-6	-4	-2	-16	-25	-28
315	18	-1	-5	-2	-3	-16	-29	-40
400	15	-4	-6	-4	-2	-21	-34	-38

Air jet width b_h

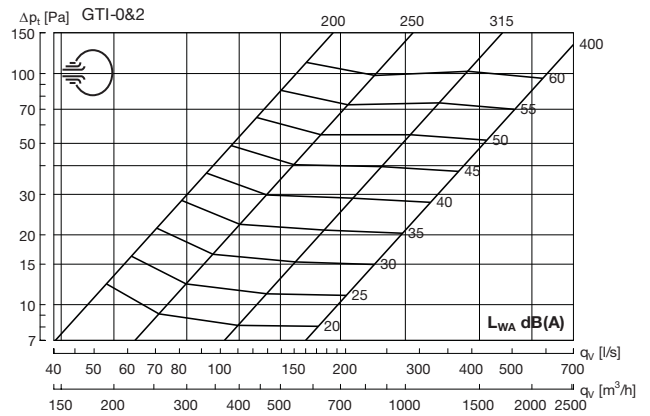
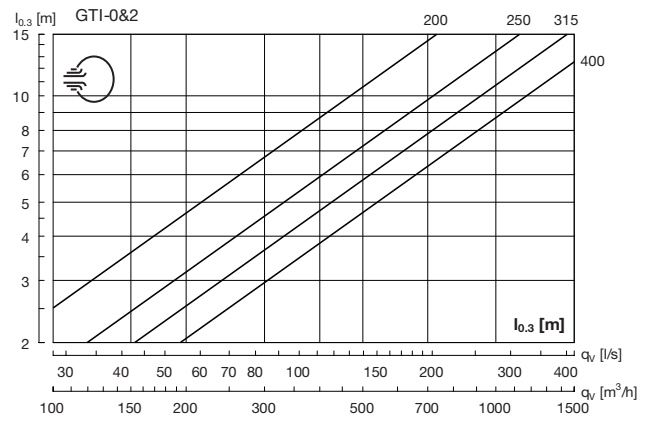
Diffuse



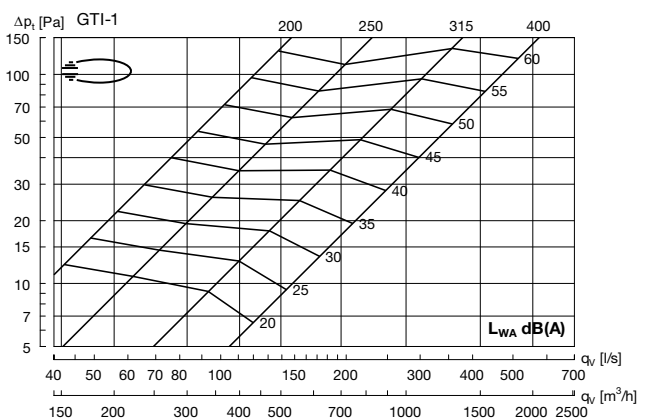
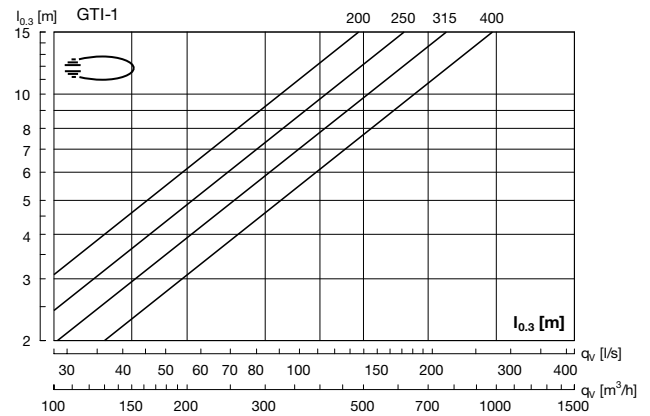
Concentrated



Diffuse supply



Concentrated supply



Supply air nozzle

DAD



Description

DAD is an adjustable supply air nozzle suitable for ventilation of large areas where long throws are required. The nozzle can be freely rotated 30 degrees in any direction in relation to the central line of the nozzle. The nozzle can be used for both heated and cooled air. The nozzle can be installed directly into a circular duct, fitting, wall or duct side. Supplied with screw holes through flange (DAD-0).

- Flexible adjustable nozzle
- Long throws
- Simple installation

Maintenance

The visible parts of the diffuser can be wiped with a damp cloth.

Materials and finish

Material: Aluminium
 Standard finish: Powder-coated
 Standard colour: RAL 9010, gloss 30

The diffuser is available in other colours. Please contact Lindab's sales department for further information.

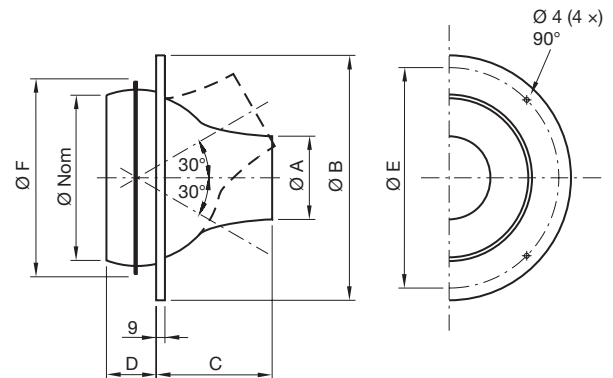
Order code

Product	DAD	a	bbb
Type			
with flange	0		
for circular ducts	1		
Size			

Dimensions

DAD-0

With flange for mounting on a wall or duct side.

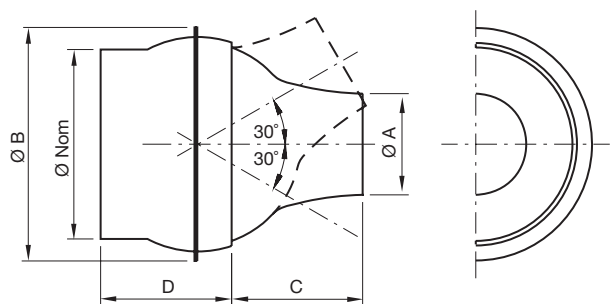


ØF = min. hole dimension

Ø nom Size	ØA mm	ØB mm	C mm	D mm	ØE mm	ØF mm	Weight kg
160	85	248	120	51	225	200	0.60
200	110	298	150	66	270	245	0.90
250	140	363	190	81	320	295	1.40
315	175	448	255	90	390	360	2.40

DAD-1

Installation in circular duct.



ØNom includes male connection measure

Ø nom Size	ØA mm	ØB mm	C mm	D mm	Weight kg
160	85	196	110	110	0.50
200	110	238	140	125	0.90
250	140	288	180	140	1.40
315	175	355	245	165	2.40

Free area for DAD nozzle – see section *Nozzle calculations*.

Supply air nozzle

DAD

Technical data

Capacity

Volume flow q_v [l/s] and [m³/h], total pressure Δp_t [Pa], throw $l_{0.3}$ and sound level L_{WA} [dB(A)] can be seen in the diagrams.

Throw $l_{0.3}$

Throw $l_{0.3}$ can be seen in the diagrams for isothermal air at a terminal velocity of 0.3 m/s

Resulting sound effect level

The sound effect level from the nozzles must be added logarithmically to the sound effect level from the flow noise in the duct. See sample calculation, section *Nozzle calculations*.

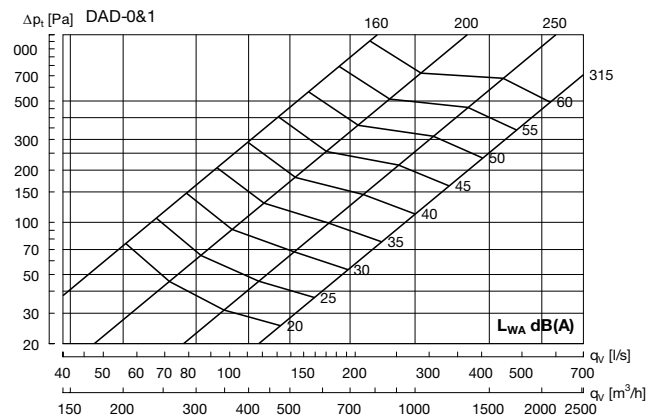
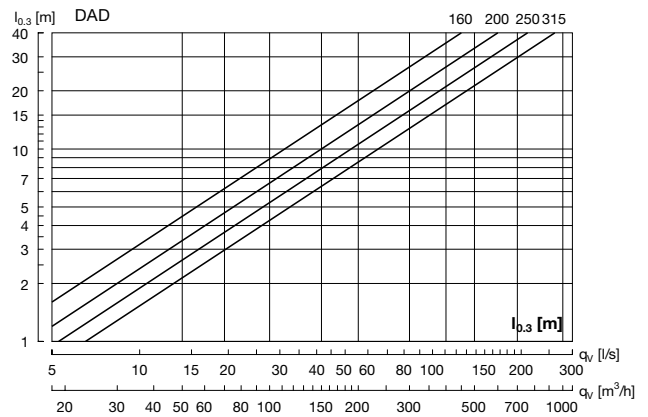
Frequency-related sound effect level

The sound effect level in the frequency band is defined as $L_{wok} = L_{WA} + K_{ok}$. K_{ok} values can be seen in the table below.

Table

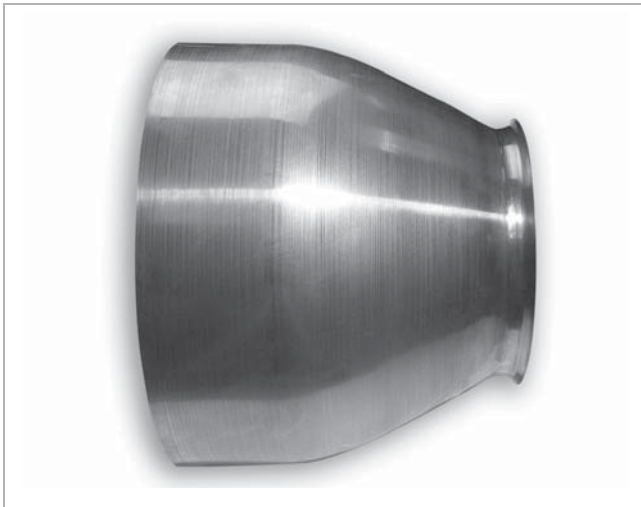
Size	Centre frequency Hz							
	63	125	250	500	1K	2K	4K	8K
160	10	-1	-5	-5	-5	-8	-9	-10
200	11	1	1	-4	-4	-10	-16	-23
250	17	0	0	-4	-4	-13	-21	-29
315	16	1	-1	-2	-4	-13	-21	-32

Supply air



Supply air nozzle

LAD



Description

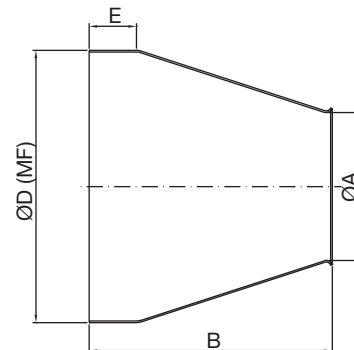
LAD is an supply air nozzle suitable for ventilation of large areas where long throws are required. The nozzle can be used for both heated and cooled air. LAD has a standard MF measure and can be installed directly on a male spigot in the desired direction.

- Directional airflow
- Long throws
- Simple installation

Maintenance

The visible parts of the diffuser can be wiped with a damp cloth.

Dimensions



Size	ØA mm	B mm	ØD mm	E mm	Free area A[m ²]	Weight kg
125	60	116	125	40	0.0029	0.10
160	95	140	160	40	0.0071	0.10
200	110	180	200	40	0.0095	0.20
250	145	205	250	60	0.0165	0.30
315	180	235	315	60	0.0254	0.50
400	225	270	400	80	0.0398	0.60

Order code

Product		LAD	a	bbb
Type				
Colour:	Untreated	0		
	Other colour	1		
Size				

Materials and finish

Material: Aluminium
 Standard finish: Untreated or powder-coated

The diffuser is available in other colours. Please contact Lindab's sales department for further information.



Supply air nozzle

LAD

Technical data

Capacity

Volume flow q_v [l/s] and [m³/h], total pressure Δp_t [Pa], throw $l_{0.3}$ and sound level L_{WA} [dB(A)] can be seen in the diagrams.

Throw $l_{0.3}$

Throw $l_{0.3}$ can be seen in the diagrams for isothermal air at a terminal velocity of 0.3 m/s

Resulting sound effect level

The sound effect level from the nozzles must be added logarithmically to the sound effect level from the flow noise in the duct. See sample calculation, section *Nozzle calculations*.

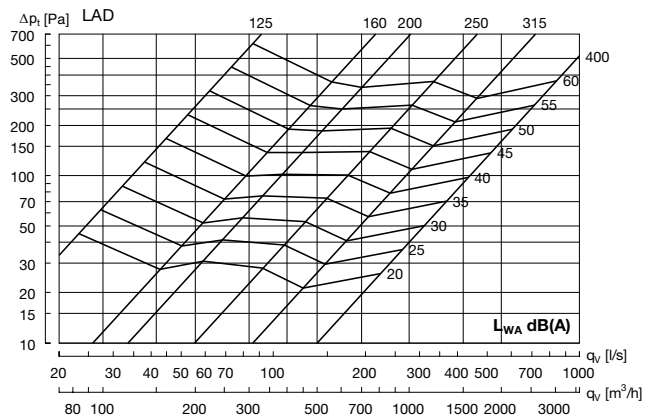
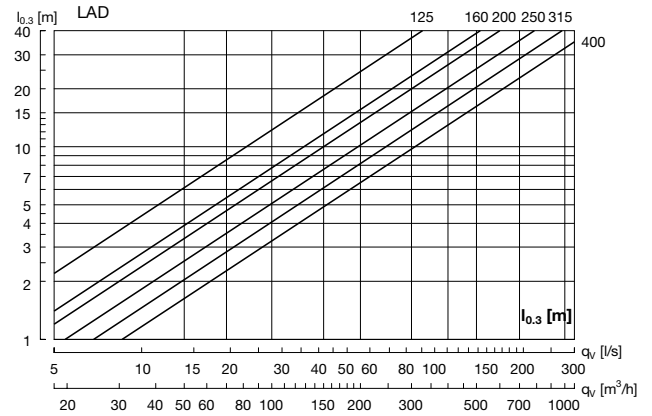
Frequency-related sound effect level

The sound effect level in the frequency band is defined as $L_{wok} = L_{WA} + K_{ok}$. K_{ok} values can be seen in the table below.

Table 1

Size	Centre frequency Hz							
	63	125	250	500	1K	2K	4K	8K
125	13	4	3	-5	-4	-18	-21	-21
160	19	6	5	-3	-10	-23	-30	-34
200	18	6	1	-1	-10	-15	-18	-26
250	19	6	3	-1	-14	-21	-24	-26
315	22	5	2	-3	-12	-14	-22	-27
400	21	3	1	-5	-7	-10	-19	-25

Supply air



Supply air nozzle

GD



Description

GD is a rubber supply air nozzle suitable for ventilation of large areas where long throws are required. The nozzle can be adjusted for directional airflow, and can be installed directly into circular ducts, (min. $\text{Ø}250$ mm), or duct walls, (min. height = 100 mm). The nozzle can be used for both heated and cooled air.

- Directional airflow
- Long throws
- Simple installation

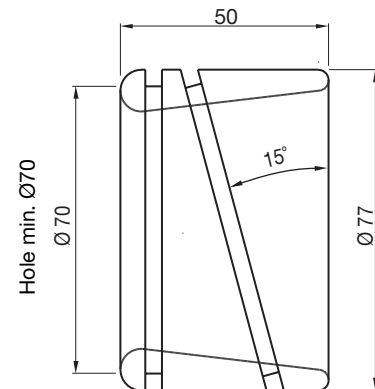
Maintenance

The visible parts of the nozzle can be wiped with a damp cloth.

Order code

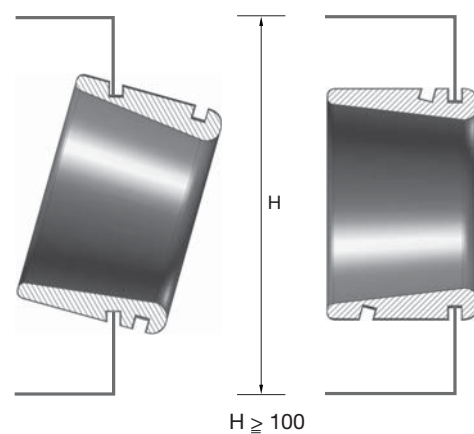
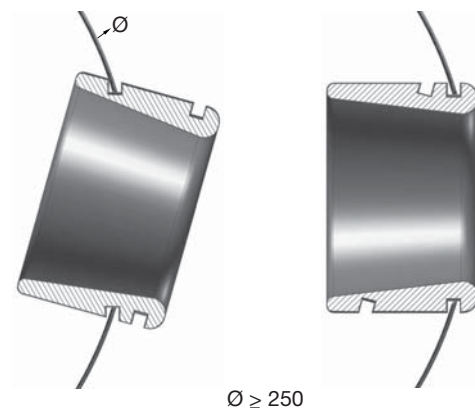
Product **GD**
Type _____

Dimensions



Free area: 0.0027 m²
Straight groove: For rectangular duct.
Oblique groove: For circular duct.

Mounted in duct



Materials and finish

Nozzle: EPDM rubber, hardness 60, black

Supply air nozzle

GD

Technical data

Capacity

Volume flow q_v [l/s] and [m³/h], total pressure Δp_t [Pa], throw $l_{0.3}$ and sound level L_{WA} [dB(A)] can be seen in the diagrams.

Throw $l_{0.3}$

Throw $l_{0.3}$ can be seen in the diagrams for isothermal air at a terminal velocity of 0.3 m/s.

Resulting sound effect level

The sound effect level from the nozzles must be added logarithmically to the sound effect level from the flow noise in the duct. See sample calculation, section *Nozzle calculations*.

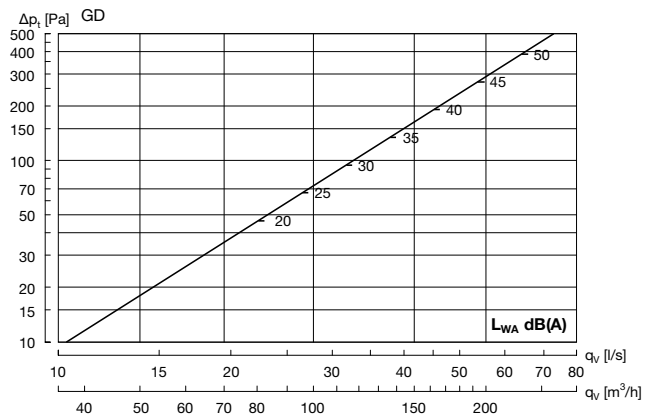
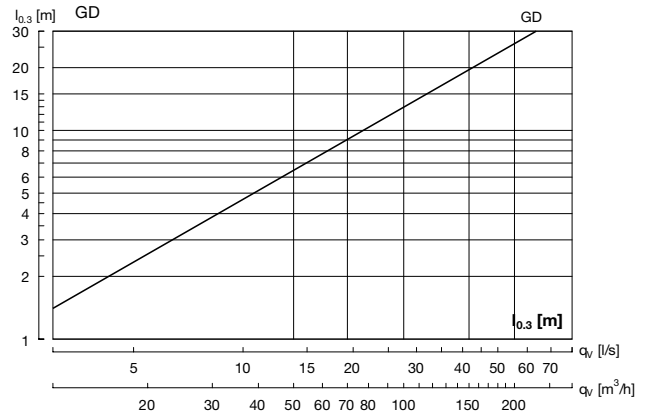
Frequency-related sound effect level

The sound effect level in the frequency band is defined as $L_{wok} = L_{WA} + K_{ok}$. K_{ok} values can be seen in the table below.

Table

Size	Centre frequency Hz							
	63	125	250	500	1K	2K	4K	8K
GD	9	-2	0	1	-6	-14	-21	-25

Supply air



Supply air nozzle

Calculation

Resulting sound effect level

To calculate the resulting sound effect level from the nozzles, add the sound effect level from the nozzles (L_{WA} nozzle) and the sound effect level from the flow noise in the duct (L_{WA} duct) logarithmically.

Diagram 1, sound effect duct, L_{WA} duct.

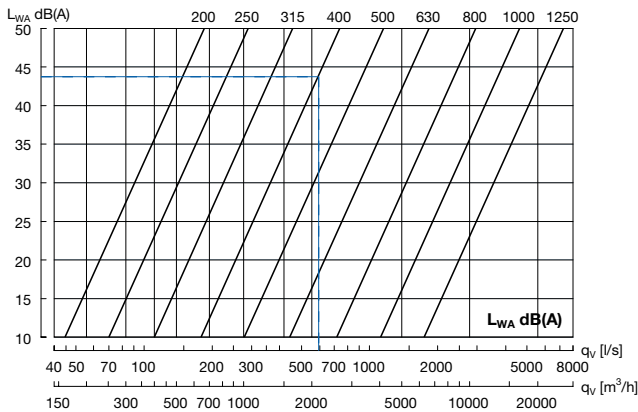
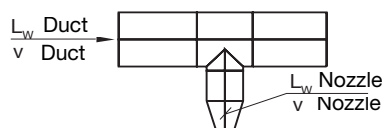
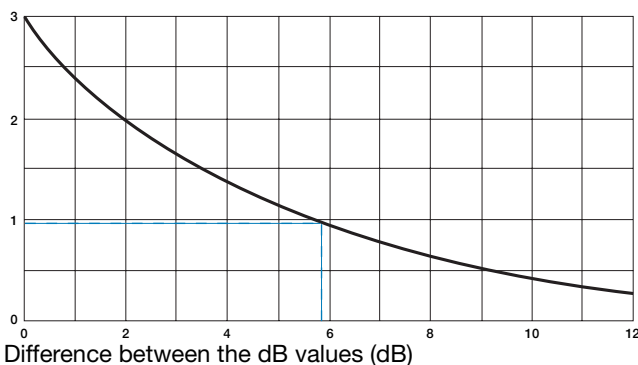


Diagram 2, addition of sound levels.

Difference to be added to the highest dB value (dB)



Sample calculation:

LAD-200 $q = 100$ l/s
 ΔP_t nozzle 90 Pa

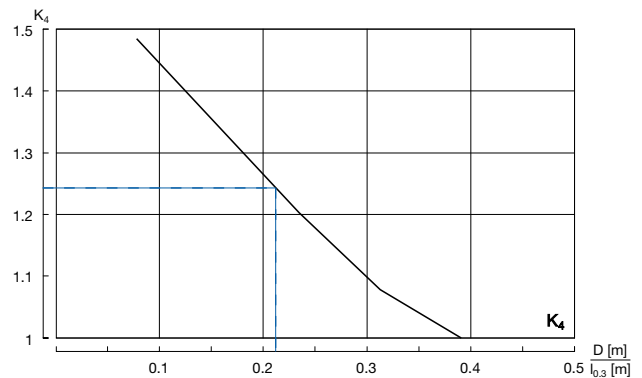
Duct size:

In order to achieve a sensible distribution of the air out to the nozzles without using a damper, it is recommended that the pressure loss in the nozzle be 3 times higher than the dynamic pressure in the duct system.

Selected duct dimension $\varnothing 400$
 Number of nozzles at joint 6
 Volume of air in the duct $6 \times 100 = 600$ l/s
 L_{WA} duct (can be seen in diagram 1) 43 dB(A)
 L_{WA} nozzle (can be seen in product diagram) 37 dB(A)
 Difference between db values 6 dB(A)
 Value to be added to the highest dB value (diagram 2) 1 dB(A)
Resulting sound effect level: $43 + 1 = 44$ dB(A)

Extension of throw for two nozzles, positioned side by side:

If two nozzles are positioned next to each other, the air jets will be amplified, thereby extending the throw. To calculate this, use the diagram below, in which the distance between the nozzles is designated D. The calculation factor K_4 must be multiplied by the throw $l_{0.3}$. The throw is not extended further with more nozzles.



Sample calculation:

LAD-125. Distance D = 1.5 metres.

Volume of air: $q = 15$ l/s

Diagram throw under selected nozzle

Specified throw: $l_{0.3} = 7$ m
 $D [m] / l_{0.3} [m]$ $1.5 / 7 = 0.21$

K_4 calculation factor

Can be seen in the diagram $K_4 = 1.25$

Resulting throw:

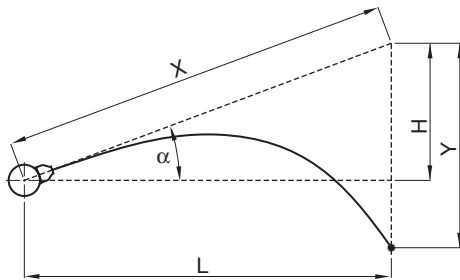
$K_4 \times l_{0.3} = 1.25 \times 7 \text{ m} = 8.75 \text{ m}$

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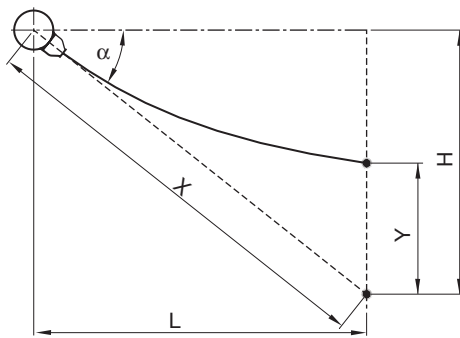
Supply air nozzle

Calculation

Supply air with cooled air



Supply air with heated air



$$X = \frac{L}{\cos \alpha} = \frac{H}{\sin \alpha}$$

$$H = L \times \tan \alpha$$

Terminal velocity V_x :

$$v_x = K_1 \times \frac{q}{X}$$

Deflection Y:

$$Y = K_2 \times \frac{X^3}{q^2} \times \Delta t$$

Sample calculation: Cooled air

LAD-200: $q = 400 \text{ m}^3/\text{h}$
 $\Delta t = -6\text{K}$ $\alpha = 30^\circ$
 Final velocity $v_x = 0,3 \text{ m/s}$

$$v_x = K_1 \times \frac{q}{X}$$

$$X = K_1 \times \frac{q}{v_x} = 0,020 \times \frac{400}{0,3} = 27 \text{ m}$$

$$Y = K_2 \times \frac{X^3}{q^2} \times \Delta t = 24 \times \frac{27^3}{400^2} \times 6 = 17,7 \text{ m}$$

$$H = X \times \sin \alpha = 27 \times 0,5 = 13,5 \text{ m}$$

$$L = X \times \cos \alpha = 27 \times 0,87 = 23,4 \text{ m}$$

Sample calculation: Heated air

LAD-200: $q = 400 \text{ m}^3/\text{h}$
 $\Delta t = -6\text{K}$ $\alpha = 60^\circ$
 Final velocity $v_x = 0,3 \text{ m/s}$

$$X = K_1 \times \frac{q}{v_x} = 0,020 \times \frac{400}{0,3} = 27 \text{ m}$$

$$Y = K_2 \times \frac{X^3}{q^2} \times \Delta t = 24 \times \frac{27^3}{400^2} \times 6 = 17,7 \text{ m}$$

$$H = X \times \sin \alpha = 27 \times 0,87 = 23,4 \text{ m}$$

$$L = X \times \cos \alpha = 27 \times 0,5 = 13,5 \text{ m}$$

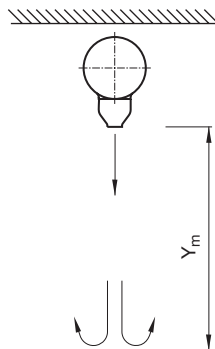
Supply air nozzle

Calculation

Calculation factors:

Size	Free area A m ²	K ₁		K ₂		K ₃	
		m ³ /h	l/s	m ³ /h	l/s	m ³ /h	l/s
LAD							
125	0.0029	0.037	0.133	3.9	0.30	0.24	0.86
160	0.0071	0.023	0.083	15.6	1.20	0.122	0.44
200	0.0095	0.020	0.072	24.0	1.85	0.097	0.35
250	0.0165	0.0153	0.055	54.4	4.2	0.064	0.230
315	0.0254	0.0122	0.044	104	8.0	0.046	0.166
400	0.0398	0.0097	0.035	206	15.9	0.033	0.119
DAD							
160	0.0056	0.026	0.094	10.7	0.83	0.145	0.52
200	0.0095	0.020	0.072	24.0	1.85	0.097	0.35
250	0.0154	0.0157	0.057	49.0	3.78	0.068	0.24
315	0.0240	0.0127	0.046	96.0	7.41	0.048	0.17
GD							
	0.0027	0.038	0.137	3.5	0.27	0.26	0.92
GTI-1							
200	0.0200	0.0090	0.032	114	8.8	0.048	0.173
250	0.0310	0.0073	0.026	219	16.9	0.034	0.122
315	0.0490	0.0058	0.021	435	34	0.024	0.086
400	0.0780	0.0046	0.017	875	68	0.017	0.062

Vertical supply air with heated air



$$Y_m = K_3 \times \frac{q}{\sqrt{\Delta t}} \text{ (m)}$$

Sample calculation:

LAD-160 q = 200 m³/h
 Δt = 10 K

The distance to the turning point of the air jet:

$$Y_m = K_3 \times \frac{q}{\sqrt{\Delta t}} \text{ (m)}$$

$$Y_m = 0,122 \times \frac{200}{\sqrt{10}} \text{ (m)}$$

$$Y_m = 7,7 \text{ m}$$

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