Theory Nozzles

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

Nozzles

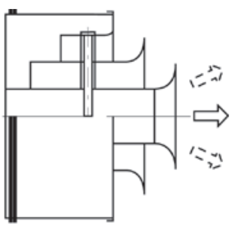
Nozzles can be used with great advantage in rooms where long air throws are desirable, even at small air flows/volumes. Nozzles are suitable for both heating and cooling. Depending on the chosen nozzle the supplied air pattern can be adapted to the job at hand.

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.

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.

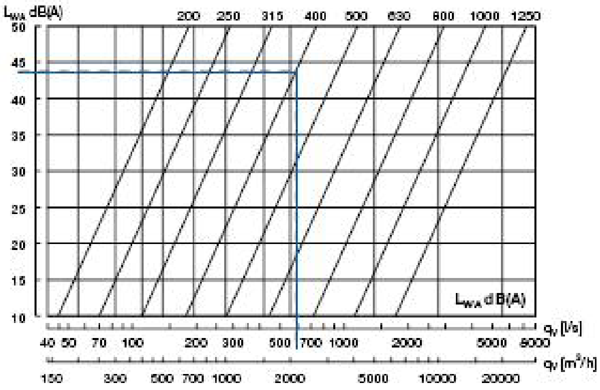
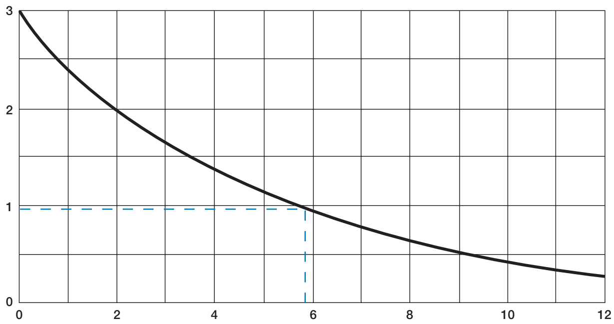
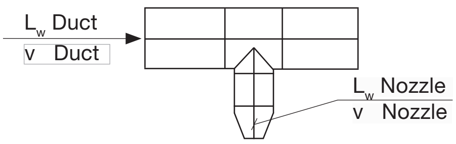


Diagram 2, addition of sound levels.
Difference to be added to the highest dB value (dB).



Difference between the dB values (dB).



Sample calculation:

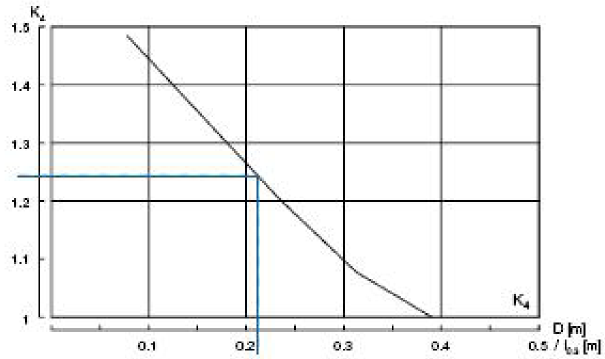
LAD-200	q = 100 l/s
ΔP_t nozzle	90 Pa

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	Ø 400
Number of nozzles at joint	6
Volume of air in the duct	6 x 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

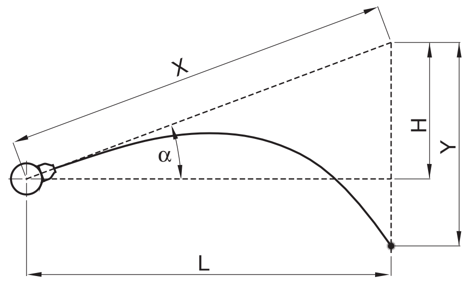
Specified throw:	$l_{0.3}$ = 7 m
D [m] / $l_{0.3}$[m]	1.5 / 7 = 0.21

K_4 calculation factor
Can be seen in the diagram K_4 = 1.25

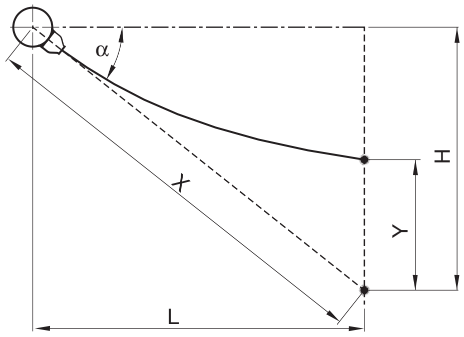
Resulting throw
$K_4 \times l_{0.3}$ = 1.25 x 7 m = 8.75 m

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:	$q = 400\ m^3/h$ $\Delta t = 6K\ \alpha = 30°$
Final velocity	$v_x = 0.3\ m/s$

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

$$X = K_1 \times \frac{q}{v_x} = 0.020 \times \frac{400}{0.3} = 27\ m$$

$$Y = K_2 \times \frac{X^3}{q^2} \times \Delta t = 24 \times \frac{27^3}{400^2} \times 6 = 17.7$$

$$H = X \times \sin\alpha = 27 \times 0.5 = 13.5$$

$$L = X \times \cos\alpha = 27 \times 0.87 = 23.4\ m$$

Sample calculation: Heated air

LAD-200:	$q = 400\ m^3/h$ $\Delta t = 6K\ \alpha = 60°$
Final velocity	$v_x = 0.3\ m/s$

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

$$X = K_1 \times \frac{q}{v_x} = 0.020 \times \frac{400}{0.3} = 27\ m$$

$$Y = K_2 \times \frac{X^3}{q^2} \times \Delta t = 24 \times \frac{27^3}{400^2} \times 6 = 17.7$$

$$H = X \times \sin\alpha = 27 \times 0.87 = 23.4$$

$$L = X \times \cos\alpha = 27 \times 0.5 = 13.5\ m$$

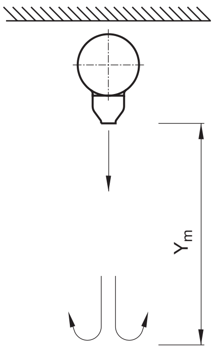
Supply air nozzle

Calculation

Calculation factors:

	Free area	K_1		K_2		K_3	
Size	Am^2	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



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

Sample calculation:

LAD-160 $q = 200\ m^3/h$
$\Delta t = 10\ K$

The distance to the turning point of the air jet:

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

$$Y_m = 0.122 \times \frac{200}{\sqrt{10}} \quad (m)$$

$$Y_m = 7.7\ m$$

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.

Lindab | For a better climate