06

Supply air nozzles

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Supply air nozzles are designed to supply air into rooms in applications requiring large throw distances and low noise levels. They are suitable for supplying either cold or warm air. They are made of anodised sheet aluminium. On request, they can be powder painted in any of the RAL scale colours. Air supply nozzles are supplied either as single components or assembled into blocks, which considerably increase throw distance.

Overview

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Supply air nozzles VŠ-1

VŠ-1 supply air nozzles are of a fixed construction. They are supplied either as single components or assembled into blocks.

Supply air nozzles VŠ-4

VŠ-4 supply air nozzles are adjustable. The air jet direction can be adjusted either manually or by means of a motor drive, within a ±30° range.

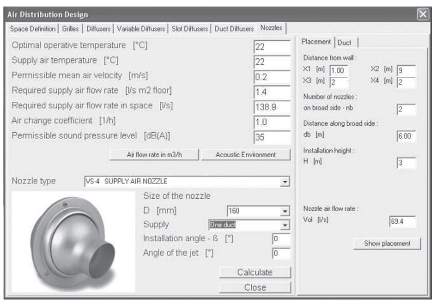
Supply air nozzles VŠ-5

VŠ-5 supply air nozzles can be adjusted in the same way as VŠ-4. Supply air nozzle is integrated into the housig and does not protrude into the room.

Software: KLIMA ADE 5.4

The air supply nozzle calculation and selection software package comprises:

- throw velocity calculation models, developed based on measurements,
- heating and cooling condition models,
- calculation of technical specifications of air supply on one wall or on opposite walls,
- calculation of throw velocities for all VŠ-4 and VŠ-5 sizes.



Software: KLIMA ADE 5.4

Supply air nozzles VŠ-1

VŠ-1

Supply air nozzles VŠ-4

VŠ-4

Supply air nozzles VŠ-5

VŠ-5

Content

Legend of symbols

Al Element is made of aluminium profiles, aluminium sheet or aluminium casting.

Element is intended to be built in the wall.

Element is suitable for the supply of cool air (cooling).

St Element is made of steel sheet.

Element is intended to be built in the ceiling or in the wall.

M Element allows regulation by electric motor (Belimo electric motors).

RAL 9010 Element is powder painted in standard RAL 9010 colour. Other desired colour is to be specified in the order.

Element for air conditioning of rooms with floor to ceiling heights room up to 4 m.

F EU... Element is intended for air filtration. The filter of class ... is built in.

Shady symbol means possibility of optional material, surface protection, motor version, ...

Element for air conditioning of rooms with floor to ceiling heights from 6 to 15 m.

CD The possibility of the automatic selection and calculation of the technical characteristics of grilles and difusers in regard to the given conditions with the assistance of the Klima ADE program.

Element is intended to be built in the floor.

Element is suitable for the supply of warm air (heating).

INOX The element is made of stainless sheet steel AISI 304.

Supply air nozzles

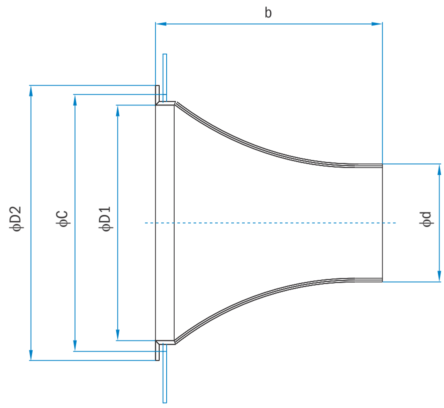
Supply air nozzles VŠ-1

Application
VŠ-1 supply air nozzles are designed to supply airinto rooms in applications requiring large throwdistances and low noise levels. By arranging nozzlesin blocks, the throw distance is considerablyincreased. In terms of materials and shape, blocks ofair nozzles can be designed according to to fit well into room decoration.

Description
VŠ-1 supply air nozzles are of a fixed construction.They are made of anodised sheet aluminium. Onrequest, they can be powder painted in any of theRAL scale colours.

Sizes and dimensions
VŠ-1 supply air nozzles are available in six sizes: from 20 to 250.

Installation methods
Size 20 and 50 VŠ-1 supply air nozzles areinstalled by gluing, while size 100, 140, 160 and 250 air supply nozzles are installed by means ofrivets or 3.5 mm self-tapping screws. VŠ-1 supplyair nozzles are supplied without mounting holes.



Size	Φd	ΦD1	ΦD2	b	ΦC	A_{ef} (m²)
20	20	40	52	60	46	0.00025
50	50	100	116	100	108	0.00181
100	100	200	220	160	210	0.00785
140	140	250	290	250	270	0.01496
160	160	250	290	250	270	0.01960
250	250	400	440	350	420	0.04830

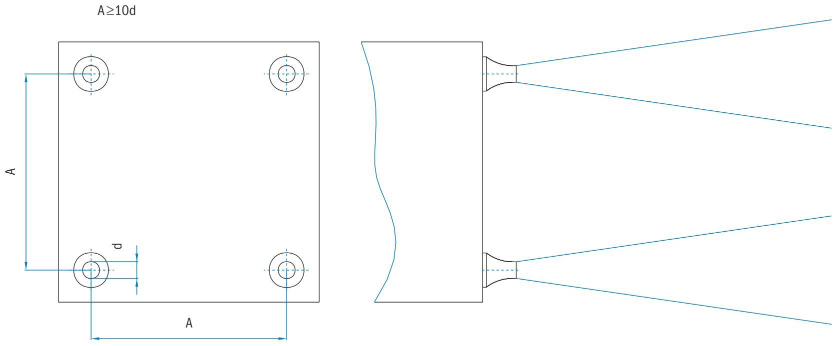
Ordering example

Supply air nozzle type: **VŠ-1**
Size: **100**
Pcs: **25**

Technical data of single supply air nozzles VŠ-1

Supply air nozzle is considered as a single unit when the distance between two adjacent nozzles is A ≥10d.

The most significant data in respect of an air supply nozzle characterization is the turbulence number m.

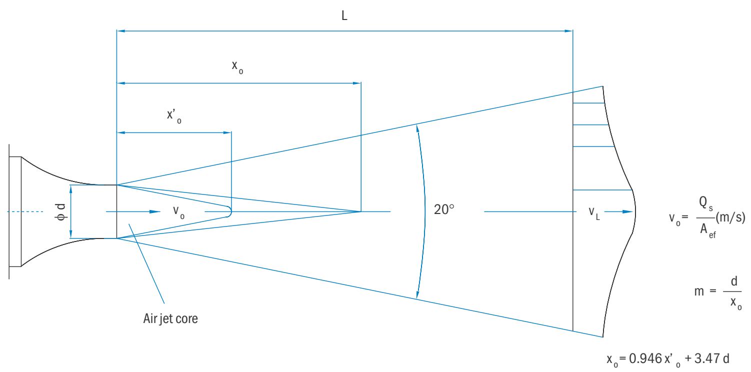


Throw distance of single supply air nozzle:

$$L = \frac{d}{m} + \frac{d}{0.128} \times \left(\frac{v_0}{v_L} - 0.63 \right) \text{(m)}$$

Method of determining induction:

$$i = 2m \frac{L}{d}$$



Size	m
20	0.180
50	0.155
100	0.150
140	0.145
160	0.145
250	0.150

Definition of symbols

v_0 (m/s)	Discharge air velocity (velocity in the air jet core)
$Q_Š$ (m³/s)	Air flow rate per single nozzle
A_{ef} (m²)	Effective nozzle cross-section area
v_L (m/s)	Desired velocity at the throw distance L
L (m)	Desired throw distance
m	Supply air nozzle turbulence number
Δt_L (°C)	Maximum difference between the jet core temperature and the room temperature
Δt_Z (°C)	Temperature difference between supply air and room air
i	Induction, i. e. the ratio between the total air jet flow rate and supply air flow rate
A (m)	Distance between nozzles
g (m/s²)	Acceleration of gravity
d (m)	Nozzle diameter
T_p (°K)	Room air absolute temperature

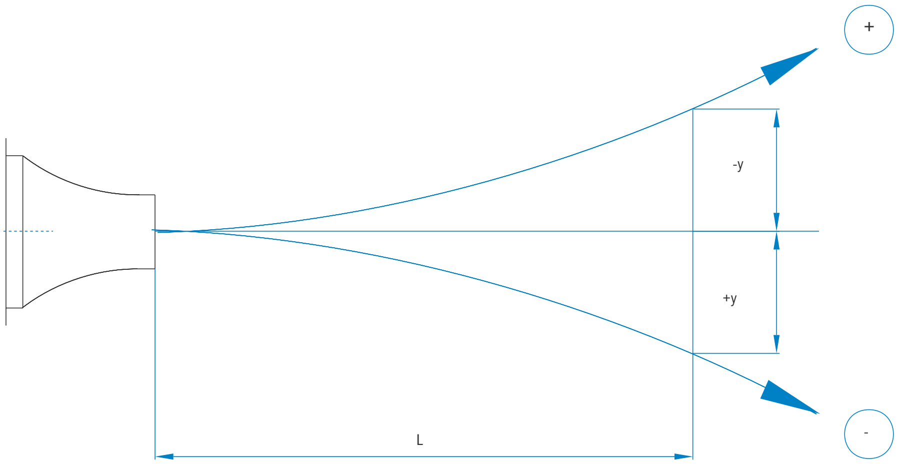
Calculation of the throw distance as a function of the temperature quotient:
In non-isothermal conditions (temperature difference between the supply air and room air) the air jet rise or drop y and temperature quotient shall be considered:

$$\frac{\Delta t_L}{\Delta t_Z}$$

$$y = 0.33 d \cdot m \cdot Ar \left[\frac{L}{d}\right]^3 \quad (m)$$

where Ar = Arhchimedean number

$$Ar = \frac{d \cdot \Delta t_Z \cdot g}{v^2 \cdot T_p}$$

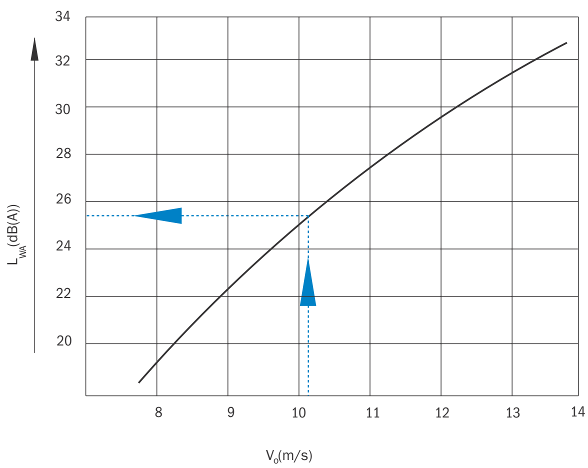


Temperature quotient:

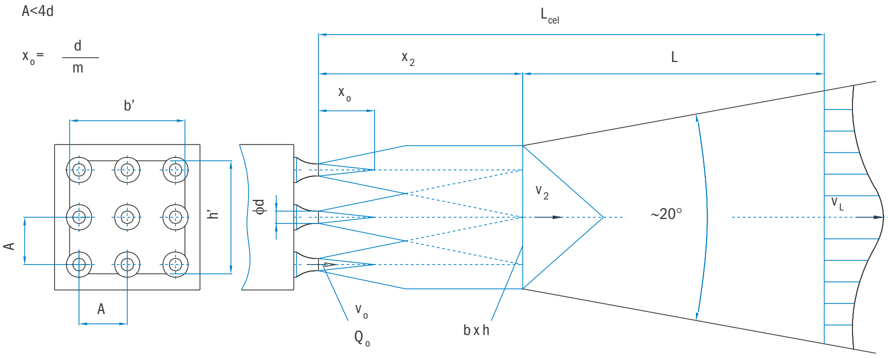
$$\frac{\Delta t_L}{\Delta t_Z} = \frac{3}{4} \cdot \frac{d}{m \cdot L} \quad oz.$$

$$\Delta t_L = \frac{3}{4} \cdot \frac{d}{m \cdot L} \cdot \Delta t_Z \quad (^0C)$$

Sound power level diagram



Arrangement of supply air nozzles in blocks
When large throw distance or greater air flow rate is required, supply nozzles are installed arranged in blocks.



Definition of symbols

Q_0 (m³/s)	Q_s x n supply air flow rate
n	Number of nozzles in a block
Q_2 (m³/s)	Air flow rate at x_2
v_2 (m/s)	Air velocity at x_2
b (m)	Air jet width at x_2
h (m)	Air jet height at x_2
L (m)	Throw distance of the combined air jet
L_{cel} (m)	Total throw distance
Q_{cel} (m³/s)	Air flow rate at the throw distance L

Isothermal conditions – rectangular array nozzle block
The indicated calculation method is applicable inisothermal conditions and for rectangular blocks of nozzles where b x h < 12. In a case of non-isothermal conditions, the air jet rise or drop due to the temperature difference has to be calculated.

Calculation method applicable to isothermal conditions and a rectangular array nozzle blocks b / h ≤12

1. Distance from the outlet to the joint air jet:

$$x_2 = 9.5 \cdot \left[A - \frac{d}{2}\right] \quad (m)$$

2. Increase of air flow rate due to induction:

$$Q_2 = \frac{2x_2}{x_0} \cdot Q_0 \left[\frac{m^3}{s}\right]$$

3. Widening of air jet up to the distance x_2:

$$b = b' + 0.2x_2 \quad (m)$$
$$h = h' + 0.2x_2 \quad (m)$$
$$F_2 = b \cdot h \quad (m^2)$$

4. Air jet velocity at x_2:

$$v_2 = \frac{Q_2}{F_2} \quad (m/s)$$

5. Air jet velocity at the throw distance L:

$$v_L = \frac{v_0 \cdot d \cdot \sqrt[3]{n}}{m \cdot L} \quad (m/s)$$

6. Throw distance:

$$L = \frac{v_0 \cdot d \cdot \sqrt[3]{n}}{m \cdot v_L} \quad (m)$$

7. Total throw distance:

$$L_{cel} = L + X_2 \quad (m)$$

8. Air supply nozzle block induction is calculated as follows:

$$i = \frac{Q_{cel}}{Q_0} \qquad Q_{cel} = 2Q_2 \frac{v_0 \cdot d \cdot \sqrt[3]{n}}{m \cdot v_L}$$

Isothermal conditions - square or circular array nozzle block
In the cases of nozzle blocks not installed in a rectangular array, the adjustments indicated on the left shall be applied.

Calculation method applicable to isothermal conditions and a square or circular array nozzle blocks:

1. Square arrangement of supply air nozzles:

$b = h = a$
$F_2 = a^2$

2. Circular arrangement of supply air nozzles:

$b = h = d$
$F_2 = \pi \times d^2 / 4$
$m = 0.20$

Non-isothermal conditions
In non-isothermal conditions, the air jet rise or drop is calculated according to formulas indicated on the left.

Calculation method applicable in non-isothermal conditions

1. Rectangular arrangement of supply air nozzles:

$$y = 0.4h \cdot \sqrt{m} \cdot Ar \cdot \left[\frac{L}{m}\right]^3$$

2. Circular arrangement of supply air nozzles:

$$y = 0.33 \cdot m \cdot Ar \left[\frac{L}{m}\right]^3 \text{ (m)}$$

Archimedean number (Ar)

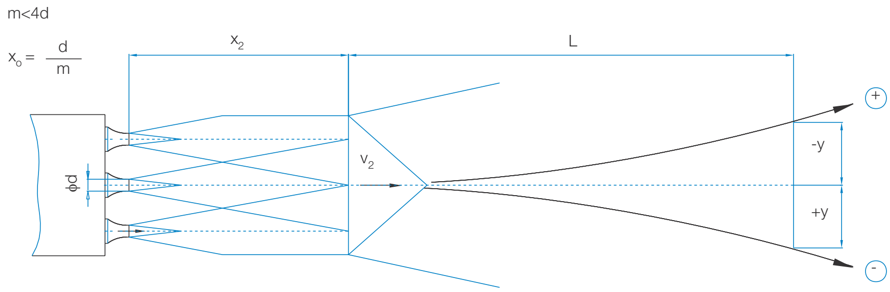
for rectangular supply air nozzle block:

$$Ar = \frac{g \cdot h \cdot \Delta t_z}{v_2^2 \cdot T_p}$$

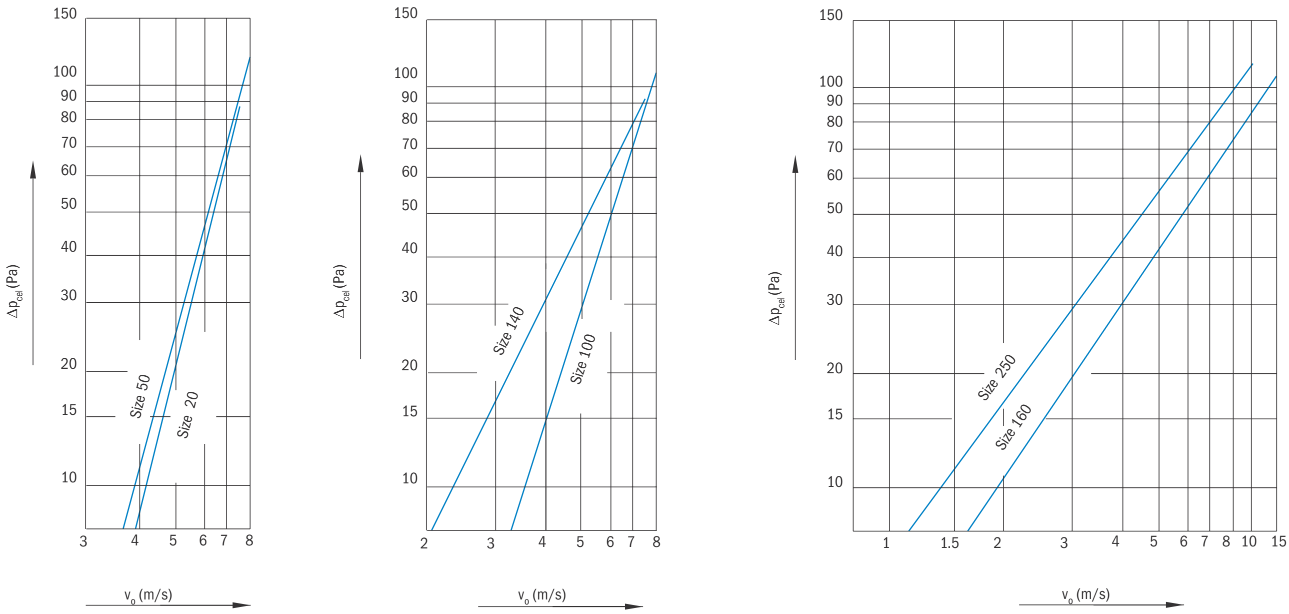
for circular supply air nozzle block:

$$Ar = \frac{d \cdot \Delta t_z \cdot g}{v_2^2 \cdot T_p}$$

The indicated calculation method provides an approximate result. In cases of sophisticated architectural demands, the designer is invited to consult our factory team for detailed design information. A model test can be carried out on request.



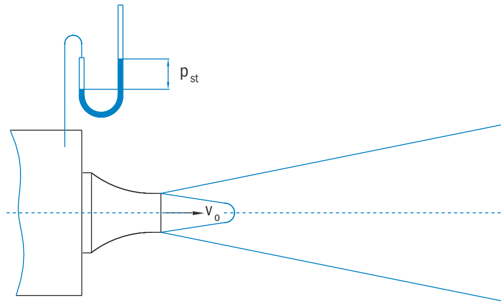
Pressure drop diagrams



Pressure drop

$$p_{st} = 1.05 \frac{\rho}{2} v_0^2 \quad \text{(Pa)}$$

ρ– air density (kg/m^3)



Definition of symbols

g (m /s)	Acceleration of gravity
d (m)	Circular air jet diameter at x_2
h (m)	Rectangular air jet height at x_2
Δt_z (°C)	Temperature difference between supply air and room air
T_p (°K)	Absolute room air temperature
m	Turbulence number (m=0.25 for rectangular block and m=0.20 For circular block)
L (m)	Throw distance

Calculation example

Required air flow rate into the hall:
15000 m³/h.

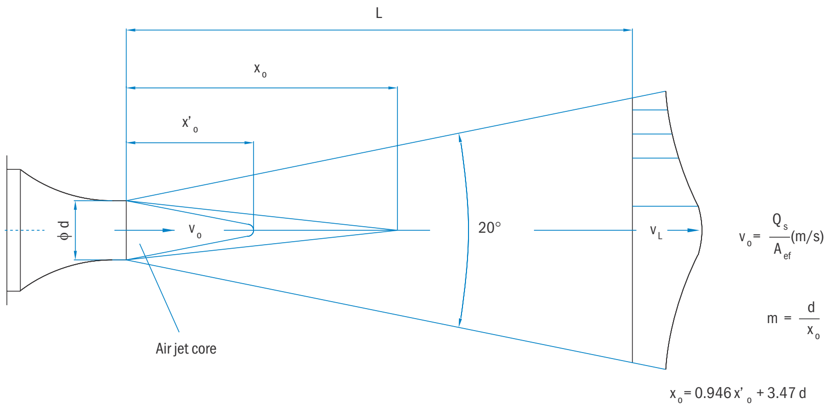
Room temperature:
t_p= 20 °C

Supply air temperature:
t_z= 26 °C

Air velocity in occupied zone:
v_L= 0.5 m/s

Solution:
52 pcs individually installed air supply nozzles VŠ-1 of size 100 are required. Air flow rate per each air supply nozzle is calculated as follows:

$$Q_S = \frac{15000}{52} = 292\ m^3/h = 0.08011\ m^3/s$$



1. Supply air velocity:

$$V_0 = \frac{Q_S}{A_{ef}} = \frac{0.08011}{0.00785} = 10.2\ m/s$$

2. Throw distance:

$$L = \frac{0.1}{0.15} + \frac{0.1}{0.128}\left[\frac{10.2}{0.5} - 0.63\right] = 16\ m$$

3. Archimedean number:

$$Ar = \frac{(0.1)\times(-6)\times(9.81)}{(10.2)^2\times 293} = \frac{-5.885}{3.047}\times 10^{-4} =$$

$$= -1.931\times 10^{-4}$$

4. Air jet rise:

$$y = 0.33\times 0.1\times 0.15\times(-1.931 \times 10^{-4})\times\left[\frac{16}{0.1}\right]^3 =$$

$$= -3.9\ m$$

5. Temperature quotient:

$$\frac{\Delta t_L}{\Delta t_Z} = \frac{3}{4}\times\frac{0.1}{0.15 \times 16} = 0.031$$

6. Pressure drop:

$$p_{st} = 1.05\times\frac{1.15}{2}(10.2)^2 = 62.7\ Pa$$

7. Self-noise level:

Determined from the diagram at
v_0 = 10.2 m/s
L_{wa} = 25 dB (A)