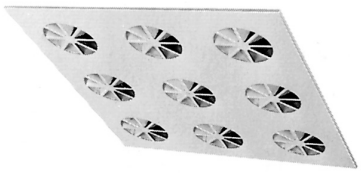
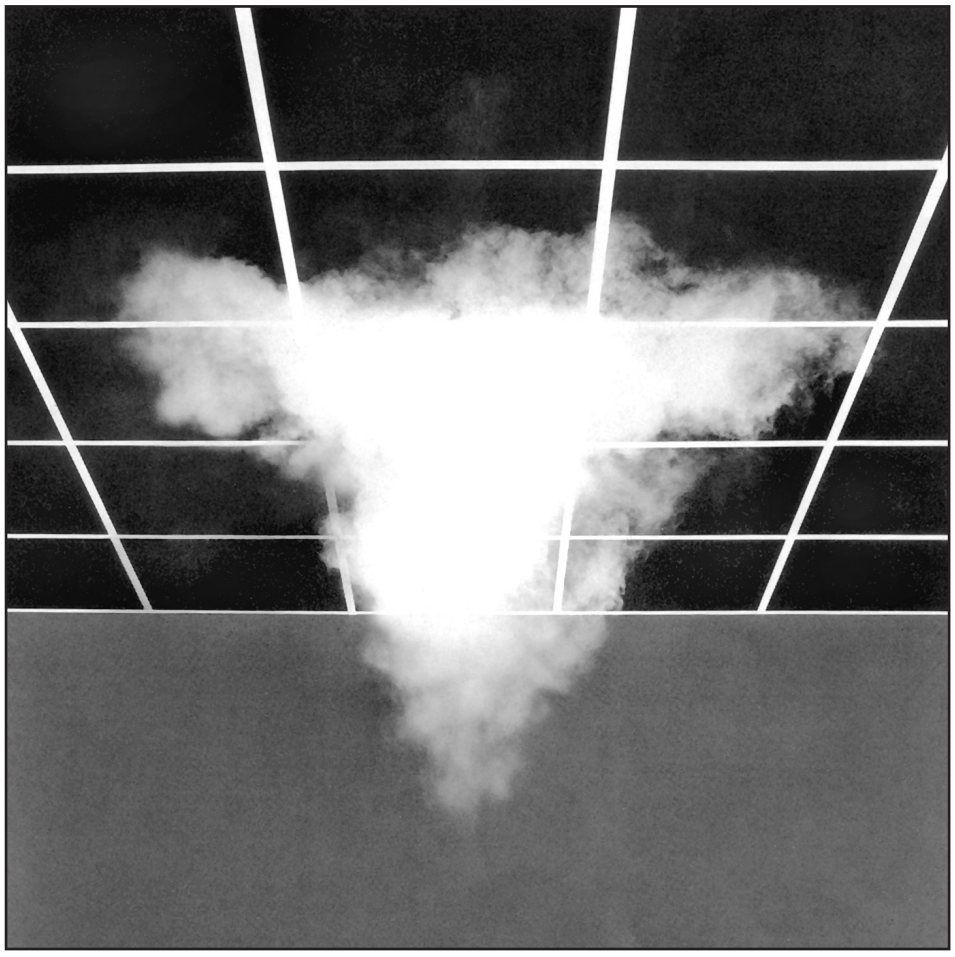


Air diffusion systems

Multi-outlet Swirl diffuser type DFA



General

The Multi-outlet Swirl diffusers are designed for the supply of air in ventilation or air conditioning systems which have high air change rate requirements.

- High cooling loads can be achieved due to high induction ability.
- High degree of air coverage with minimum distance between diffusers.
- Symmetrical low room air movement in the occupied zone with high air change rates.

Air flow rate range:

33–180 $l.s^{-1}$ (120–650 $m^3.h^{-1}$)

Mounting height:

3,0–4,0 m

Temp. diff. supply to room air:

+ 8 K Cooling
– 8 K Heating

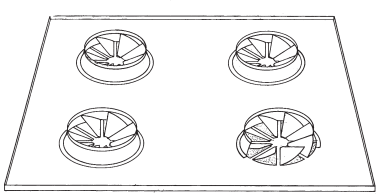
Function

Each of the individual swirl diffusers produce separate swirling jets which create a high induction at the outlet of the diffuser resulting in horizontal air patterns.

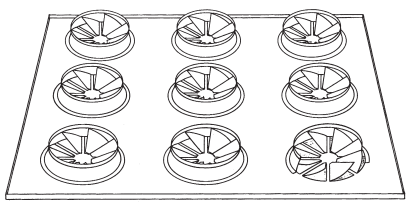
At the inner section of the diffuser matrix the horizontal air patterns converge and subsequently form vertical air pattern below the diffuser.

Through pre-determined selection of the arrangement of the individual diffuser elements, various air patterns can be obtained.

Available sizes



Size 4



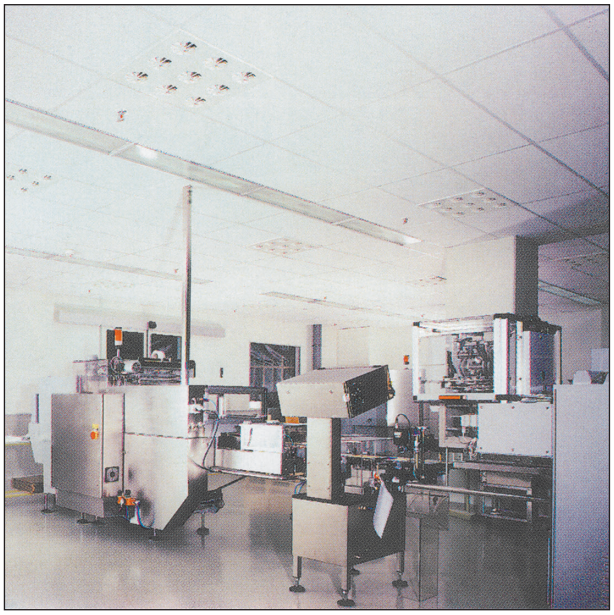
Size 9

Multi-outlet Swirl diffuser type DFA

Applications

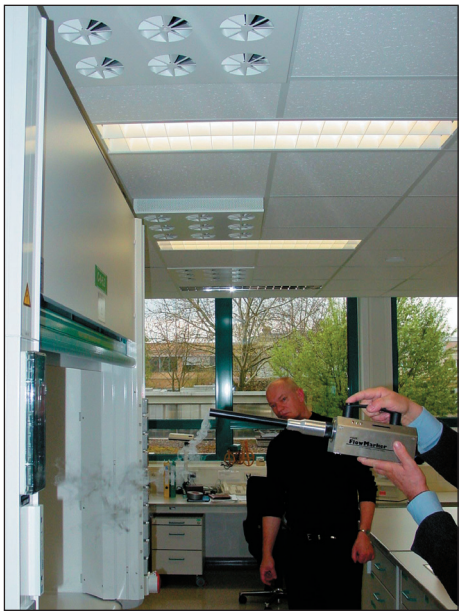
- Clean rooms
- Laboratories
- Kitchens
- Production areas

Content



Clean room: Packing area at Pfizer, Freiburg

Kitchen: Senior citizens centre, Ratzeburg



Clean room: Lab at Pfizer, Freiburg

Printers: B + L Rollenoffset, Lübeck

The company reserves the right of design change without notice.

DG

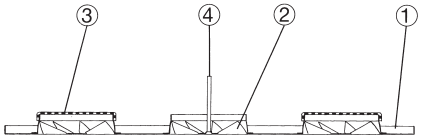
Strulik GmbH D-65597 Hünfelden Neesbacher Str. 15 Phone (+49) 64 38 8 39-0 Fax (+49) 64 38 8 39-30 Email: contact@strulik.com · duisburg@strulik.com
Strulik GmbH D-47138 Duisburg Am Alten Viehhof 7 Phone (+49) 2 03 4 29 46-0 Fax (+49) 2 03 4 29 46-66 Email: contact@strulik.com **www.strulik.com**

Construction and dimensions

The Multi-outlet Swirl diffuser DFA consists of the diffusion plate (1), into which are installed, depending on the nominal size, either 4 or 9 individual size 125 swirl diffusers (2).

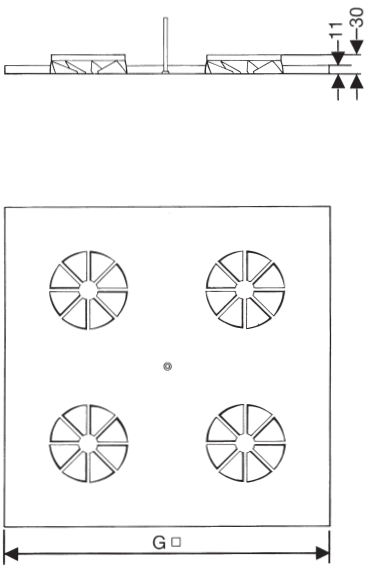
The air flow pattern, especially the vertical projection, can be varied by means of perforated plates installed at the upstream entry to the diffuser element (3).

The Multi-outlet Swirl diffusers DFA are also available in stainless steel.



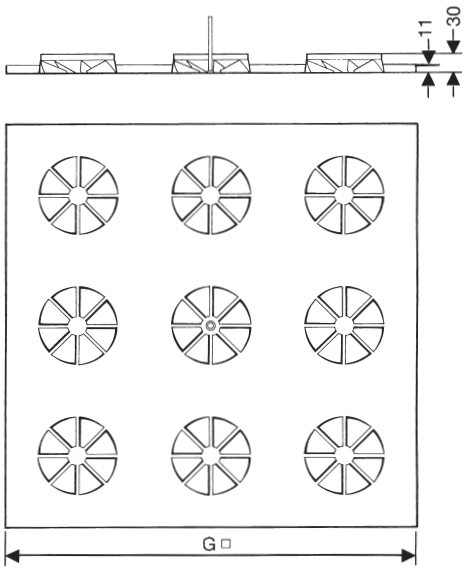
① Diffusion plate
② Swirl diffuser
③ Perforated plate
④ Assembly fixing screw

Size 4



G (mm)	Style
515	Standard
594	600 sq. lay-in tile module
619	625 sq. lay-in tile module
600	600 sq. tile module
625	625 sq. tile module

Size 9



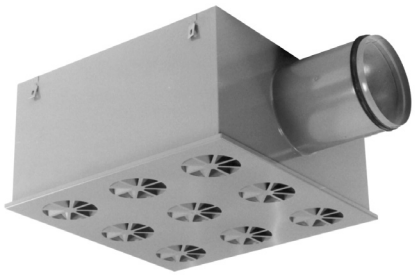
G (mm)	Style
594	600 sq. lay-in tile module
619	625 sq. lay-in tile module
600	600 sq. tile module
625	625 sq. ltile module

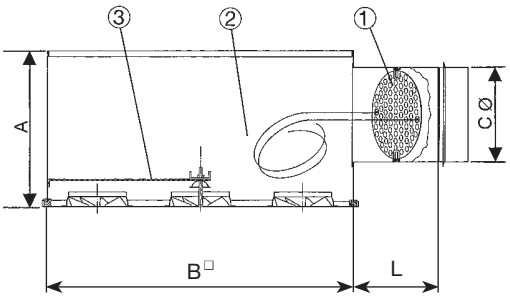
Multi-outlet Swirl diffuser type DFA

Connection method

Connection plenum box (AK) standard system

The standard connection is by means of a rectangular plenum box to which the diffuser plate is fitted by a central fixing screw. The plenum box consists of: horizontal connection spigot with damper and sealant ring (1), plenum box from zinc coated steel (2) and perforated plate flow equaliser (3).





Dimensions (mm)	Size		
	DFA 4	DFA 9	
B□	495	580	580
A	260	350	350
C Ø	DN 160	DN 200*	DN 250
L	185	225	275

Connection plenum boxes can also be supplied with internal insulation and/or to special execution.

*Standard

Multi-outlet Swirl diffuser type DFA

Selection data

Diffuser size

Effective air flow

Selection data

In order to achieve the required air flow pattern in the occupied zone it is necessary to take the following into consideration.

- Selection of the correct size of diffuser
- Vertical air projection as a function of:
  – Air flow rate
  – Air flow pattern setting at the diffuser (only for size DFA 9)
  – Temperature difference, supply air – room air

Selection of the correct size of diffuser

Fig. 1 shows the recommended size of diffuser against flow rate range for normal use and application. The minimum air flow rate (q_{min}) shown guarantee stable conditions at $\Delta t = 8$ K cooling.
The maximum flow rate (q_{max}) is the flow rate where the noise level is equal to 45 NR.

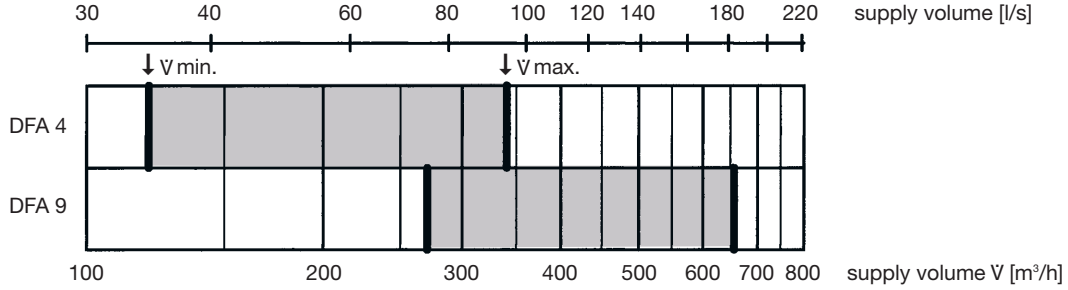


Fig. 1: Air flow rate range vs Multi-outlet Swirl diffuser size.

Effective air flow rates

The Multi-outlet Swirl diffuser DFA has an essentially vertical air projection.

At the region of the diffuser outlet there exists an intensive mixing of the air streams with a very rapid reduction of the temperature difference between supply and room air. At about 100 mm from the diffuser the mixing air stream changes to a vertical piston effect.

Multi-outlet Swirl diffuser type DFA

Selection data

Effective air flow

Vertical air projection

Fig. 2 shows an example of the typical air flow characteristics with an isovel of 0,25 m.s^{-1} of a Multi-outlet Swirl diffuser DFA 9/0.

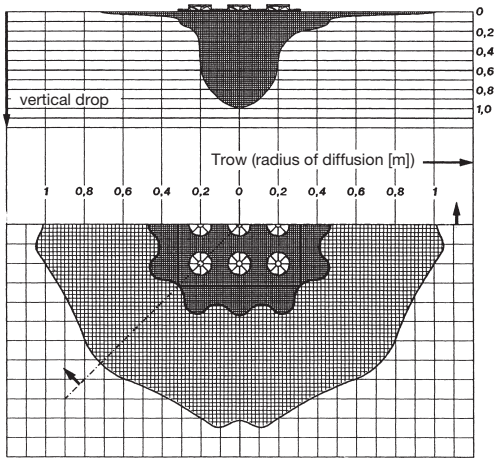
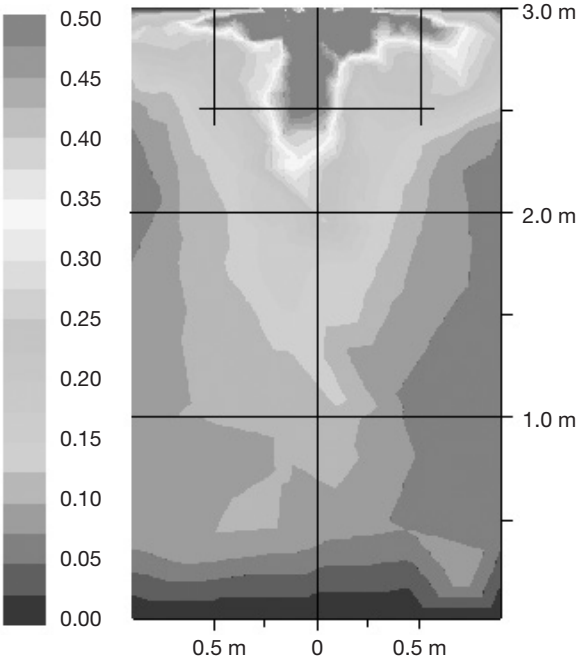


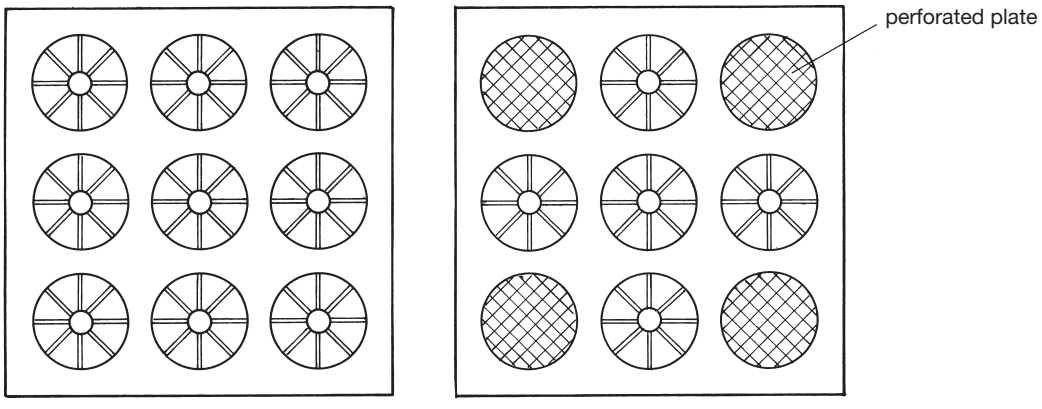
Fig. 2: Air flow pattern of a Multi-outlet Swirl diffuser type DFA 9/0. Throw and vertical drop at q = 140 l.s^{-1} and isothermal conditions.



Distribution of air velocities, shown by Computer simulation.

Vertical drop

The vertical drop of a Multi-outlet Swirl diffuser depends principally on the air flow rate q.
With the DFA 9/0 there is the possibility to change the vertical drop and air flow pattern by the use of perforated plates at the upstream entry of the individual diffusers (see fig. 3).



DFA 9/0 DFA 9/4

Fig. 3: Variations available of the Multi-outlet Swirl diffuser DFA 9.

Multi-outlet Swirl diffuser type DFA

Selection data

Vertical air projection

Figs. 4 to 6 show the typical vertical drop and throw (radius of diffusion) characteristics of DFA diffusers at an 0,2 m.s^{-1} isovel.

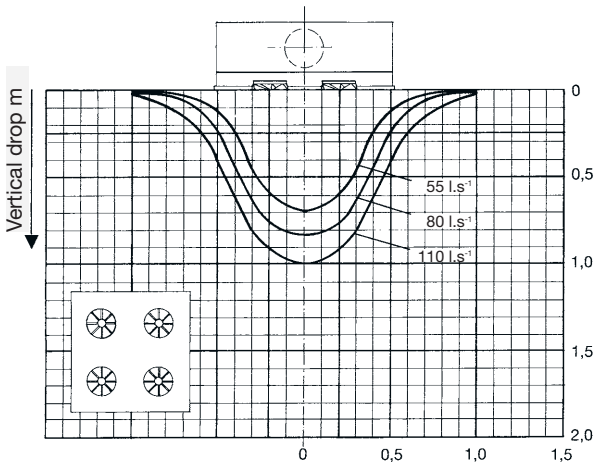


Fig. 4: DFA 4 at 0,2 m.s^{-1} isovels.

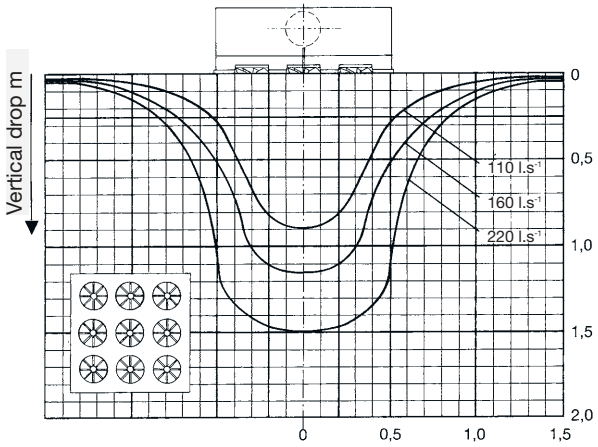


Fig. 5: DFA 9/0 at 0,2 m.s^{-1} isovels.

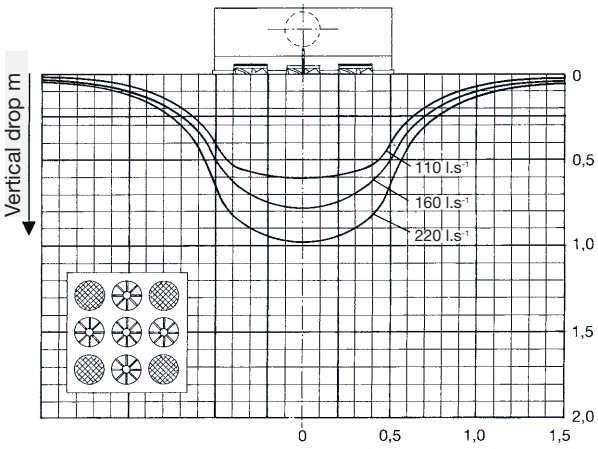


Fig. 6: DFA 9/4 at 0,2 m.s^{-1} isovels.

Multi-outlet Swirl diffuser type DFA

Selection data

Vertical air projection

Figs. 7 and 8 show the vertical drop to terminal velocities (v_t) of 0,1 and 0,2 m.s^{-1} under isothermal conditions as a function of air flow rate.

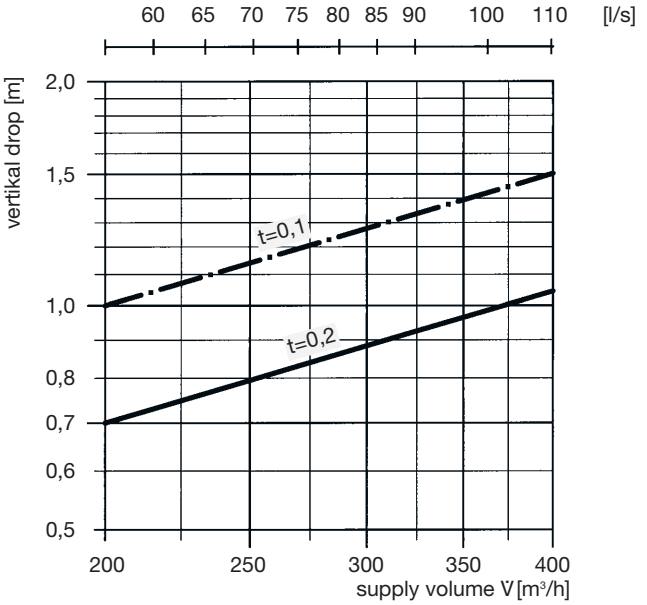


Fig. 7: Vertical drop as a function of flow rate for DFA 4.

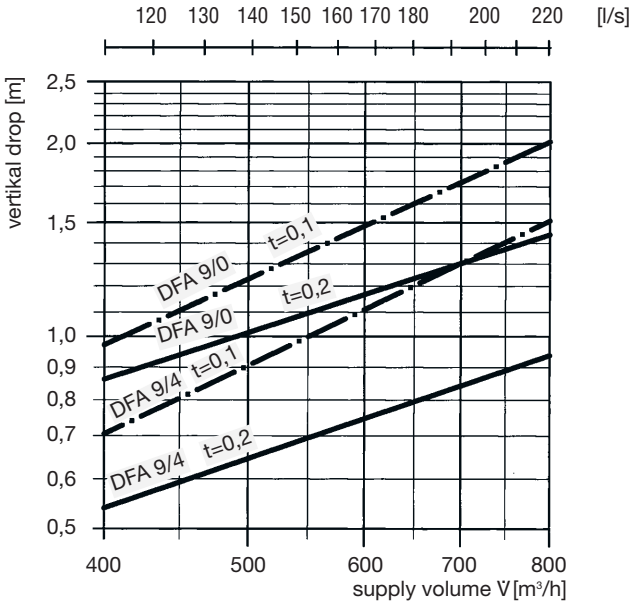


Fig. 8: Vertical drop as a function of flow rate for DFA 9/0 and 9/4.

Influence of temperature difference on the vertical drop

Due to the high induction at the region of the diffuser outlet the temperature difference between supply and room air is rapidly reduced.

In the cooling mode the temperature difference at the 0,2 m.s^{-1} isovel is reduced by 80%.

Fig. 9 shows the change in the vertical drop as a function of the supply to room air temperature difference. The factor **F** should be used to multiply the vertical drop obtained from the data related to isothermal conditions to obtain the correct vertical drop.

Δt (K)	Cooling mode				Iso-thermal	Heating mode			
	+ 8	+ 6	+ 4	+ 2	0	– 2	– 4	– 6	– 8
F	1,20	1,15	1,1	1,04	1,0	0,96	0,91	0,88	0,83

Fig. 9: Correction factors for vertical drop as a function of temperature difference.

Multi-outlet Swirl diffuser type DFA

Selection data

Minimum distance between diffusers

Pressure loss Noise level

Minimum distance between diffusers

The minimum distance between 2 diffusers is dependent on the radius of diffusion from the diffuser. Multi-outlet Swirl diffusers have, due to the converging air jets, a very small radius of diffusion. Therefore the minimum distance between diffusers is also very small.

For Multi-outlet Swirl diffusers there is a constant minimum distance between diffusers:

$$t_{min} = 1{,}25 \text{ m} = \text{constant}$$

Pressure loss and noise level

Figs. 10 an 11 show the total pressure loss and noise levels for the complete diffuser assembly of **Multi-outlet Swirl diffuser and connection plenum.**

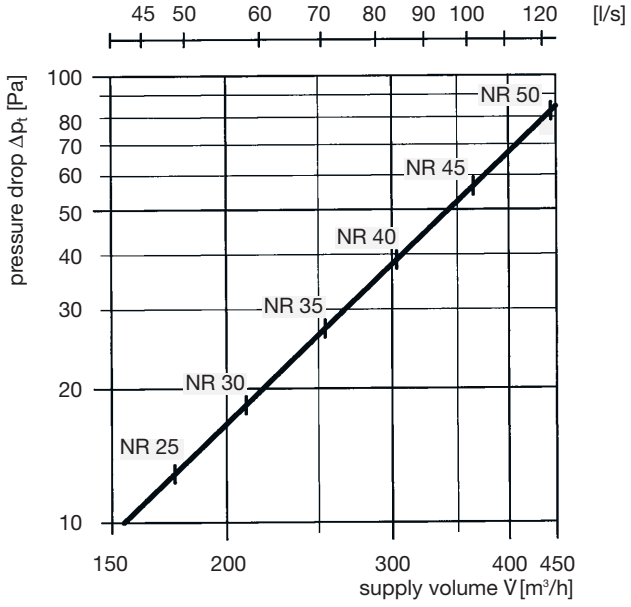


Fig. 10: Total pressure loss (Pa) and noise levels (NR) for Multi-outlet Swirl diffuser DFA 4.

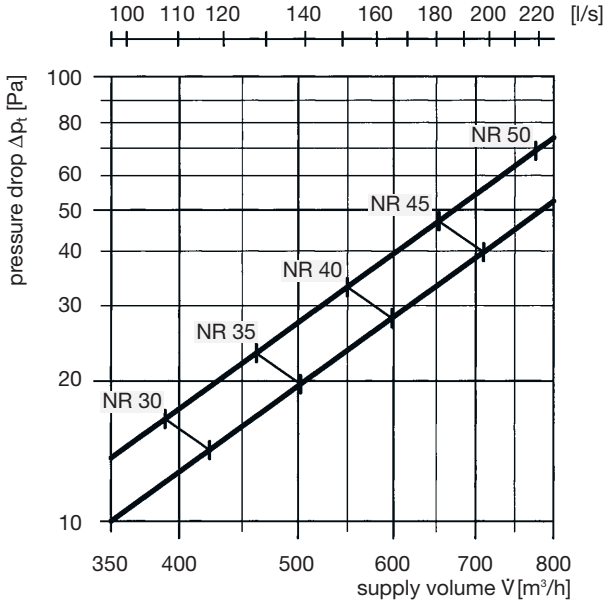
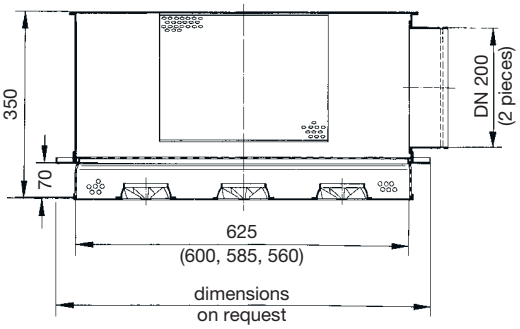


Fig. 11: Total pressure loss (Pa) and noise levels (NR) for Multi-outlet Swirl diffusers DFA 9 (DFA 9/0 and DFA 9/4).

Multi-outlet Swirl diffuser type DFA

DFA Variation type DFA-AKQ

DFA Variation type DFA-AKQ



For high air flow rates ($q_v \leq 330 l.s^{-1}$ – $\leq 1200\ m^3.h^{-1}$) the DFA 9 is available in the special version DFA-AKQ which has an extended section with perforated plate to simulate a displacement effect. 50% of the supply air passes through the Swirl diffuser elements and 50% through the perforated plate section.

Air flow rate range =
125–330 $l.s^{-1}$ (450–1250 $m^3.h^{-1}$)

The connection plenum is fitted with 2Ø200 inlet spigots at 90° to each other.

Vertical air projection
The vertical air projection is determined by the 50% of the supply air which passes through the Swirl diffuser elements and can be established by the data in Figs. 5 to 9.

Example:
Total flow rate = 280 $l.s^{-1}$ (1008 $m^3.h^{-1}$)
amount passing through the elements:
140 $l.s^{-1}$ (554 $m^3.h^{-1}$)
from Fig. 5 or 8 the vertical drop can be read for $v_{t0,2}$ of 1 m.

From Fig. 12 NR = 38 and PI = 42 Pa.

Distance between diffusers
For the DFA-AKQ there is a constant minimum distance between diffusers:

t_{min} = 1,75 m = constant

Noise level and pressure loss

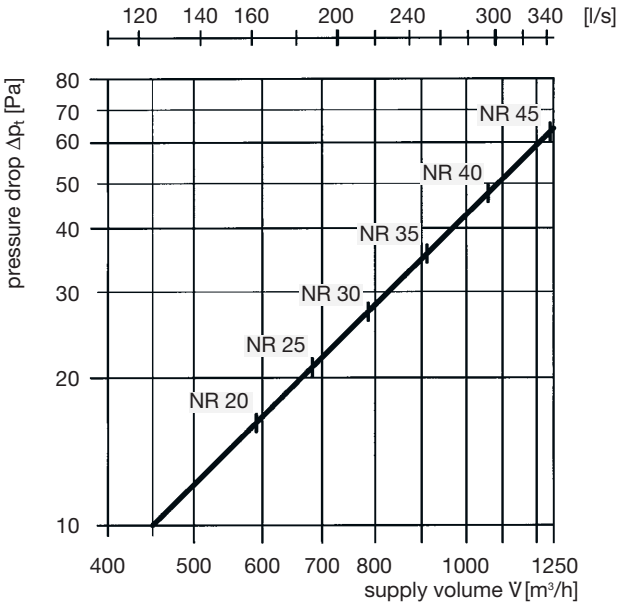


Fig. 12: Total pressure loss (Pa) and noise levels (NR) for Multi-outlet Swirl diffuser DFA-AKQ 9

Multi-outlet Swirl diffuser type DFA

Selection example

Selection example

Given:

Laboratory with the following details:

Length:	6,0 m
Width:	4,5 m
Height:	2,8 m
Supply air flow rate q:	750 l.s^{-1} (2700 m^3.h^{-1})
Temp. diff. cooling	4 K
Temp. diff. heating	2 K
Air velocity in occupied zone v_t	≤ 0,15 m.s^{-1}
Maximum noise level L_w	≤ 40 NR

Required:

Diffuser size
Number of diffusers
Air flow rate per diffuser
Lay-out of diffusers
Pressure loss and noise level

Procedure:
Vertical drop allowable
$t_v = H - 1{,}8\ m = 2{,}8 - 1{,}8 = 1\ m$

Correction from isothermal case –
From Fig. 9: at $\Delta t = -4K$, $F = 1{,}1$
$v_t = 1/1{,}1 = 0{,}91\ m$

Maximum flow rate for the allowed vertical drop:

From Figs. 7, 8, 10 and 11 the following data can be derived for the different sizes of the DFA diffusers:

DFA 4: q = 65 l.s^{-1} (234 m^3.h^{-1}) at 36 NR
DFA 9/0: q = 110 l.s^{-1} (396 m^3.h^{-1}) at 32 NR
DFA 9/4: q = 170 l.s^{-1} (612 m^3.h^{-1}) at 42 NR

Type DFA 9/4 exceeds the allowed 40 NR noise level. Therefore from Fig. 11 the maximum flow rate is 150 l.s^{-1} (540 m^3.h^{-1})

Number of diffusers:

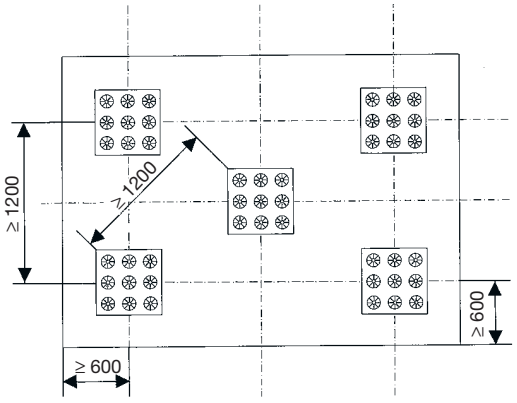
DFA 4: 750/65 l.s^{-1} = 11,54 say 12 diffusers (2700/234 m^3.h^{-1})

DFA 9/0: 750/110 l.s^{-1} = 6,81 say 7 diffusers (2700/396 m^3.h^{-1})

DFA 9/4: 750/150 l.s^{-1} = 5,00 say 5 diffusers (2700/612 m^3.h^{-1})

For economic reasons type DFA 9/0 is the obvious choice.

Diffuser lay-out:



Conclusions:

5 off Multi-outlet Swirl diffusers type DFA 9/4 handling 150 l.s^{-1} (540 m^3.h^{-1}) each

t_v ≤ 1 m with Δt of 4 K cooling

L_w = 40 NR (see Fig. 11)

Δp = 60 Pa (see Fig. 11)

Tender text

Position	Description	No. of units	Unit price	Extended price
	Multi-outlet supply air Swirl diffusers for applications requiring even air diffusion and the minimum possible temperature gradient. Particularly suitable for very high air change rates. Air is introduced through a matrix of either 4 or 9 individual 125 Ø swirl diffuser elements. Connection plenum boxes are from zinc plated steel with perforated equalising plate and horizontal inlet spigot having a self sealing gasket. **Type of swirl diffuser** ☐ DFA 4 (4 diffuser elements) ☐ DFA 9 (9 diffuser elements) ○ without perforated capping plate (DFA 9/0) ○ with perforated capping plate (DFA 9/4) **Material** ☐ Steel (standard) ☐ Stainless steel (1.4301) **Face flange dimensions** …….. mm x …….. mm **Finish diffusers (outer surface)** ☐ Powder coated RAL 9010 (standard) ☐ Enamelled to RAL…….. ☐ Stainless steel (1.4301) mill ○ normal ○ blasted **Connection component plenum box** ☐ Plenum box (standard) (DFA-AK) Spigot DN ..... ☐ Plenum with displacement section (DFA-AKQ) 1 Spigot DN ..... 2 Spigot DN ..... ○ Positioning 90° ..... ○ Positioning 180° ..... **Finish (outer surface) plenum box** ☐ Steel plate, galvanized ☐ Plenum box enamelled to RAL .....(AK-RAL) ☐ Stainless steel (1.4301) ☐ Plenum with displacement section, enamelled to RAL .....(AKQ-RAL) Air flow rate: ..... l/s or m^3/h Max. noise level: ..... NR or dB (A) Max. pressure loss: ..... Pa Manufacturer: **Strulik** Type: **DFA**			