EN

Movement by Perfection

The Royal League in **ventilation**, control and drive technology

General notes

Installation and operating instructions for centrifugal fans in parallel operation

Edition 10/2025

ZIEHL-ABEGG

Installation and operating notes

Measuring device for airflow determination

The active pressure process compares the static pressure upstream of the inlet nozzle with the static pressure in the inlet nozzle at the location of the greatest constriction (smallest, free nozzle cross sectional area). The active pressure (differential pressure of the static pressures) can be assigned to the volume flow as follows via the energy retention set:

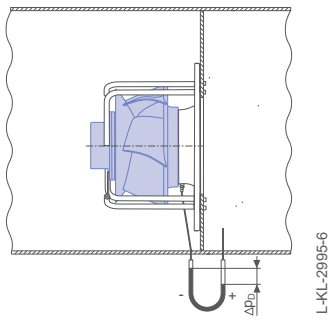
At standard state of 20 °C:

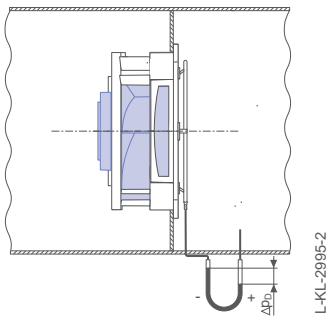
$$q_{V1} = k \cdot \sqrt{\Delta p_D}$$

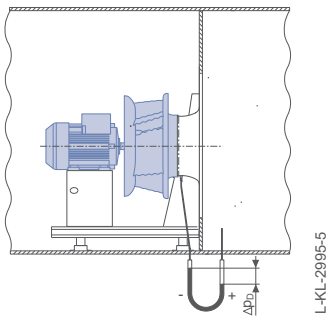
In the case of deviating air conditions:

$$q_{V1} = \sqrt{\frac{\rho_N}{\rho_D}} \cdot k_{20} \cdot \sqrt{\Delta p_D}$$

q_{V1}	Volume flow in m³/h
Δp_D	Differential pressure of the static pressures in Pa
k	Factor for specific nozzle properties, nozzle coefficient
ρ_N	Standard air density of 1.2 kg/m³
ρ_D	Air density at present operating point in kg/m³







Nozzle coefficients

Size	ZAbluefin			Cpro			C series			C-ATEX	
	k	k_g	k_{ZAflow}	k	k_g	k_{ZAflow}	k	k_g	k_{ZAflow}	k	k_g
160											
175											
190											
200											
220											
225							47	46	46		
250	67	63	66	60	58	59	60	58	59	55	53
280	85	80	83	75	72	74	75	72	74	69	66
315	106	100	104	95	91	93	95	91	93	87	83
355	140	130	137	121	116	119	121	116	119	111	106
400	180	170	176	154	148	151	154	148	151	141	135
450	220	210	216	197	189	193	197	189	193	181	173
500	280	265	274	252	242	247	252	242	247	231	221
560	355	335	348	308	295	302	308	295	302	284	271
630	420	400	412	381	365	373	381	365	373	350	334
710	530	500					490	470		450	429
800	670	630					620	594		569	543
900	850	800					789	756		724	691
1000	1050	1000					999	958		916	875
1120	1250	1200					1233	1072			

ρ = 1,20 kg/m³
k = Standard
k_g = With guard grille
k_{ZAflow} = With inlet guide grille

Installation and operating notes

Measuring device for airflow determination

Nozzle coefficients

Size	ZAvblue2			ZAvblue			ZAvblue with EC055		ZApilot		Vpro
	k	k_g	k_{ZAflow}	k	k_g	k_{ZAflow}	k	k_{ZAflow}*	k	k_{ZAflow}*	k
160							36	35			
175							38	37	38	37	
190							38	37	38	37	
200							38	37	38	37	
220							71	70	71	70	
225							75	74	71	70	50
250	95	85	94	80		79	112	110	90	88	63
280	120	110	118	95		93					86
315	150	140	147	120		118					112
355	190	180	187	150		147					144
400	240	220	236	200		196					180
450	300	280	295	240		235					220
500	360	340	354	320		314					291
560	450	420	443	400		392					360
630	530	500	519	480		470					445
710											
800											
900											
1000											
1120											

ρ = 1,20 kg/m³
k = Standard
k_g = With guard grille
k_{ZAflow} = With inlet guide grille
*k_{ZAflow} = With guard grille / inlet guide grille

Example:
If a differential pressure of 625 Pa is measured for frame size GR35D, the air volume flow can be calculated using the simplified formula as follows. The nozzle coefficients (k-factors) were determined under laboratory conditions with an undisturbed inflow:

$$q_{V1} = k \cdot \sqrt{\Delta p_D} = 190 \cdot \sqrt{625} = 4750 \text{ m}^3/\text{h}$$

The nozzle coefficients (k-factors) were determined under laboratory conditions with an undisturbed supply. If suction side guard grilles (mounted in front of the inlet nozzle) are also used, use the factor k_g. If ZAflow inlet guide grilles (mounted in front of the inlet nozzle) are also used, use the factor k_{ZAflow}.

Notes pertaining to the measuring method
The measured values, which were determined using the active pressure method, are subject to a tolerance of +/- 8.0% as they pertain to the air flow result. This tolerance is reached above a minimum air velocity of approx. 29.53 ft/s at the place of greatest constriction.
The tolerances cannot be clearly quantified below this minimum air velocity.

This air flow measuring method is only suitable for acceptance measurements on site.
For a more accurate airflow determination in the existing installation setup, a counter calibration of the air flow has to be carried out on site to measure the active pressure. The nozzle factors determined during this process apply exclusively to this installation setup.
If identical fans can be used in the parallel operation the according K-factor must be multiplied with the numbers of the installed fans.

Installation and operating notes

Installation notes for multiple fans in parallel operation

1st Definition of the geometric reference dimensions

1.1. General nomenclature

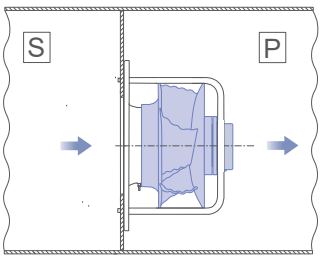
The working area of a free-running fan is divided into two basic areas:

- Suction side “S”
- Pressure side “P”

The fan conveys the air or gaseous medium as a volume flow from the suction to the pressure side, with a corresponding pressure increase.
The suction and pressure sides must always be completely separated in aerodynamic terms.

Suction side “S”
In front of the inlet nozzle

Lower pressure (-) or vacuum to environment for device installation



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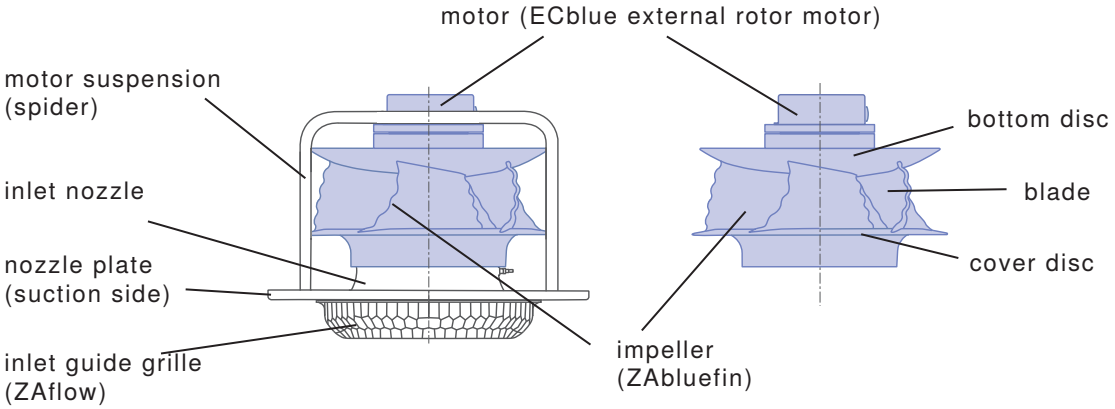
Pressure side “P”
After leaving the impeller

Higher pressure (+) overpressure to environment for device installation

The fan’s components are uniformly defined in order to ensure clear allocation in the following instructions:



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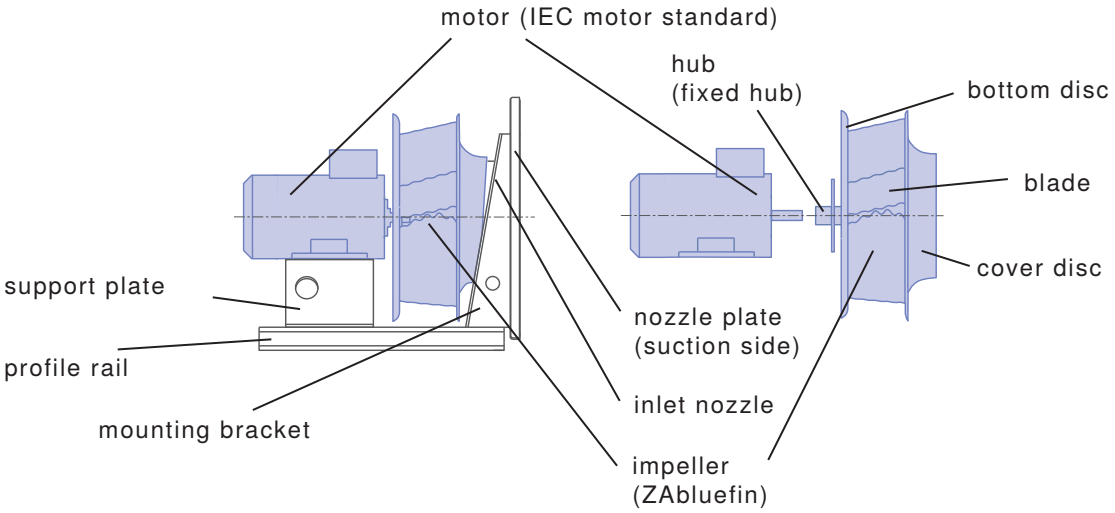

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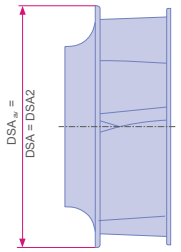
Installation and operating notes

Installation notes for multiple fans in parallel operation

1.2. Nominal size

The nominal size indicates the size of the impeller according to standardized sizes. Since ZIEHL-ABEGG centrifugal impellers are largely scaled, they broadly follow the standardized size and can be equated to the effective blade external diameter DSA or DSAav as a mm specification.

For ZIEHL-ABEGG fan products, the respective size can always be read in the type code and is therefore ideally suited as a specification for the following specifications. ZIEHL-ABEGG has defined factors for the respective specifications, which must be multiplied by the nominal size (BG) used.



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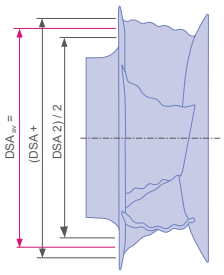

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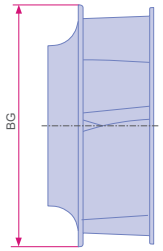

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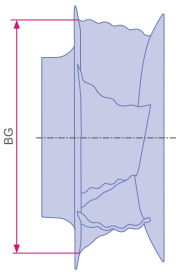

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Example of nominal size

Type key	Code → Nominal size	**Size [BG] mm**
GR25I-6ID.BD.CRP	Code 25 → ∅ 250	**250**
RH56I-ZID.GQ.CR	Code 56 → ∅ 560	**560**
GR63I-ZID.GQ.1R	Code 63 → ∅ 630	**630**

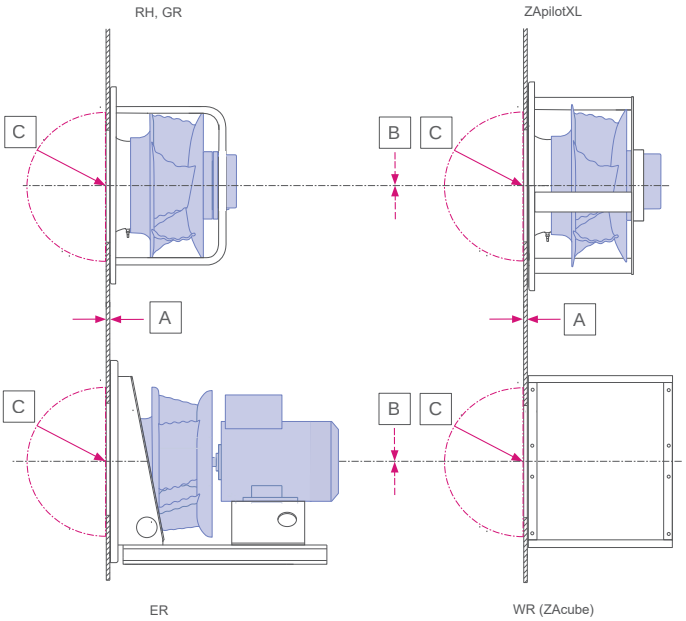
Example of type designation

Trade name	Type designation	Example
ZAbluefin	RH__**I** / GR__**I** / ER__**I**	RH56**I**-ZID.GL.CR
Cpro / C	RH__**C** / GR__**C** / ER__**C**	ER31**C**-2DN.B7.CR
ZAvblue2	RH__**D** / GR__**D**	GR45**D**-ZIK.DG.VRP
ZAvblue	RH__**V** - .**A**R / GR__**V** - .**A**R RH__**V** - .**B**R / GR__**V** - .**B**R RH__**V** - .**V**R / GR__**V** - .**V**R	GR25**V**-4IP.ZC.**A**R GR22**V**-4IP.Z8.**B**R RH45**V**-ZIK.GG.**V**R
Vpro	RH__**V** - .**1**R / GR__**V** - .**1**R	GR50**V**-ZIK.GG.**1**R

1.3. Definition of general reference ranges for dimensions

There are three defined reference ranges for clearances:

- “A” For clearances in the air flow direction - leading edge of inlet nozzle (plane)
- “B” For radial specifications - fan shaft (axle)
- “C” For radial and axial specifications - intersection point of the leading edge of the inlet nozzle to the fan shaft (point)



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Installation and operating notes

Installation notes for multiple fans in parallel operation

2nd Definition of the suction side installation instructions

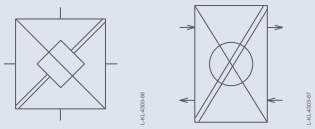
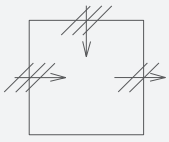
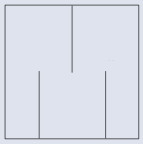
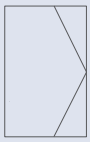
2.1. Suction side - Flow critical components before inlet nozzle

- Critical components are defined here as components installed in air handling units or ventilation ducts that can cause an uneven or non-continuous/-homogenous flow to the downstream fan inlet nozzle
- Such critical components in front of a fan require a compensation section to homogenize a disturbed flow. A recommended minimum distance based on flow velocity (in free cross-section):

  - 0,5 to 1,5 m/s → Factor x 1,0 x Size (BG)
  - 1,5 to 3,0 m/s → Factor x 1,5 x Size (BG)
  - 3,0 to 5,0 m/s → Factor x 2,0 x Size (BG)

- The factor can be found in the corresponding installation situation in the following chapters
- ZAflow offers a standardized solution and has shown that a significant improvement already has been achieved in many applications

List of the respective components and symbols

1.		• Plate and rotary heat exchanger with side bypass Asymmetric inflow with open bypass and thus change of inflow for fan or fan wall
2.		• Mixing chambers Irregular inflow due to different flap positions, which is why the volumetric flow rates hit the inlet nozzle in at least two different directions (vortex system)
3.		• Splitter attenuators Uneven flow downstream profile due to high gap speed between the splitters in relation to the speed within the entire device cross-section
4.		• Demister High potential for turbulent vortexes due to separator profiles within the air flow upstream of the inlet nozzle
5.		• Pocket and V-filters If the degree of contamination is high, large blockages can occur, which can result in a high potential for turbulent vortexes in the subsequent air flow upstream of the inlet nozzle

Installation and operating notes

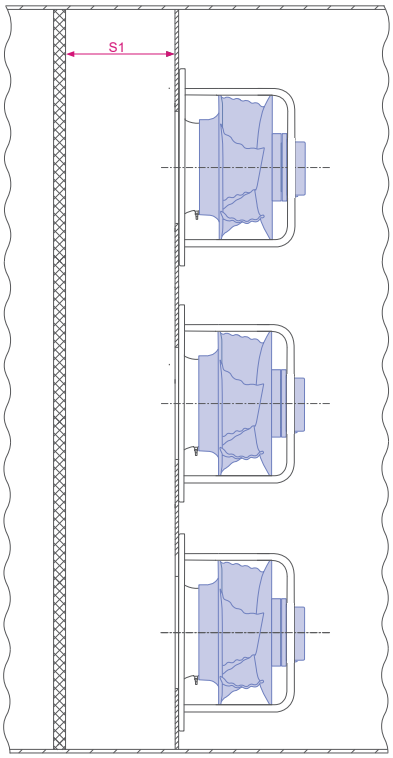
Installation notes for multiple fans in parallel operation

2.2. Suction side - axial inflow in the device or from the duct

Installation recommendation using defined factors

- The prerequisite for the specifications is a homogeneous speed profile upstream of the inlet nozzle
- Components with uneven velocity profiles in the outflow must be assessed on a situational basis

Example calculation:
S1 = BG (mm) x Factor
For GR56I-ZID.GQ.CR with ZAflow:
GR56I-ZID.GQ.CR Code 56 → ∅ 560
(See example table presentation nominal size)
S1 = 560 mm x 0,80 = 448 mm



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	Evaluation	ZAbluefin	C- / Cpro	ZAvblue2	ZAvblue	Vpro
Recommended	+++	1,00	1,00	1,00	1,00	1,00
Minimum clearance with ZAflow*	++	0,80	0,70	0,85	0,80	0,70
Minimum clearance to other guiding mechanisms*	+	0,80	0,70	0,85	0,80	0,70
Absolute minimum clearance (do not undershoot)**	0	0,60	0,50	0,65	0,60	0,50

*) Additional components to create a more homogeneous air intake
**) If these dimensions are not met, the plant designer is responsible for safe operation

Installation and operating notes

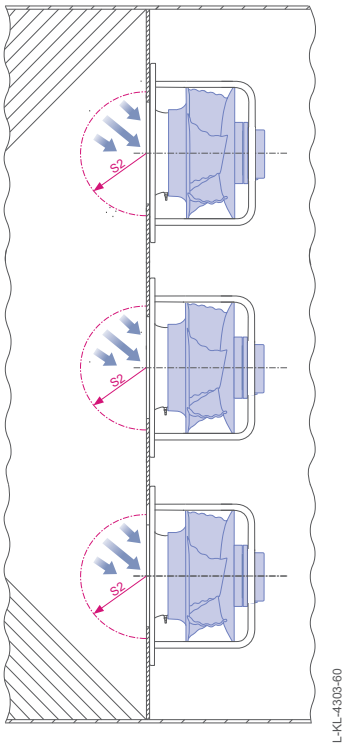
Installation notes for multiple fans in parallel operation

2.3. Suction side - radial/deflected inflow in the device

Installation recommendation using defined factors

- If air is deflected directly in front of the inlet nozzle, a continuous, circumferential flow of replenishment air is required for effective operation in addition to the most homogeneous flow profile possible Therefore enough space infront of the inlet nozzle is important.
- This also applies to plate heat exchangers with 45° air outlet or mixing chambers (see critical components) upstream of the inlet nozzle

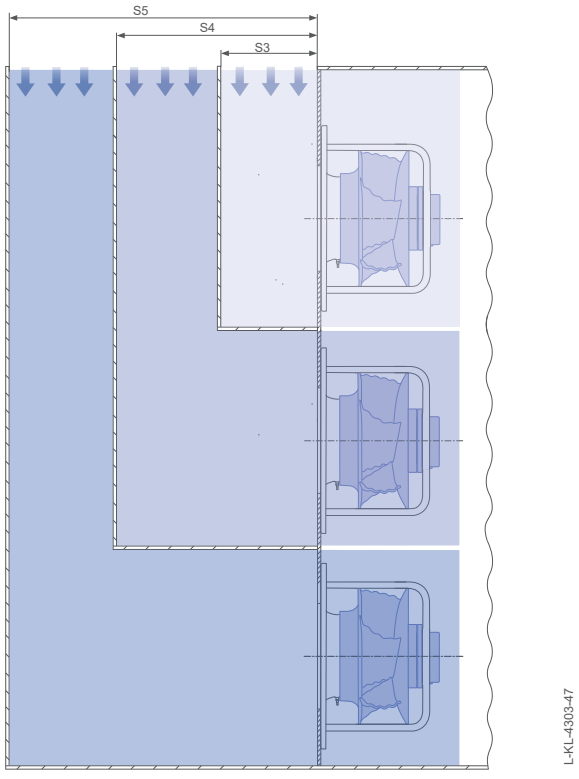
The calculation follows the same principle as the example in chapter 2.2.



- S3 corresponds to the distance recommendations for the single fan (see following table)
- S4 corresponds to factor S3 plus 0.7
- S5 corresponds to factor S4 plus 0.7

General information:
By each added fan in a section the relevant factor must be added 0.7.

The calculation follows the same principle as the example in chapter 2.2.



	Evaluation	ZAbluefin	C- / Cpro	ZAvblue2	ZAvblue	Vpro
Recommended	+++	1,30	1,20	1,40	1,30	1,20
Minimum clearance with ZAflow*	++	0,80	0,70	0,85	0,80	0,70
Minimum clearance to other guiding mechanisms*	+	0,90	0,80	1,00	0,90	0,80
Absolute minimum clearance (do not undershoot)**	0	0,70	0,70	0,80	0,70	0,70

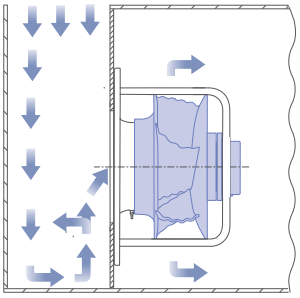
*) Additional components to create a more homogeneous air intake
**) If these dimensions are not met, the plant designer is responsible for safe operation

Installation and operating notes

Installation notes for multiple fans in parallel operation

2.5. Suction side - inlet flow support upstream of inlet nozzle (dead space)

- The dead space between the inlet nozzle and the device side wall facing away from the flow in the inflow area has an additional adverse effect on the inflow situation, especially in narrow ducts (minimum clearance)
- Closing the dead space with sheets (90° or 90° + 45°) reduces this influence. Place sheets as close as possible to the inlet nozzle, but not over the inlet nozzle



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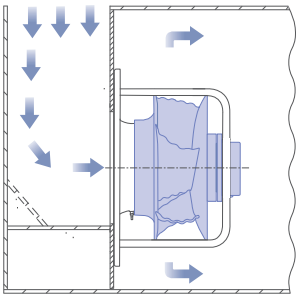

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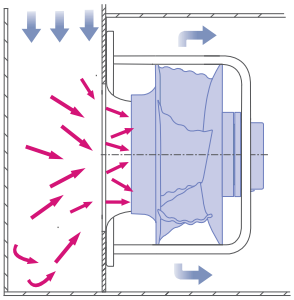
2.6. Suction side - inlet flow support upstream of inlet nozzle (ZAflow)

- The aim of a suction-side inlet guide grille is to ensure as uniform a sink flow as possible at the fan inlet (inlet nozzle)
- Turbulence and irregularities in the flow caused by the installation condition are homogenised by inserting an inlet guide grille (ZAflow). This improves the flow conditions for the fan



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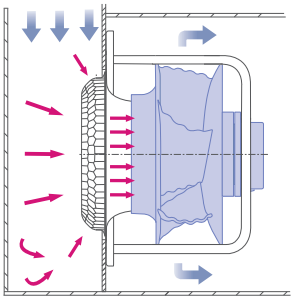

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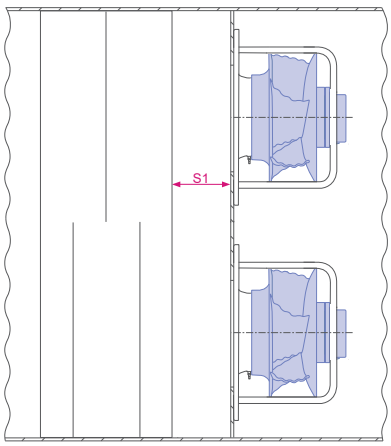
2.7. Example of suction side flow critical components

Two GR fans from size 560 with ZAvblue2 are installed in a duct. A rotary splitter attenuator is due to be connected upstream of them. It must now be clarified whether a ZAflow needs to be installed due to the distance of S1 = 0.6 m between the reference plane and the rotary splitter attenuator.

Calculation without ZAflow: 1 x 0,56 m = 0,56 m
Calculation with ZAflow: 0,85 x 0,56 m = 0,476 m

Answer: No, it is not necessary to install a ZAflow for this example, as the distance is more than 0.56 m. Nevertheless, use of the ZAflow is always recommended in integrated applications.



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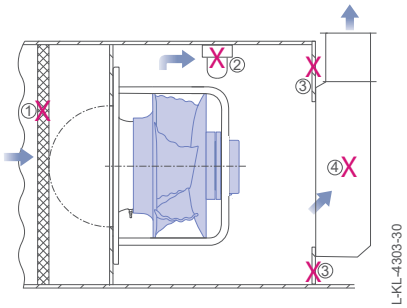
Installation and operating notes

Installation notes for multiple fans in parallel operation

3. Definition of pressure-side installation notes

3.1. Pressure side - flow critical components downstream of the impeller



- Interference in the impeller's outflow area leads to increased pressure losses in the device due to the high air velocity behind the impeller. Although these losses are not caused by the impeller, they are often attributed to the fan as a deficiency in the event of a complaint
- Pressure-side interference is often the cause of increased sound power. Interference at high speeds leads to higher turbulence and this is the cause of a possible increase in sound power
- An unfavourable pressure chamber design can lead to sudden operating point fluctuations. An example of this is a membrane-like change in the pressure chamber caused by instable side walls
- It should be noted that a centrifugal fan impeller's outflow area is subject to heavy swirling, i.e. there is a high speed component perpendicular to the axis of rotation
- Components and slats in the axial direction have a very strong influence on the turbulent outflow. For this reason, such components must be moved to an area in which the swirl component is no longer effective
- The swirl component is the reason why lamella heat exchangers or similar should be installed as far downstream from the impeller as possible. Upstream rectifiers may be helpful for loss-free reduction of the swirl component
- Since the flow velocity on the housing side walls (near the impeller outlet) is higher, installations in this area are particularly critical and can significantly increase the pressure loss and/or sound power in the device
- Other possible sources of fault during installation are:
  ② Blockage on the pressure side
  (long lamp, fluorescent lamp, braces)
  ③ Narrowing at the outlet
  ④ 90° change in flow direction and
  cross-section reduction outside the defined specifications

Installation and operating notes

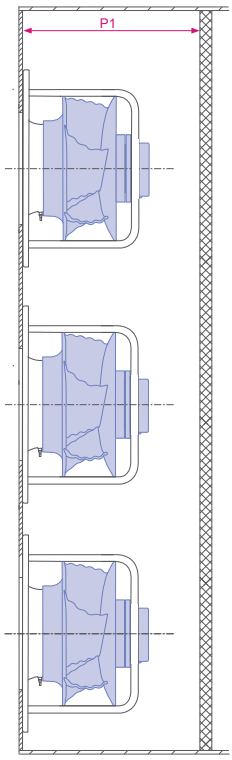
Installation notes for multiple fans in parallel operation

3.2. Pressure side - axial outflow in the duct

Installation recommendation using defined factors

- Centrifugal fans have a predominantly perpendicular outflow to the axis of rotation
- In a box installation situation, the walls act as a deflection aid, which causes an inhomogeneous axial speed profile to be formed behind the impeller. Only a sufficient settling section or the use of auxiliary inserts leads to moderation of the speed profile
- For this reason, the defined factors apply based on the reference plane “Leading edge of the inlet nozzle”
- With a fan wall, it must be ensured that accessibility for maintenance / clearing is provided for all fans, even at higher levels

The calculation follows the same principle as the example in chapter 2.2.



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	Evaluation	ZAbluefin	C- / Cpro	ZAvblue2	ZAvblue	Vpro
Recommended	+++	1,55	1,60	1,55	1,60	1,65
Absolute minimum clearance (do not undershoot)*	0	1,35	1,40	1,35	1,40	1,45

*) If these dimensions are not met, the plant designer is responsible for safe operation

Installation and operating notes

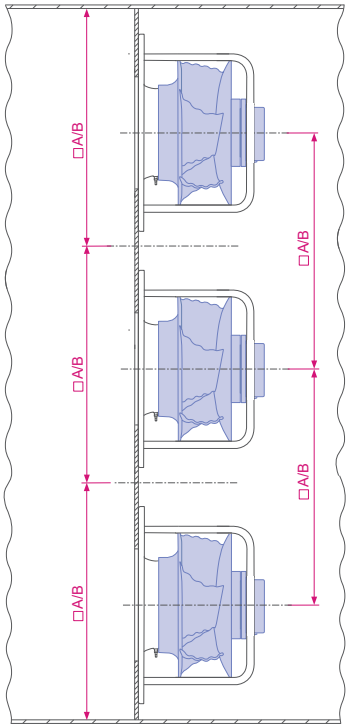
Installation notes for multiple fans in parallel operation

3.3. Pressure side - wall clearance with a square cross-section

Installation recommendations using defined factors

- The lateral clearance from surrounding surfaces/walls is very important for free-running impellers, as these are located opposite the impeller air outlet
- The surrounding surfaces serve as guiding surfaces, which deflect the escaping air volume flow in the axial direction and subsequently join behind the impeller
- Insufficient clearance between the surrounding surfaces reduces the air volume flow and thus the static efficiency of the impeller
- If the lateral center distance is less than 1,6x size of the fan, we strongly recommend using the ZAflow inlet guide grille with all fans

The calculation follows the same principle as the example chapter 2.2

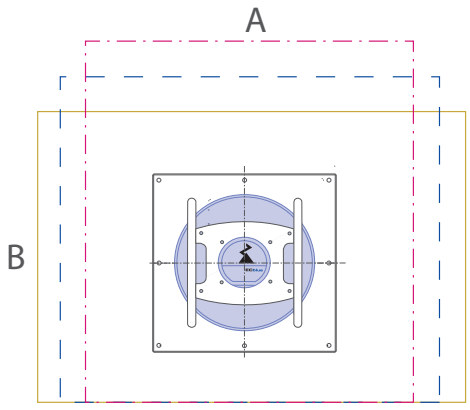


L-KL-4303-52

	Evaluation	ZAbluefin (RH/GR/ER)	C- / Cpro / Vpro (RH/GR/ER)	ZAvblue / ZAvblue2 (RH/GR)	ZApilot / ZApilot XL (GR-Module)	ZAcube (WR-Module)
Recommended	+++	1,70	1,80	1,70	1,90	Defined by cube dimensions
Minimum clearance	+	< 1,55	< 1,60	< 1,55	< 1,75	
Absolute minimum clearance (do not undershoot)*	0	1,40	1,40	1,40	1,60	

*) If these dimensions are not met, the plant designer is responsible for safe operation

- A rectangular cross-section can be calculated as follows, using the example of a ZAbluefin ventilation unit GR: (A + B) / 2 = 1,7 x size of the fan
- Up to a ratio of 2.0 to 1.4 deviating from the square, compensate the two opposite smaller clearances with larger clearances on the other sides
- Similarly, an asymmetrical arrangement of impeller's cross-section can be almost fully compensated if the absolute minimum clearance is not undershot on max. two sides
- This recommendation will be transmitted on the parallel operation of fans. The lenght or high dimension must be divided through the specific numbers of fans per planes



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Example calculation:

$$\frac{(A + B)}{2} = 1,7 \times BG$$

$$\frac{(1,7 + 1,7)}{2} = 1,7 \times BG$$

$$\frac{(1,85 + 1,55)}{2} = 1,7 \times BG$$

$$\frac{(2,0 + 1,4)}{2} = 1,7 \times BG$$

L-KL-4303-63

Installation and operating notes

Installation notes for multiple fans in parallel operation

3.4. Pressure side - radially deflected outflow

- “P4” The radial outlet opening should ideally be in a range of at least P2 = 1.5 to 2 x BG

  Evaluation: +++

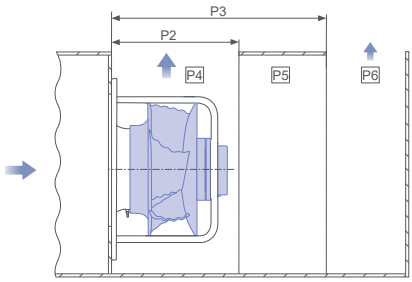
- “P6” If it is not possible to implement an outflow duct at the height of the impeller (see P4), a clearance of P3 = 3.5 to 4 x BG in relation to the reference plane must be maintained. Subsequently, at least one radial outlet opening must be guaranteed, as defined under P4

  Evaluation: +

- “P5” Positioning the radially deflected outflow duct between the areas P4 and P6 is only allowed with additional deflection aids, as otherwise the deflection of the gaseous fluid cannot be optimally guaranteed due to the high axial speed on the device wall

  Evaluation: 0

Please note that the outlet profile of the air or gaseous medium contains an additional component with high turbulence.

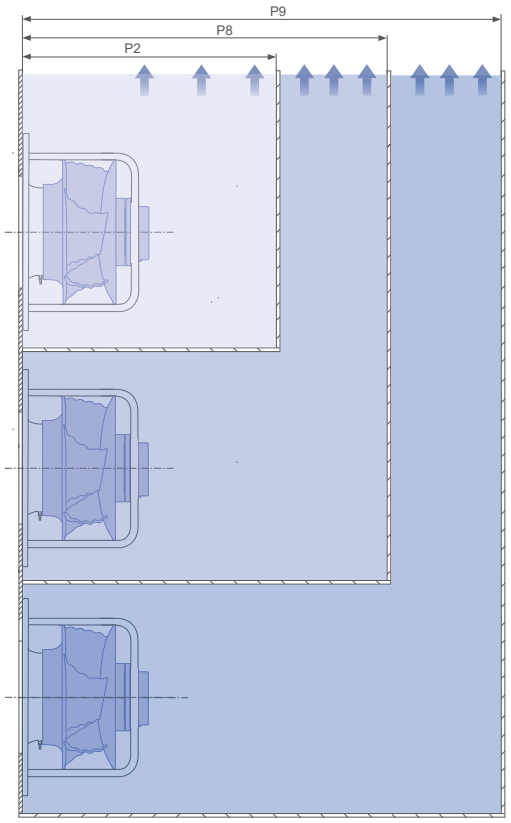


L-KL-4303-45

- P2 corresponds to the distance recommendations (see table on top)
- P8 corresponds to factor P2 plus 0.7
- P9 corresponds to fakcor P8 plus 0.7

General information:
The distances are served for the calculation as abasic specification for the single fan., as defined above.
By each added fan in a plane the relevant factor must be added 0.7.

The calculation follows the same principle as the example in chapter 2.2.



L-KL-4303-51

Installation and operating notes

Installation notes for multiple fans in parallel operation

3.5 Pressure side - Side distance with separating plate

Installation recommendation using defined factors

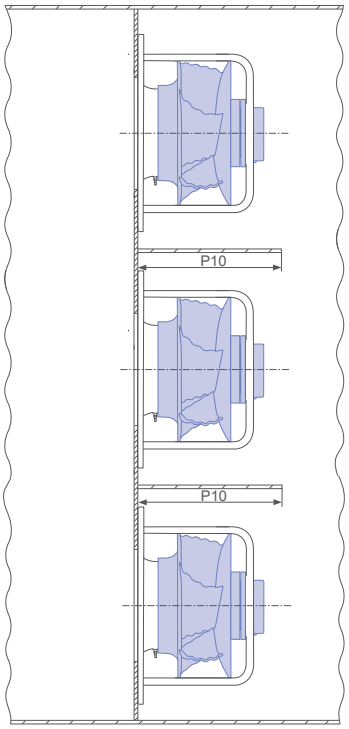
A pressure-side separating of the outflowing gaseous medium /fluid is helpful for ↑ (increasing) the efficiency and ↓ (reducing) the acoustics.

The depth of the separating plate in air direction P10 must be least 0.8 x size of the fan so that it ends behind the bottom disk of the impeller.

If impellers are positioned too close to each other, they may react as follows:

- On the pressure side, the outflow of the individual fans has a negative effect due to the small distance between the fan impellers, so that the gaseous medium / fluid cannot flow homogeneously in the axial direction
- Increased acoustics, in particular regarding the respective rotational sound depending on the impeller
- Increased vibration amplitudes due to the mutual excitation caused from the outflow of the gaseous medium /fluid

The calculation follows the same principle as the example in chapter 2.2.



L-KL-4303-53

Factor variable P10	Evaluation	ZAbluefin	C- / Cpro	ZAvblue2	ZAvblue	Vpro
rear edge separating plate	+++			>0,80*		

* The rear edge of the separator plate must protrude beyond the rear edge of the impeller.