EN

Movement by Perfection

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

General notes

Installation and operating instructions for centrifugal fans with external and internal rotor motors

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:

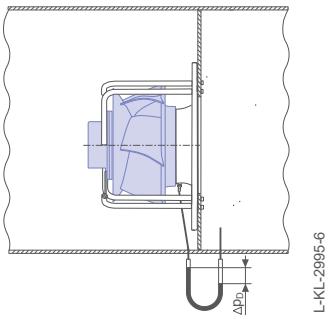
At standard state of 20 °C:

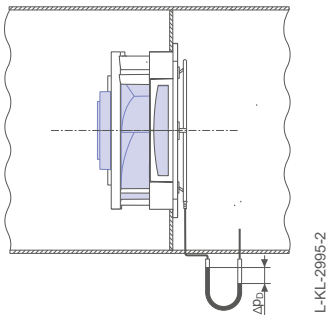
$$q_{V1} = k \cdot \sqrt{\Delta p_D}$$

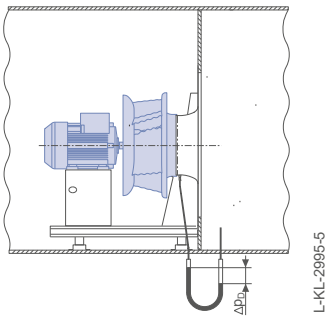
In the case of deviating air conditions:

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

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 model range			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
1,000	1050	1,000					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							112	110	90	88	63
280				86		84					86
315				112		110					112
355	160	150	157	144		141					144
400				180		176					180
450				220		215					220
500				291		285					291
560				360		352					360
630	530	500	519	445		435					445
710											
800											
900											
1,000											
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.

$$q_{V1} = k \cdot \sqrt{\Delta p_D} = 160 \cdot \sqrt{625} = 4000 \text{ m}^3/\text{h}$$

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 on the measuring procedure
The measured values determined with the active pressure process are subject to a tolerance of +/- 8.0% in the volume flow result. This tolerance is achieved above a minimum air velocity of approx. 9.0 m/s at the location of the strongest constriction.
Below this minimum air velocity the tolerances cannot be clearly quantified.

This flow measurement method is not suitable for tapping measurements at the location.
For more accurate airflow determination in the existing installation situation, counter calibration of the airflow for active pressure measurement must be carried out at the location. The nozzle coefficients determined here apply explicitly to this installation situation only.

Installation and operating notes

Installation notes for free-running impellers

1st Definition of the geometric reference dimensions

1.1. General nomenclature

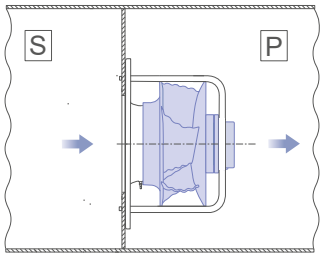
The working area of a free-running fan is divided into two basic areas:

- **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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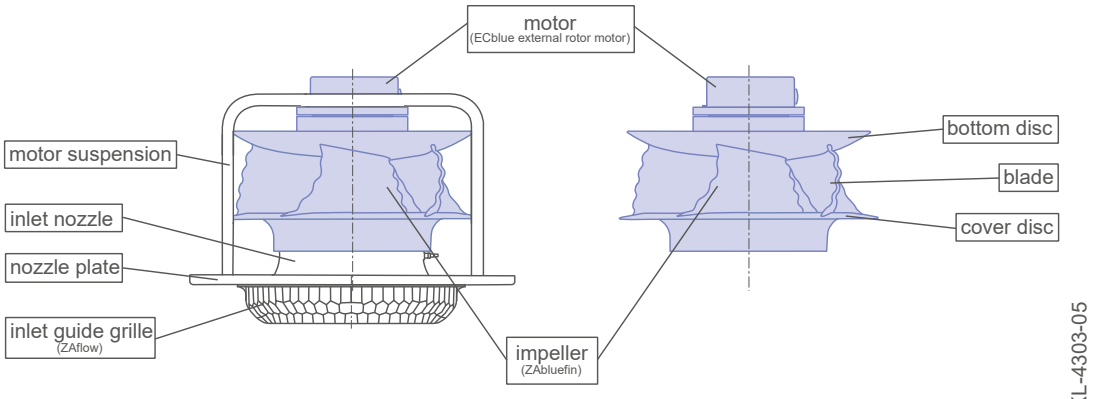
Pressure side P
After leaving the impeller

Higher pressure (+) or 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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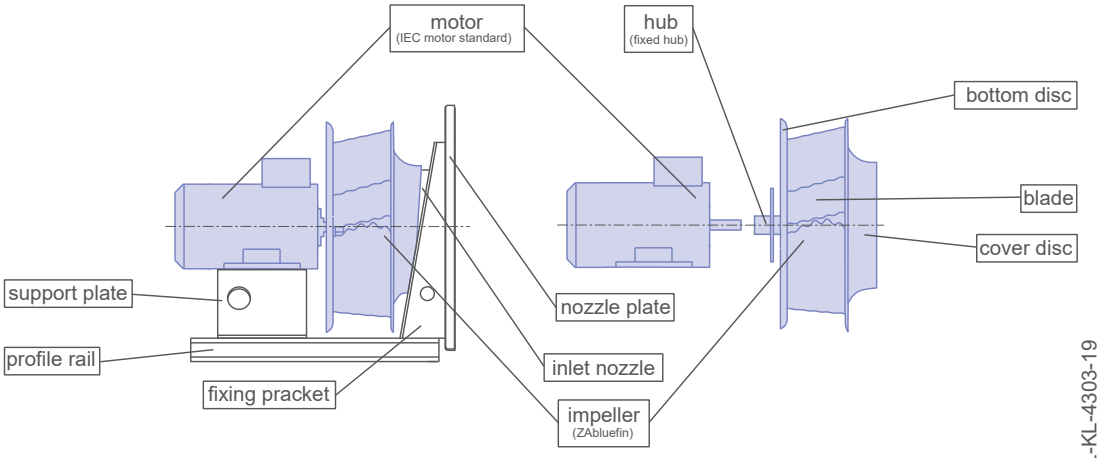

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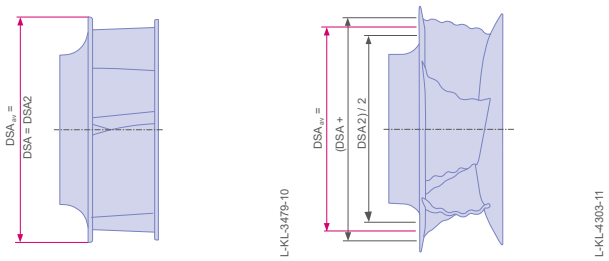
Installation and operating notes

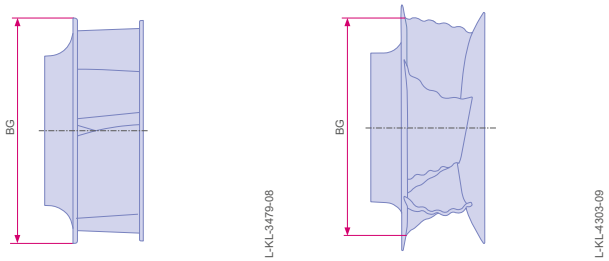
Installation notes for free-running impellers

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.





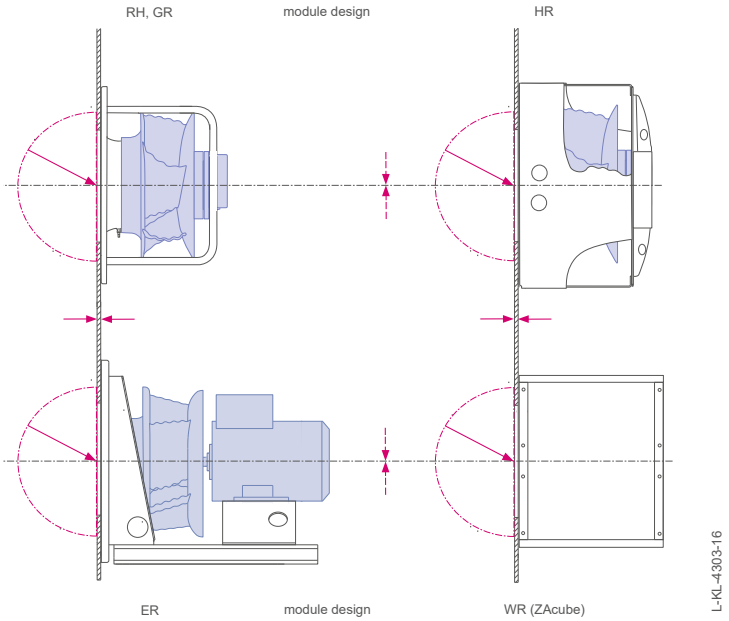
Example of nominal size notion

Model range	Vpro	Cpro	ZAbluefin
	mm	mm	mm
Size 250 mm [BG]			
Ø-DD (outside)	251	290	285
Ø-DSA_{av}	250	257	251
Size 560 mm [BG]			
Ø-DD (outside)	584	644	639
Ø-DSA_{av}	568	572	563

1.3. Definition of general reference ranges for dimensions

There are three defined reference ranges for clearances:

- For clearances in the air flow direction – leading edge of inlet nozzle **(plane)**
- For radial specifications – fan shaft **(axle)**
- For radial and axial specifications – intersection point of the leading edge of the inlet nozzle to the fan shaft **(point)**



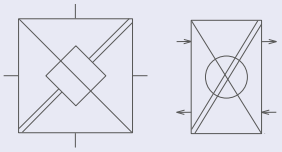
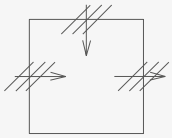
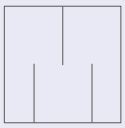
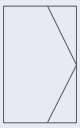
Installation and operating notes

Installation notes for free-running impellers

2nd Definition of the suction side installation instructions

2.1. Suction side – Flow critical components before inlet nozzle

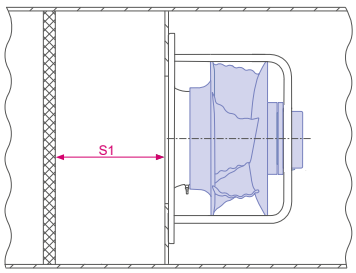
List of the respective components and symbols

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

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



	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

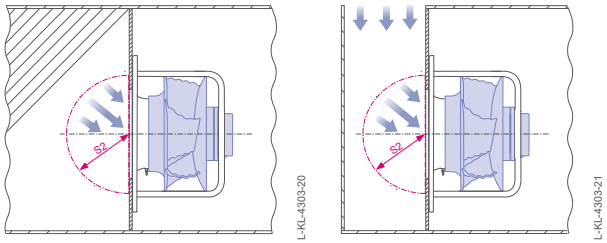
Installation and operating notes

Installation notes for free-running impellers

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
- This also applies to plate heat exchangers with 45° air outlet or mixing chambers (see critical components) upstream of the inlet nozzle



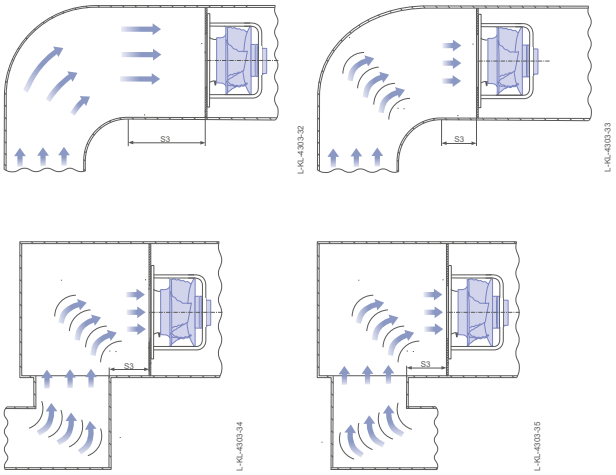
	Evaluation	ZAbluefin	C- / Cpro	ZAvblue2	ZAvblue	Vpro
Recommended	+++	1.30	1.20	1.40	1.30	1.20
Minimum clearance with ZAflow*	++	0.70	0.70	0.70	0.70	0.70
Minimum clearance to other guiding mechanisms	+	0.90	0.80	1.00	0.90	0.80
Absolute minimum clearance (do not undershoot)**	0	0.70	0.70	0.80	0.70	0.70

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

2.4. Suction side – radial/deflected inflow from the duct

Installation recommendation using defined factors

The air or gaseous medium does not follow the specified geometry due to its inertia. The higher the air velocity, the greater the inertia. To restore the flow profile before deflection, a settling section is required. This is recommended accordingly in the following table. In the case of inflow from ventilation ducts, the inflow profile is significantly more important than the inflow for devices due to the tendency towards higher air velocities in the duct (usually 5–8 m/s). If there are several air deflectors, these must always be equipped with baffles. The clearance to air deflectors in the duct upstream of the fan inlet nozzle must therefore be carefully considered.



	Evaluation	All model ranges
Recommended	+++	3.00
Minimum clearance with ZAflow*	++	1.00
Minimum clearance with multiple, parallel deflectors*	+	1.00
Absolute minimum clearance (do not undershoot)**	0	1.00

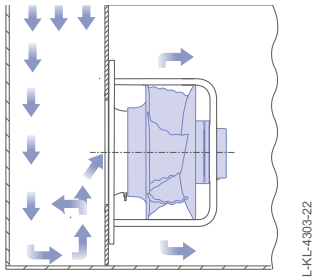
*) Additional components to create a more homogeneous air intake
**) If these dimensions are not met, the plant designer is responsible for safe operation

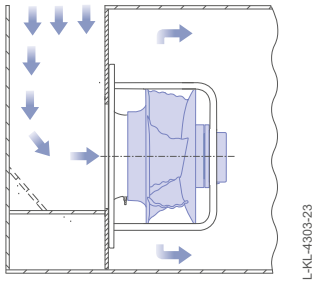
Installation and operating notes

Installation notes for free-running impellers

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

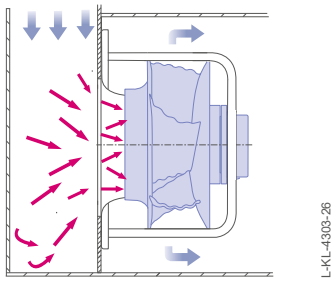
- The dead space between the inlet nozzle and the device side wall facing away from the flow in the inflow area has an additional adverse effect on the inflow situation, especially in narrow ducts (minimum clearance)
- Closing the dead space with sheets (90° or 90° + 45°) reduces this influence. Place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

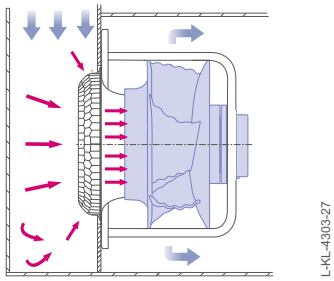




2.6. Suction side – inlet flow support upstream of inlet nozzle (ZAflow)

- 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



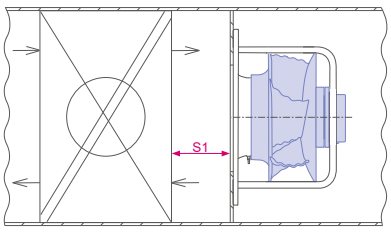


2.7. Example of suction side flow critical components

A GR fan size 560 with ZAvblue2 is installed in a duct. A rotary heat exchanger is due to be connected upstream of this. It must now be clarified whether a ZAflow needs to be installed due to the distance of 0.6 m between the reference plane and the rotary heat exchanger.

Calculation without ZAflow: 1 * 0.56 m = 0.56 m
Calculation with ZAflow: 0.85 * 0.56 m = 0.476 m

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



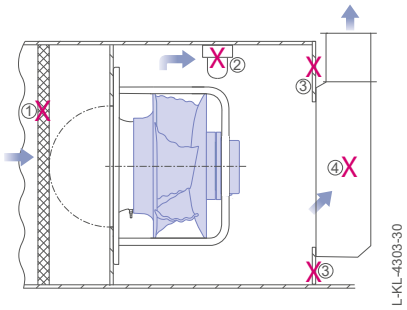
Installation and operating notes

Installation notes for free-running impellers

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



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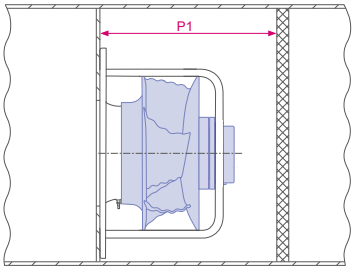
3.2. Pressure side – axial outflow in the duct

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”



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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

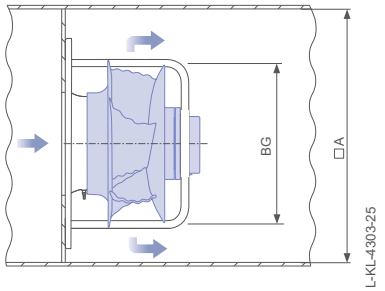
Installation and operating notes

Installation notes for free-running impellers

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

Installation recommendations using defined factors

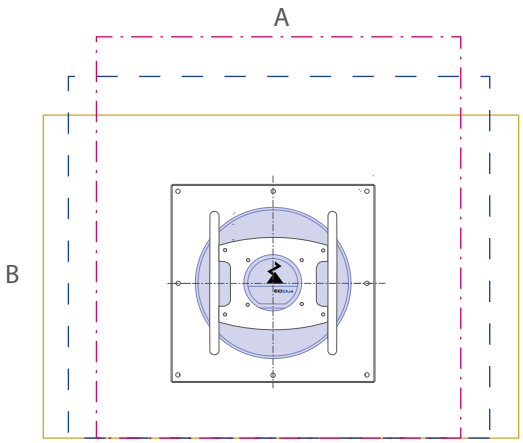
- The lateral clearance from surrounding surfaces/walls is very important for free-running impellers, as these are located opposite the impeller air outlet
- The surrounding surfaces serve as guiding surfaces, which deflect the escaping air volume flow in the axial direction and subsequently join behind the impeller
- Insufficient clearance between the surrounding surfaces reduces the air volume flow and thus the static efficiency of the impeller



	Evaluation	ZAbluefin (RH/GR/ER)	C- / Cpro / Vpro (RH/GR/ER)	ZAvblue / ZAvblue2 (RH/GR)	Highly efficient (HR modules)	ZApilot / ZApilot XL (GR modules)	ZAcube (WR modules)
Recommended	+++	1.70	1.80	1.70	2.10	1.90	Defined by cube dimensions
Minimum clearance	+	< 1.55	< 1.60	< 1.55	< 1.95	< 1.75	
Absolute minimum clearance (do not undershoot)*	0	1.40	1.40	1.40	1.80	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 * BG
- Up to a ratio of 2.2 to 1.4 deviating from the square, compensate the 2 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. 2 sides



Installation and operating notes

Installation notes for free-running impellers

3.4. Pressure side – radially deflected outflow

P4 The radial outlet opening should ideally be in a range of at least 1.5 to 2 x BG

Evaluation: +++

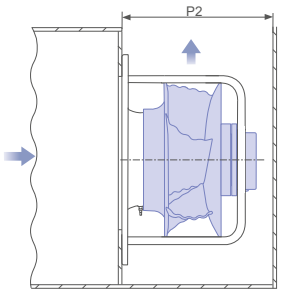
P6 If it is not possible to implement an outflow duct at the height of the impeller (see P4), a clearance of 3.5 to 4 x BG in relation to the reference plane must be maintained. Subsequently, at least one radial outlet opening must be guaranteed, as defined under P4

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.



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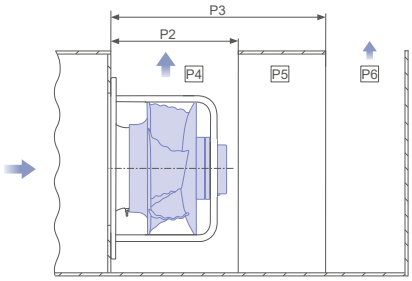

L-KL-4303-45