Air distribution systems Theory

Mixed ventilation

In mixed ventilation the air is supplied with a relatively high velocity outside the occupied zone, usually from the ceiling or the wall. The high velocity of the supplied air means, that a considerable amount of room-air is circulated as well. The velocity of the supplied air should be kept at a level which ensures that the mixing is effective, but at the same time ensures that the air velocity has fallen to the required level by the time it reaches the occupied zone. This makes demands on the efficiency of the units used as regards to velocity and mixing capacity.

An increase in the supplied air velocity will cause an increase in the sound level. Requirements for a low sound level consequently means a limit on the diffusers efficiency. The temperature and the contamination concentration is roughly the same throughout the room, for both isothermal and cold air.
Mixed ventilation is mostly unaffected by outside influences and can be used for both heating and cooling needs.

Supply of heated air

Since heated air is lighter than the room-air, it takes a considerable energy to force the air into the occupied zone. This means that the requirements for the downward supply air velocity rises with the increase of ceiling height and rising temperatures. When the ceiling height is high, it is usually necessary to blow the air vertically down wards.

Supply of cold air

The heavier cold air, supplied from the ceiling, may lead to excessive air velocity in the occupied zone if the thermal loads are large. The air jets from diffusers (normally horizontal) and the convection streams from the heating sources (people, lighting, machines) result in a velocity in the occupied zone, which in addition to the supplied air velocity from the diffuser, depends on the removed effect per square meter (W/m^2), the distribution on the individual diffusers and the diffusers jet pattern.

The supply of both heated and cold air in the same diffuser, from the ceiling cannot normally fulfil requirements for temperature gradient, ventilation efficiency and velocity in the occupied zone at the same time.

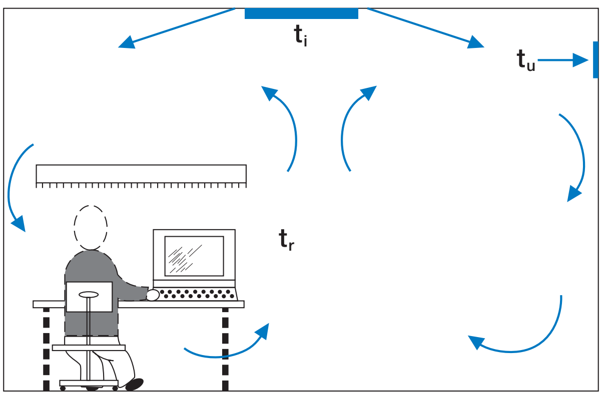


Fig. 1, Illustration of mixed ventilation.

The solution to this problem may be motorized diffusers, which can change the jet patterns. Another option is to dimension the diffusers to suit the cooling situation in question, and then add vertical nozzles for supply of heated air.

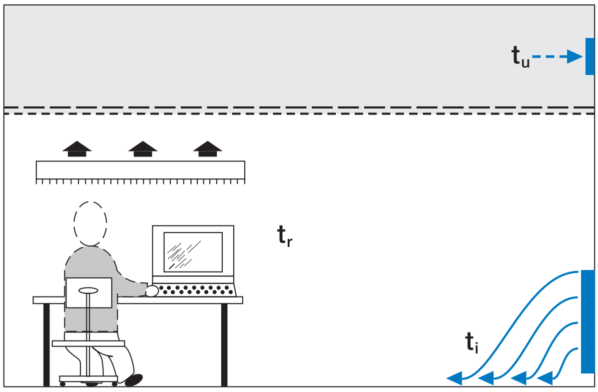


Fig. 2, Illustration of displacement ventilation.

Displacement ventilation

When using displacement ventilation, it is the thermal forces from the heating sources in the room, that control the air distribution. The air is supplied directly into the occupied zone at floor level - at low velocity and a cooling temperature. The air spreads across the floor, and displaces the hot, contaminated air, which is forced to the ceiling by the convection flow from the heating sources. Exhaust units should be placed in the ceiling, where a hot "contaminated" layer is formed.

The ventilation efficiency of displacement ventilation is larger than the mixed ventilation owing to this stratification of the air. The difference is increased with the ceiling height. The increased temperature efficiency means, that cooling power can be saved, or that the cooling effect of the outside air can be used better, since the exhaust air is warmer and consequently will transport more effect from the room. In normal circumstances displacement ventilation is not suitable for heating purposes.

The near-zone of the units depends primarily on the amount of supplied air, the cooling temperature and the placement of the unit. Within the recommended air flow area, the units size has no practical influence on the near-zone. The near-zone geometry can however be altered to suit the individual needs just by adjusting the nozzles.

Air distribution systems Theory

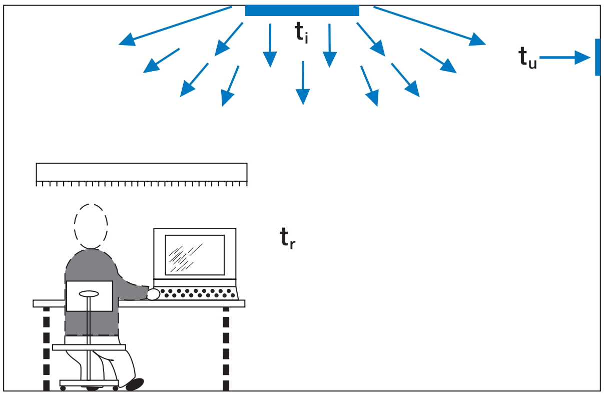


Fig. 3, Illustration of low impulse supply air.

Low-impulse supply air

By using low-impulse supply air, cold air from the ceiling is supplied at a low velocity. The clean air displaces the contaminated air.

The best result is obtained by distributing the supplied air flow in small portions spread out over the entire ceiling.

The system cannot be used for heating.

Choice of air distribution system

The different systems have their advantages and disadvantages. These should be considered carefully before choosing a system solution.
All the system solutions have one thing in common: the more units used, and the better the distribution of units in the room the better the thermal and atmospheric comfort achieved.
The advantages and disadvantages are outlined below.

Mixed ventilation
- + Can be used for cooling and heating
- + Large induction allows supply air with a larger cool ing temperature.
- + Largely the same temperature and air-quality through out the room, ie. a small temperature gradi ent and a small concentration gradient.
- + Stable flow pattern.
- + Flexibility with regards to placement of the diffusers.
- + No reduction of useful area (near-zone).
- - Risk of short-circuits/low ventilation efficiency (particularly for heating).
- - More power required for cooling.
- - Risk of draft when large cooling effect.

Displacement ventilation
- + High ventilation - and temperature efficiency.
- + High air quality in the occupied zone.
- + Low velocity in the occupied zone, although not in the near-zone.
- + Suitable for cooling of rooms with high ceiling height.
- - Less freedom with regard to furniture positioning, and the room space is reduced due to the diffusers near-zone.
- - Low induction.
- - Large vertical temperature gradient.
- - Heating is not possible.

Low impulse
- + No reduction of useful area.
- + Suitable for large air replacement with limited cooling temperature.
- + High local efficiency.
- - Low induction.
- - Heating is not possible.
- - Risk of short-circuit when the exhaust is in the ceil ing.

Air distribution systems Theory

Choice of air distribution system

		Mixed								Displacement			Low-impulse
		Nozzles	Grilles	wall diffusers	Ceiling diff. w. one slot	Perf. diffusers	Cone diffusers	Swirl diffusers	Slot diffusers	Wall diffusers	Floor diffusers	Under seat supply	
Office	Heat + cold				••	••	••	•••					
	0-30 W/m²			••	•••	•••	•••	•••	•	•••			
	30-60 W/m²				••	•••	••	•••					
	>60 W/m²					••	••	••		••	•••		
Audience	Conference rooms				•	••	••	••		•••	•••		
	Cinema					•	•	•		••	••	•••	
	Auditoria					•	•	•		••	••	•••	
	Restaurants				•	••	••	••		•••	••		
	Educational estab.			••	••	•••	•••	•••		•••			
	Exhibition halls		•	••	•••	•••	•••	•••	•	•••	•••		
Stores	Shops	•	•	••	••	•••	•••	•••	•				
	Supermarkets	•	•		•••	•••	•••	•••					
	Sportshalls	•••	••				••			•			
	Swimming baths	•••	••			•	••	••					
	Industrial kitchens				•	••	••	••		••			•••
	Laboratories				•	••	••	••		••			•••
	"Clean room"				•	••	••	•••					
	Homes		••	••	•••	•••			••				
	Institutions		••	••	•••	•••				••			

• Usable •• Good ••• Best

Choice of air distribution system in industrial environments

Ventilation need	Heating need	Cooling need	Mixed ventilation	Displacement ventilation	Low-impulse
Little	Little	Little	X		
Little	Large	Little	X		
Little	Large	Large	X		
Little	Little	Large		X	X
Large	Little	Little	X		X
Large	Large	Little	X		
Large	Large	Large	X		
Large	Little	Large		X	X

❄ Little need ❄ Large need

Mix ventilation

Theory

Mixed ventilation

An air distribution unit must supply a certain amount of air, in order to provide adequate ventilation. At the same time requirements for sound pressure, air velocity and temperature gradient in the occupied zone must be respected. In order to fulfil these requirements, certain planning guidelines are necessary. The most important ones are specified below. When choosing a diffuser, values such as pressure loss, sound level and air throw have to be taken into account. This data is specified for each individual product separately.
The selection and performance data contained in the Lindab catalogue are the result of measurements conducted in Lindabs laboratory using modern precision instruments. The conditions are rarely as ideal in practice as in a laboratory, since constructional choices, furnishing, placement of air distribution units etc. have a great influence on the distribution of the air in the room. Lindab offers to test the conditions in practice by conducting full-scale testing, which is very useful when large and complicated projects are being planned.

Descriptions

A	Total room absorption	[m²]
b_h	Maximum horizontal spread to final velocity 0,2 m/s	[m]
b_v	Maximum vertical spread to final velocity 0,2 m/s	[m]
F	Free cross-section (q/v_0,where v_0 is measured)	[m²]
K_{ok}	Octave correction value for sound power level	[dB]
$l_{0,2}$	Air throw to terminal velocity 0,2 m/s	[m]
$l_{0,0}$	Turning point at vertical supply air	[m]
l_b	Distance from the unit to point of maximum spread	[m]
L_A	A-balanced sound pressure level	[dB(A)]
L_{WA}	A-balanced sound power level	[dB(A)]
L_{Wok}	Sound power level in octave-bands	[dB]
L_p	Sound pressure level	[dB]
L_W	Sound power level	[dB]
ΔL	Sound attenuation	[dB]
D	Room attenuation	[dB]
Δp_t	Total pressure loss	[Pa]
q	Air flow	[m³/h], [l/s]
Δt	Temperature difference between supply air temperature and room air temperature	[K]
v_0	Supply velocity	[m/s]
v_x	Jet velocity at distance ‘x’ from centre of diffuser	[m/s]
v_{term}	Thermal maximum velocity in the occupied zone	[m/s]

Pressure loss

The diagram shows the total pressure loss for the diffuser (at ρ = 1,2 kg/m³), meaning the sum of static and dynamic pressure (incl. a possible plenum box) connected to a straight air duct with a length of 1 m and the same dimensions as the diffuser.

Sound level

The diagrams show the A-balanced sound power level L_{WA} for diffuser and possible plenum box connected with a straight air duct with a length of 1 m and the same dimensions as the diffuser.
Sound pressure level is a measurement for the power of the sound, ie. the pressure vibrations we perceive, while the sound power level is a parameter to characterize the source of the sound. Both are normally noted in the unit dB (decibels), which can cause some confusion.

<u>Sound pressure (Lp)</u>
Is a measure of the intensity of the sound, characterized by pressure vibrations, perceived by the ear or measured with a microphone on a noise meter. Sound pressure is measured in Pascal (Pa) and is usually noted as sound pressure level in decibels (dB) or dB(A).

<u>Sound power (Lw)</u>
The power, a sound source (eg. a machine) sends out in the shape of a sound. The sound effect is measured in Watt (W) and is usually noted as sound effect level in decibels (dB) or dB(A).

In the catalogue, sound properties of the diffusers are specified as sound power level.

Sound power level $L_W = 10 \times \log \frac{N}{N_{re}}$ [dB]

N is the actual sound power [W], which is sent out in the shape of pressure vibrations and $N_{re}=10^{-12}$ W which is the reference sound power.

Sound pressure level: $L_P = 20 \times \log \frac{P}{P_{re}}$ [dB]

P is the actual sound pressure [N/m²] and $p_{re} = 2 \times 10^{-5}$ N/m² is the reference sound pressure.
Room attenuation D [dB] is the difference between sound power level and the sound pressure level

$L_P = L_W - D$

The A-balanced sound power level, L_{WA} is calculated to sound power level in the individual octave-bands by

$L_{Wok} = L_{WA} + K_{ok}$

K_{ok} is a correctional value. K_{ok} is noted in tabular form for each unit.

Sound attenuation

Is noted for each unit, and refers to the reduction in sound power level between duct and room (incl. end-reflection).

Isothermal supply air

All technical data refer to isothermal conditions.

Air throw

The air throw $l_{0,2}$ is defined as the largest distance between the centre of the unit and the terminal velocity 0,2 m/s.
The values specified for air throw $l_{0,2}$ correspond to diffusers mounted in the ceiling. *(Fig. 4)*

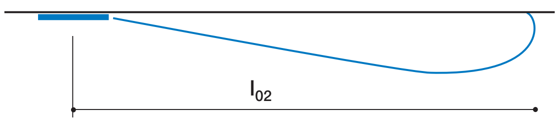


Fig. 4, Air throw $l_{0,2}$ for diffusers mounted in ceiling

Mix ventilation

Theory

Suspended mounting, ie. diffusers mounted more than 300 mm from the ceiling *(Figure 5)*, reduces the air throw by 20 %, so that $l_{0,2}$ suspended = 0,8 × $l_{0,2}$.

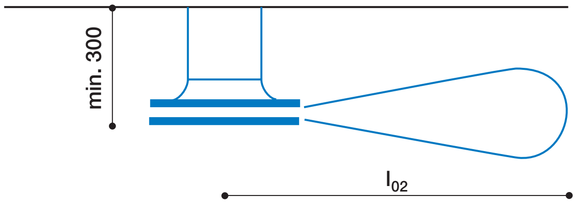


Fig.5, Suspended diffuser.

For grilles $l_{0,2}$ applies for mounting more than 800 mm from the ceiling. *(Figure 6)*.

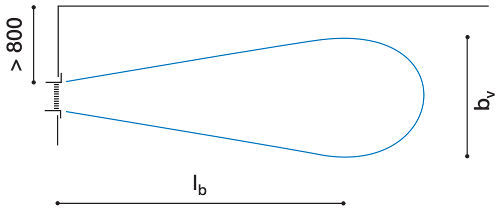


Fig. 6, Air throw for grilles mounted more than 800 mm from ceiling.

Should a grille be mounted less than 300 mm from the ceiling *(Figure 7)* the air throw $l_{0,2}$ is extended by 40%, so that $l_{0,2}$ grilles by ceiling = 1,4 x $l_{0,2}$.

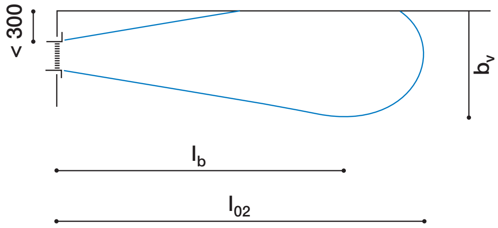


Fig.7, Air throw for grille mounted less than 300 mm from ceiling.

Spread

The maximum vertical spread b_v specifies the largest vertical distance between the ceiling and the terminal velocity 0,2 m/s *(Figure 8)*.

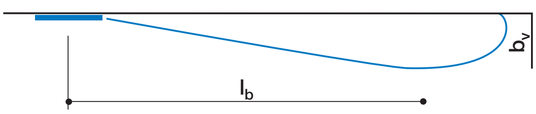


Fig.8, Vertical spread.

The horizontal spread is noted as b_h and specifies the maximum horizontal spread of the air jet for the terminal velocity 0,2 m/s *(Figure 9)*. The distance between the unit and the point of largest jet width is noted as l_b. b_v, b_h and l_b are specified for each unit as a function of the air throw $l_{0,2}$.

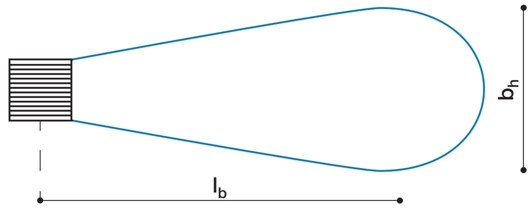


Fig. 9, Horizontal spread.

Coanda effect

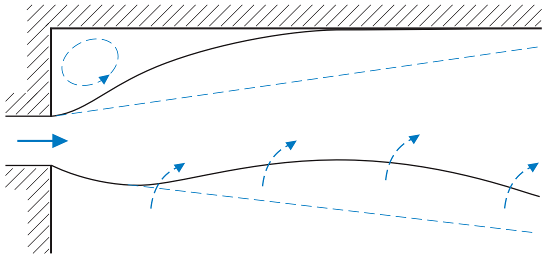


Fig. 10, Air flow with Coanda effect.

When the air is supplied parallel to a surface (eg. a ceiling) negative pressure occurs between the air jet and the ceiling, causing the jet to "stick" to the ceiling (this is known as the Coanda effect). *(Figure 10)*. This effect is of great importance, particularly when supplying cooling air.
To achieve the greatest possible Coanda effect, the air should be supplied in small quantities to each unit, with the widest possible spread on the ceiling and the greatest possible velocity.
This means that the best method is always to supply the air from the diffuser in a full 360°-pattern without side covers. In particular, linear diffusers (MTL) are divided into active and inactive sections to avoid drop.

Velocity in the jet

The air velocity of the core jet can be calculated within a limited area, using the following formula:

$$v_x = \frac{l_{0,2} \times 0,2}{x} \quad <=> \quad x = \frac{l_{0,2} \times 0,2}{v_x}$$

Where x is the distance in metres between the unit and the point in the core jet where the air velocity is v_x m/s.

<u>Example</u>
A diffuser has an air throw of $l_{0,2}$ = 3 m. The distance to the point where the jet velocity is 0,3 m/s is calculated as follows:

$$X = \frac{3\text{ m} \times 0,2\text{ m/s}}{0,3\text{ m/s}} = 2\text{ m}$$

Mix ventilation

Theory

Thermal supply air

The catalogue values for air throws are valid in the case of isothermal supply air.
When using cold or heated supply air the thermal forces work by forcing the jet downwards (cooling) or giving the jet a lift (heating). A description of the jet flow would require a determination of the ratio of temperature difference and supplied air velocity (in the jet-theory expressed by Archimedes number). If a more detailed calculation of supply air velocities is needed - where this is factored in - in addition to a visual of the jet flow from the diffusers, we refer you to the software programme DIMcomfort.

The general rule below for horizontal and vertical supply air with cold- or heated air, can however be used for correction of the air throw in a more simple calculation.

Horizontal supply air at the ceiling

1. When air is supplied horizontally with cold air, the air throws are reduced by 1,5% per degree *(Figure 11)*, while the vertical spread b_V is increased.

2. When air is supplied horizontally with heated air, the air throws are increased with 2% per degree *(Figure 11)*.

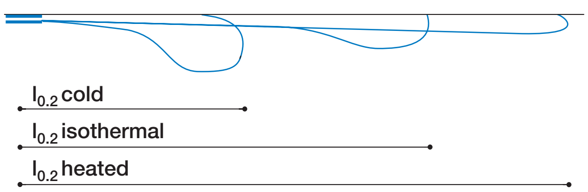


Fig. 11, Air throw $l_{0,2}$ for diffusers mounted in ceiling.

Vertical supply air at the ceiling

The throw lengths for vertical supply air is are valid for isothermal conditions.

1. When air is supplied at a cooling temperature the throw length is increased. The throw length is doubled at Δt = -10°C.

2. When air is supplied with heated air, the throw length is reduced. The throw length is halved at Δt = 10°C.

For products, which can be set for vertical supply air, there are also other separate turning point diagrams for heated air (Δt = +5K, +10K and possibly +15K) for turning point $l_{0,0}$ in addition to the other product data.

Dimensioning mixed ventilation

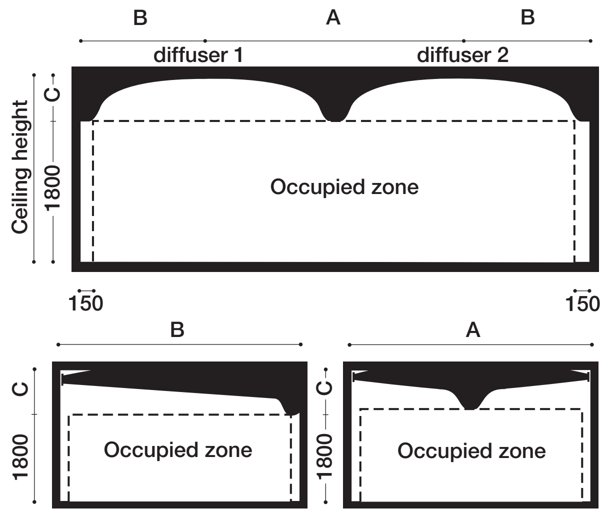


Fig. 12, Planning af mixed ventilation.

In order to avoid velocities more than 0,2 m/s in the occupied zone, the diffusers must be dimensioned so that the air throw $l_{0,2}$ has the right ratio to the distance A, B and C *(Figure 12)*. If there are two opposing diffusers the following formula must be observed.

$$0,75 \times \left(\frac{A}{2} + C\right) \le l_{0,2} \le \left(\frac{A}{2}\right) + C$$

In the case of a diffuser blowing towards a wall the following formula must be observed
$0,75 \times (B + C) \le l_{0,2} \le B + C$

If two or more diffusers with a parallel delivery of supply air (1-way or 2-way) are placed with a spacing A between them, which is less than b_h, the air throw increases in accordance with the following formula :

$$l_{0,2}\,(\text{corrected}) = K \times l_{0,2}$$

where K is the correctional factor to be read from *Figure 13*.

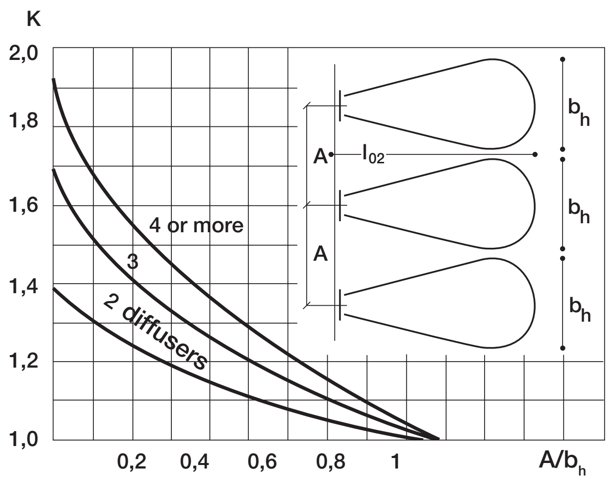


Fig. 13, Planning mixed ventilation

We reserve the right to make changes
2011-09-28

Lindab®

Mix ventilation

Theory

For nozzles and suspended diffusers with 1-way supply of air, the lift or drop of the jet as a consequence of heating or cooling supplied air can be read in *Figure 14*.

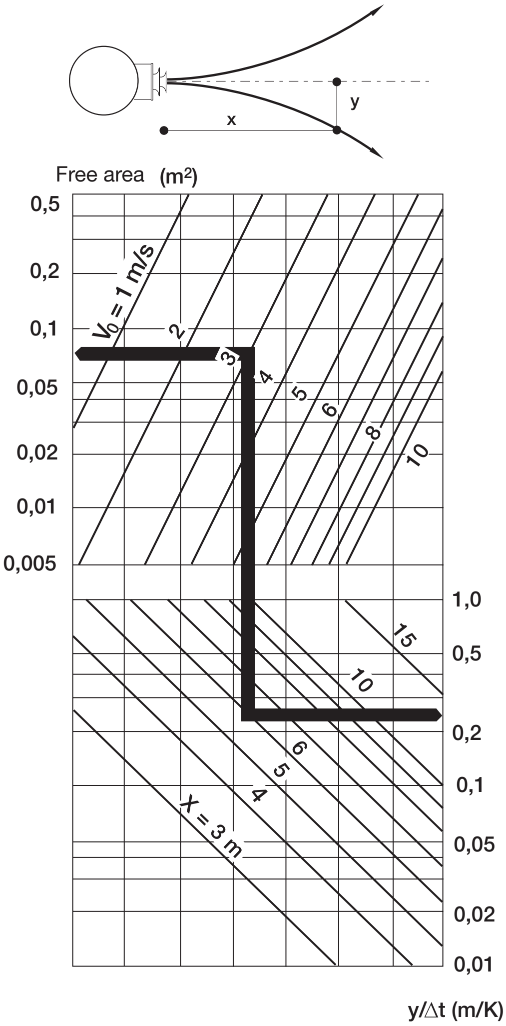


Fig. 14, Planning mixed ventilation.

<u>Example</u>

A nozzle has a free area of 0,075 m².

With an air volume of 756 m³/h a supplied air velocity of v_0 = 3 m/s ($v_0 = q / A_0$) is achieved.

Figure 14 has a thick horizontal line between A_0 = 0,075 m² and v_0 = 3 m/s.

By following the thick line straight down to x = 6 m and then horizontal to the right, the ratio between y (lift/drop) and Δt (temperature difference between supplied air and room air) can be read to be 0,24.

With a temperature difference of 10 K a lift/drop at y = 0,24 m/K × 10 K = 2,4 m at a distance of x = 6 m from the nozzle is achieved.

To avoid the jet being deflected by possible obstacles, the minimum distances in *Figure 15* must be observed.

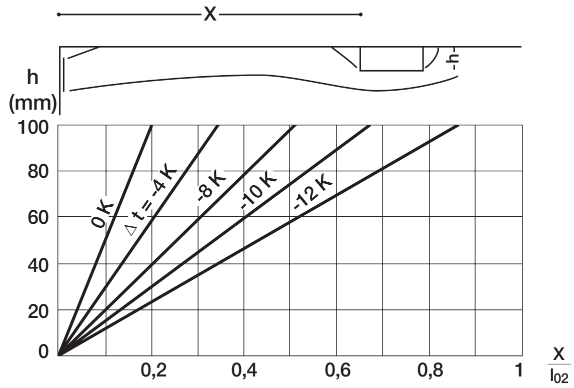


Fig. 15, Air throw $l_{0,2}$ for diffusers.

Mix ventilation

Theory

Heat loads in the room create upward convection flows, and in the same manner downward cold convection flows are created from the supplied air.

The calculated maximum velocity v_{term} in the occupied zone, which occurs due to thermal flows is shown in *Figure 16*. These flows depend on the heat load in the room (W/m²) in addition to the distribution of the supplied air (number of diffusers and jet pattern), but not of the impulse of the supplied air. Furthermore the velocity depends on the ceiling height.

The determination of the maximum velocity in the occupied zone is made by the help of an empirical model from the heat load (W/m²), number of diffusers (W/diffuser) and air pattern (1-, 2-, 3-, 4-way) at a ceiling height of 2,5 m.
If there is any doubt regarding a project, or special conditions need investigating, Lindab offers to test the conditions by conducting a full-scale test, which will often hold great value in the case of bigger and more complex constructional tasks.

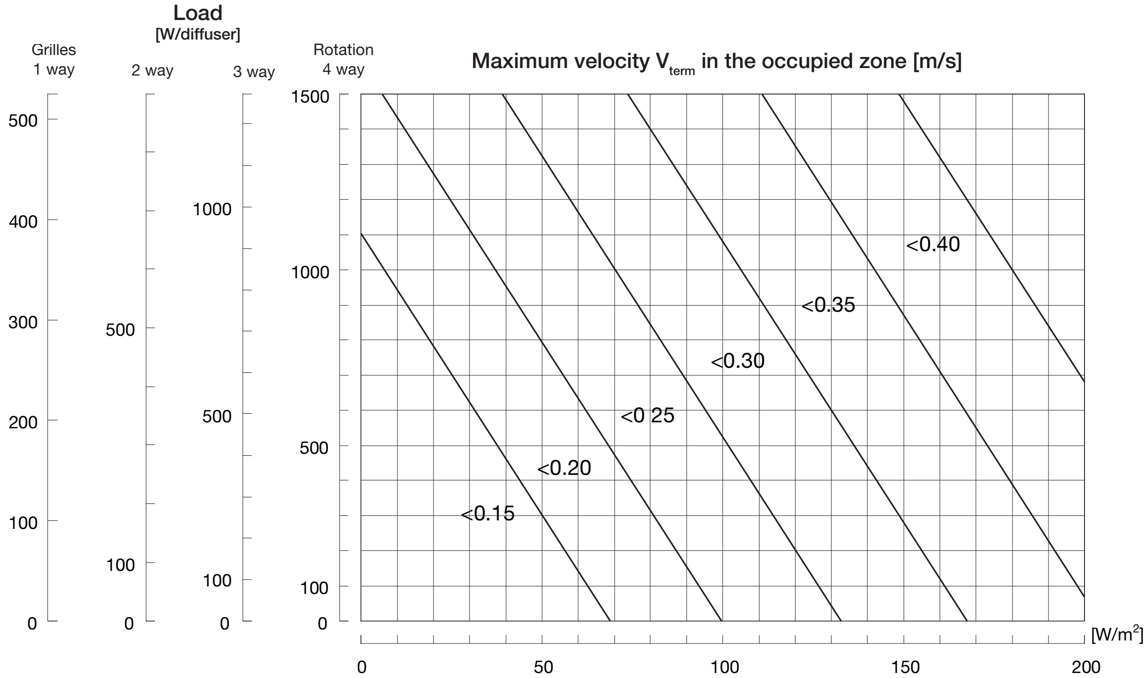


Fig. 16 a, Thermal maximum velocity in the occupied zone. The diagram is advisory and valid for ceiling heights of 2,5 m.

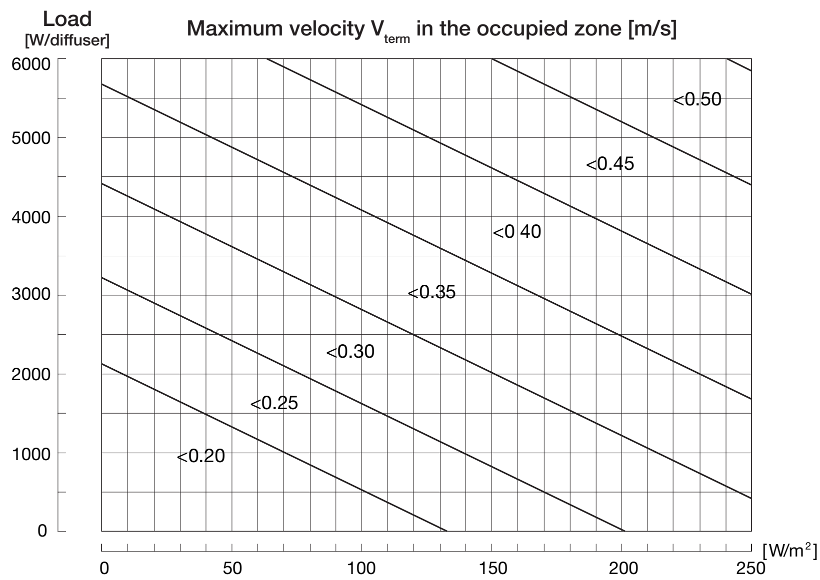


Fig. 16 b, Thermal maximum velocity in the occupied zone. The diagram is advisory and valid for ceiling heights > 4 m.

Mix ventilation

Theory

Calculation example

Room: L × B × H = 10 m × 6 m × 4 m

Thermal load:

10 pers., sitting activity (10 × 130 W)	= 1300W (22 W/m²)
10 table lamps of 60 W (10 × 60 W)	= 600 W (10 W/m²)
10 machines of 100 W (10 × 100 W)	= 1000 W (17 W/m²)
Total	= 2900 W (48 W/m²)

In order to achieve a satisfactory air quality in the room, the typical calculations determine that the ventilation should have a supply air of 4-10 l/s per person in addition to 0,4 l/s per m² floor area. If 10 l/s is used, the following necessary air volume can be calculated.

q_{min} =

10 persons × 10 l/s per person + 60 m² × 0,4 l/s per. m²

= 124 l/s

If the ventilation at the same time has to remove the collective heat load in the room, it is necessary to have a temperature difference Δt between the supply air and the room/ exhaust air.

Δt can be determined to be :

$$\Delta t = \frac{2900\ \text{W}}{\frac{124\ \text{l/s}}{1000\ \text{l/m}^3} \times 1{,}2\ \text{kg/m}^3 \times 1007\ \text{J/kg/K}} = 19{,}4\ \text{K}$$

Since Δt of almost 20 K is very likely to cause thermal discomfort, eg. due to drop from a ceiling diffuser, it is recommended to increase the air volume and use less Δt between supply and room temperature.

If Δt = 6 K is chosen the air volume can be determined to be :

$$q = \frac{2900\ \text{W}}{6\ \text{K} \times 1{,}2\ \text{kg/m}^3 \times 1007\ \text{J/kg/K}} \times 1000\ \text{l/m}^3 = 400\ \text{l/s}$$

Displacement ventilation Theory

Displacement ventilation

A displacement unit should add a certain amount of air to properly ventilate the room, and at the same time meeting the requirements for sound level, air velocity and temperature gradient in the occupied zone. In order to meet these requirements, planning guidelines are needed, and the most important ones are stated hereafter. When choosing a unit, the demands on pressure loss, sound level and air throw should be made clear. These data can be found for each individual product. The selection- and performance data shown in Lindabs catalogue is the result of measurements carried out in Lindabs laboratory and are all conducted with modern and accurate measuring devices. In practice the conditions are rarely as ideal as in a laboratory, since the constructional environments, furnishing, placement of the air distribution units etc. has a great influence on the jet pattern spread in the room. Lindab attempts to test the conditions in practice by carrying out full-scale testing, which is often very valuable in the case of bigger and complicated tasks.

Descriptions

$a_{0,2}$	Width of near-zone	[m]
$b_{0,2}$	Length of near-zone	[m]
ε_t	Temperature efficiency	[-]
K_{ok}	Octave Correction value for sound power level	[dB]
L_A	A-balanced sound pressure level	[dB(A)]
L_{WA}	A-balanced sound power level	[dB(A)]
L_{Wok}	Sound power level in octave bands	[dB]
L_p	Sound pressure level	[dB]
L_w	Sound power level	[dB]
ΔL	Sound attenuation	[dB]
D	Room attenuation	[dB]
Δp_t	Total pressure	[Pa]
q	Air flow	[m³/h], [l/s]
t_i	Supply air temperature	[°C]
t_r	Room temperature (1,1 m over the floor)	[°C]
t_u	Exhaust air temperature	[°C]
Δt	Temperature difference between room air and supply air	[K]
v_x	Velocity at distance x from the centre of the unit	[m/s]

Vertical temperature distribution

Due to the stratified flow, displacement ventilation causes a big difference in temperature throughout the room. In comfort ventilation, where the heating sources are placed in the bottom part of the room, the temperature gradient, meaning the temperature rise per m (K/m) will be bigger in the lower part of the room, and smaller in the upper part.
The simplest models for description of the vertical temperature distribution are the so-called "%-rules".
The most used one is the 50%-rule, in which it is assumed, that half of the temperature rise from supply air to exhaust air occurs at the floor, and the other half occurs up throughout the room *(see Figure 17)*. The model is a good one, as a first evaluation of the most typical rooms and units, but because of the simplicity it does not precise determine the temperature gradient in the occupied zone.
Lindab recommends the use of a more detailed model instead. One that describes the variation of the temperature gradient up through the room. A close assumption is that the temperature gradient in the occupied zone is half of the temperature difference between the room air and the supply air. The model is based on a number of full scale tests, and factors in the temperature efficiency and the fact that the temperature gradient is larger in the lower part of the room than in the upper part.

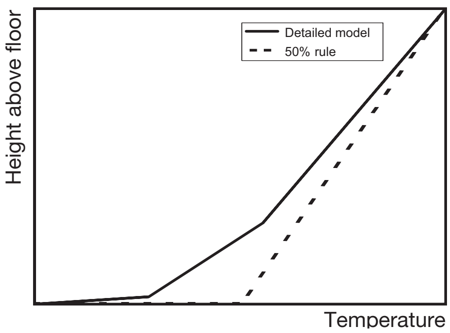


Fig. 17, Comparison of models for description of the vertical temperature distribution

Temperature efficiency

The efficiency in displacement ventilation is due to the stratification. The difference is increased at larger ceiling heights. The effect taken from the room is proportional to the temperature difference between supply air and exhaust air (t_u-t_i).
Since the exhaust temperature (t_u) is higher than the room temperature (t_r) in displacement ventilation, the same effect can be taken from the room at a higher supply air temperature (t_i) than with mixed ventilation, where $t_u \leq t_r$. This means that cooling effect can be spared, or that it is possible to use the cooling effect of the outer air more efficiently.
Displacement ventilation is furthermore partly self-regulating at varying thermal loads, because a rising load first and foremost will give a higher temperature gradient and consequently a higher temperature at the ceiling.
The temperature efficiency is given at:

$$\varepsilon_t = \frac{t_u - t_i}{t_r - t_i} \times 100\%$$

With displacement ventilation it is the case that ε_t > 100% ($t_u \geq t_r$),
while $\varepsilon_t \leq$ 100% at mixed ventilation ($t_u \leq t_r$).
By ideal mixing ε_t = 100% ($t_u = t_r$).

Pressure loss

The diagrams show the total pressure loss for the unit (at ρ = 1,2 kg/m³), meaning the sum of static and dynamic pressure, connected to a straight air duct with a length of 1 m and the same dimension as the diffuser.

Sound level

The diagrams show the A-balanced sound power level L_{WA} for a diffuser connected with a straight air duct with a length of 1 m and the same dimensions as the diffuser.
Sound pressure level is a measurement of the result of the sound, ie. the pressure vibrations we perceive, while the sound power level is a parameter to characterize the source of the sound. Both are normally noted in the unit dB (decibels), which can cause some confusion.

Displacement ventilation Theory

Sound pressure (Lp)
Is a measure of the intensity of the sound, characterized by pressure vibrations, perceived by the ear or measured with a microphone on a noise meter. Sound pressure is measured in Pascal (Pa) and is usually noted as sound pressure level in decibels (dB) or dB(A).

Sound power (Lw)
The power, a sound source (eg. a machine) sends out in the form of a sound. The sound effect is measured in Watt (W) and is usually noted as sound effect level in decibels (dB) or dB(A).

In Lindabs catalogue sound properties of the units are named sound power level.

Sound power level: $L_W = 10 \times \log \frac{N}{N_{re}}$ [dB]

where N is the actual sound power [W], which is sent out in the shape of pressure vibrations and $N_{re} = 10^{-12}$ W is the reference sound power.

Sound pressure level: $L_P = 20 \times \log \frac{P}{P_{re}}$ [dB]

where p is the actual sound pressure [N/m^2] and $p_{re} = 2 \times 10^{-5}$ N/m^2 which is the reference sound pressure.

Room attenuation D [dB] is the difference between sound power level and sound pressure level. $L_{wok} = L_W - D$

The A-balanced sound power level, L_{WA} is calculated to sound power level in the individual octave bands by :

$L_P = L_{WA} + K_{ok}$,

K_{ok} being a correctional value. K_{ok} is specified in tabular form for each individual unit.

Sound attenuation

Specified for each individual diffuser, the reduction of sound power level from air duct to room (including end reflection).

Near-zone

The area around the unit, where the air velocity is above 0,2 m/s, is referred to as the near-zone.
The size of the near-zone is specified for each unit at a cooling temperature of $\Delta t = t_r - t_i = 3K$.
The near-zone length (a_0) and – width (b_0) is valid for evenly distributed thermal loads.

Dimensioning displacement ventilation

To plan a ventilation system by displacement principle, which "works" on the basis of thermal powers, and where the supply air is added directly to the occupied zone, makes special demands on dimensioning and placement of the air distribution units. They should, as such, never be placed directly by a powerful heating source, like a radiator. Powerful sunlight can also disturb the system, and in some cases make it function as a mixed ventilation system. Large, cold walls - or window surfaces in the room can also cause a back-flow of contaminated air to the occupied zone.

The system is not suitable for heating purposes, and consequently requires heating and ventilation to be separate. Exhaust should always take place as high up in the room as possible.
If in any doubt about a project, or if there are any points to be analysed, Lindab offers to test the conditions in practice by conducting full-scale tests, which is often of great value, at bigger and complicated tasks.

Convection flow

The supplied air flow should at least be the same as the total convection flow in the room *(Figure 18)*. If the supplied air flow is less than this the convection flow will draw contaminated air from above down into the occupied zone *(Figure 19)*.
The following factors affect the convection flow:

- The shape and surface of the heat source
- The surface temperature of the heat source
- Convective proportion of the heating output emitted
- Mean temperature of the room
- The level of the contaminated zone in relation to the level of the heat sources in the room

The convection flow from people, lighting, and machinery can be determined from the output and the placement of the heat sources in the room *(see Table 1 and Table 2)*.

Table 1, Convection flows for people based on experiences

Activity	met	Heat outputW	airflow l/s 1.2 above floor	1.8 above floor
Sitting, relaxing	1,0	100	8-10	-
Sitting activity	1,2	130	10-12	-
Light act., standing	1,6	170	-	25-30
Medium act.,standing	2,0	200	-	30-35
High act. standing	3,0	300	-	35-40

Met: metabolism, 1 met = 58 W/m^2 body surface.

Table 2, Convection flows for various heat sources.

Heating source	Airflow l/s pr. W 1.2 above floor	1.8 above floor
Table lamps	0,10	0,20
Ceiling lights	-	-
Machines	0,10	0,20
Sunlight	0,11	0,22

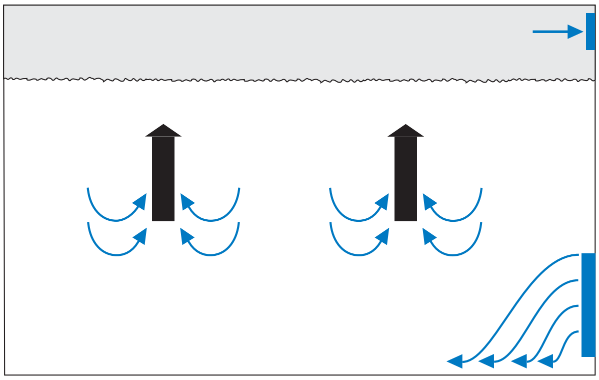


Fig. 18, Displacement ventilation with sufficient air flow.

Displacement ventilation Theory

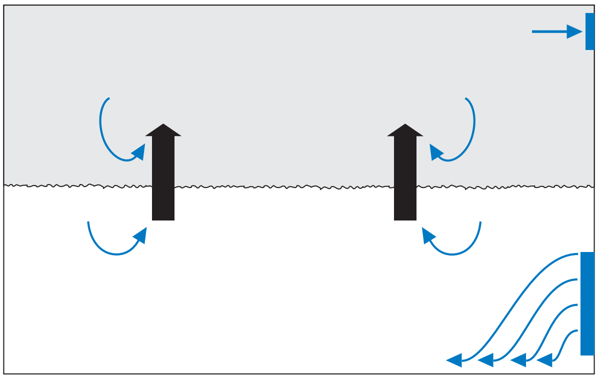


Fig. 19, Displacement ventilation with insufficient air flow.

Temperature gradient

The demands made on thermal comfort in the occupied zone places a limit on the size of the temperature gradient. *Table 3* show the maximum gradient recommended by Lindab Comfort at various levels of activity.
Further more the corresponding maximum cooling temperature (t_r-t_i) is mentioned when using Lindabs COMDIF-units. The temperature gradient in the occupied zone (K/m) can with a small margin be set at half of the cooling temperature t_r-t_i (K).

Table 3, Recommended temperature gradients and cooling temperatures

Activity	Max. temperature gradient (K/m)	Max. undertemperature t_r-t_i (K)
Sitting, relaxing	1,5	3,0
Sitting activity	2,0	4,0
Light act., standing	2,5	5,0
Medium activity	3,0	6,0
High activity	3,5	7,0

Near-zone

The size of the near-zone is specified for each unit in the catalogue. If several units are placed close to one another, the near-zone will increase *(Figure 20)*.

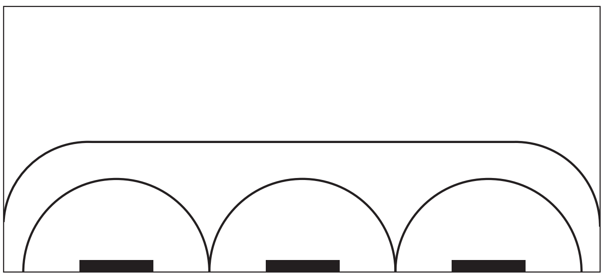


Fig. 20, Diffusers placed too close, limiting the individual diffusers induction.

A big air flow from one unit can result in a too big near-zone *(Figure 21)*. If the air is instead distributed on two units, smaller near-zones are the result. *(Figure 22)*.
To achieve the smallest possible near-zones, and thus the best possible use of the room, the air flow should be distributed evenly in the room with as many units as possible.

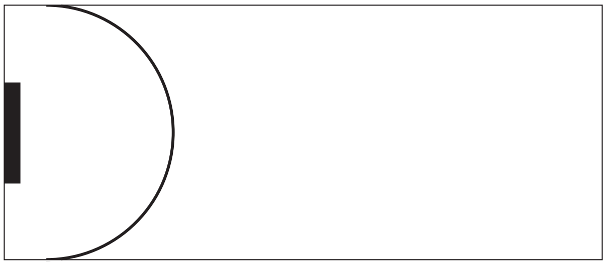


Fig. 21, Too great air flow on one diffuser results in a too big near zone.

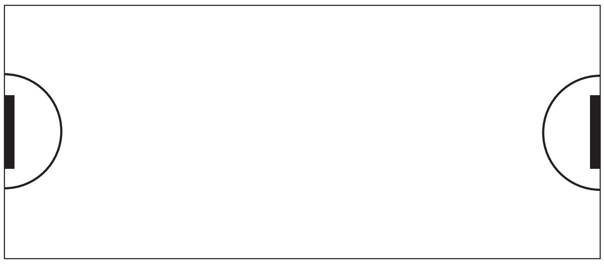


Fig. 22, Less air flow per diffuser and smaller near zones.

More units

When several units are placed too close to one another by the same wall, the near-zone is increased as shown in *Figure 20*, since jet streams can form between the units. In a certain distance from the units however, a continuous jet flow will be formed with a near constant velocity. This end-velocity is dependent on the total airflow per m wall and the cooling temperature. In *Figure 23* this end-velocity can be read. It will often be an advantage to distribute the air on units placed on adjacent walls at a 90 degree angle. In this case, the units should also be placed evenly along the walls, since of course jets also form between too closely placed units around the corner of a wall.

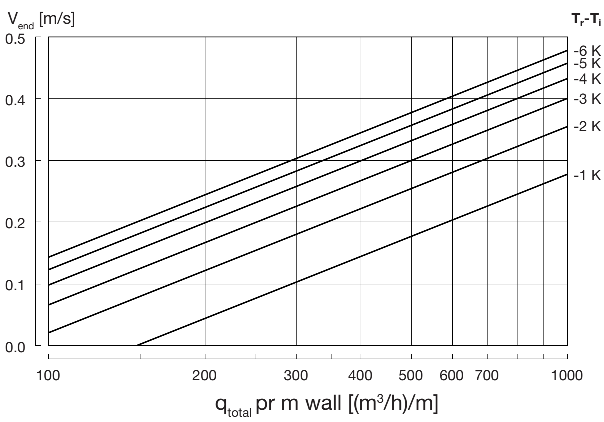


Fig. 23, End velocity at continuous jet flow.

Displacement ventilation Theory

Output

In order to calculate the output which can be removed from the room by a displacement system, the temperature difference t_u-t_i, has to be known (depends on the thermal load, ceiling height and cooling temperature (t_r-t_i)).

By calculating the temperature efficiency and the necessary difference in temperature t_u-t_i the heating sources close to the ceiling (eg. lighting) are accounted for by 50% of the output.

From *Figure 24* the temperature efficiency ε_t can be read at different combinations of ceiling height and heat loads.

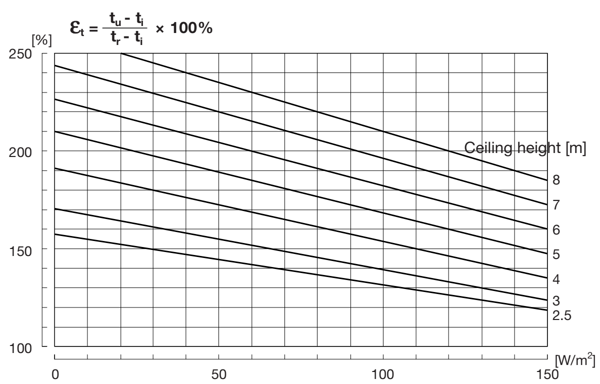


Fig. 24, Temperature efficiency is dependent on ceiling height and heat load.

Calculation example

Room: L × B × H = 10 m × 6 m × 4 m

Thermal load:

10 pers., sitting activity (10 × 130 W)	= 1300W (22 W/m²)
10 table lamps of 60 W (10 × 60 W)	= 600 W (10 W/m²)
10 machines of 100 W (10 × 100 W)	= 1000 W (17 W/m²)
Total	= 2900 W (48 W/m²)

Minimum air flow *(from Table 1 and Table 2)*:
q_{min} = 10 pers. × 11 l/s/pers. + 10 table lamps × 60 W/table lamps × 0,1 l/s/W + 10 machines × 100 W/machines × 0,1 l/s/W = 270 l/s

Required temperature difference (t_u-t_i):

$$t_u - t_i = \frac{2900\ W}{\frac{270\ l/s}{1000\ l/m^3} \times 1,2\ kg/m^3 \times 1007\ J/kg/K} = 8,9\ K$$

From *Figure 24* the temperature efficiency can be read at ε_t = 178% by a ceiling height of 4 m and a heat load of 48 W/m².
Consequently the temperature difference t_r-t_i can be determined by using the formula:

$$\varepsilon_t = \frac{t_u - t_i}{t_r - t_i} \iff t_r - t_i = \frac{t_u - t_i}{\varepsilon_t} = \frac{8,9\ K}{1,78} = 5\ K$$

which gives a temperature gradient in the occupied zone of 2,5 K/m (since the temperature gradient in the occupied zone can be set to the half of the cooling temperature t_r-t_i).

Lindab recommends a temperature gradient of <2 K/m and therefore the air flow should be increased.

A temperature gradient of 2 K/m gives t_r-t_i = 4 K and with unchanged temperature efficiency of 178% the acceptable temperature difference is t_u-t_i = 7,1 K.

To remove the thermal load of 2900 W the air flow must be changed to:

$$q = \frac{2900\ W}{7,1\ K \times 1,2\ kg/m^3 \times 1007\ J/kg/K} \times 1000\ l/m^3 = 337\ l/s$$

Planning of sound level

Theory

Planning sound level

The diagrams in the catalogue specify the A-weighted sound effect level L_{WA} for diffusers connected to a straight air duct with a length of 1 m and the same dimension as the diffuser.
The actual sound pressure level that we hear is determined as shown below.

Key

A	Total room absorption	[m²]
K_{ok}	Octave correction value for sound power level	[dB]
L_A	A-balanced sound pressure level	[dB(A)]
L_{WA}	A-balanced sound power level	[dB(A)]
L_{Wok}	Sound power level in octave bands	[dB]
L_p	Sound pressure level	[dB]
D	Room attenuation	[dB]
L_w	Sound power level	[dB]
V	Room volume	[m²]
T_s	Reverberation time	[-]
D	Room attenuation	[dB]
Q	Direction factor	[-]
Δ	Increase in sound power level at a given number of identical units	[dB]
r	Distance to closest unit	[m]
α	Absorption factor	[-]
n	Number of units	[-]

Sound pressure level

The collective sound effect L_W from a number of similar diffusers is found through a logarithmic multiplication of the number of diffusers with the sound power level from an individual diffuser

$L_W = L_{W1} \otimes n$

where L_{w1} is the sound power level from an individual diffuser [dB] and n is the number of diffusers.
The collective sound power can, by help of *Figure 25* be calculated as $L_W = L_{W1} + \Delta$ where Δ is the increase of sound power level for a given number of identical diffusers.

n	1	2	3	4	5	6	7	8	9	10	15
Δ	0	3.0	4.8	6.0	7.0	7.8	8.5	9.0	9.0	10.0	11.8

Fig. 25, Increase of sound power level (logarithmic multiplication) by a number of identical sound sources

With the knowledge of the sound sources and the absorption area of the room, the attenuation of the room is determined by *Figure 26*, *Figure 27 and Figure 28* at one or several identical sound sources in the room.
The actual sound pressure level is the difference between the sound power level and the room attenuation where L_p is the sound pressure level [dB], L_W is the sound power level [dB] and D is the room attenuation [dB].
In the case of different sound sources in the same room, the sound pressure level is found at a given point by a logarithmic addition of the sound pressure levels for the individual sound sources (Figure 29).

A can also be calculated from reverberation time by using the formula:

$$A = 0.16 \times \frac{V}{T_s}$$

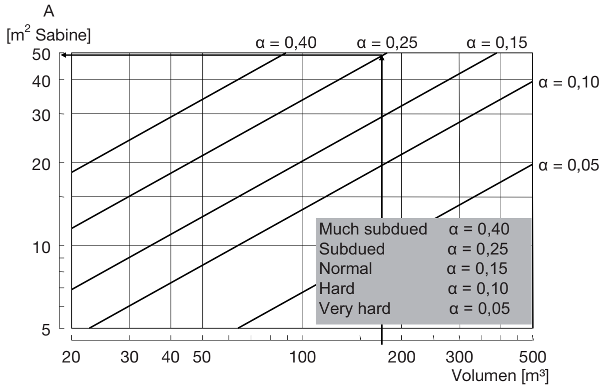


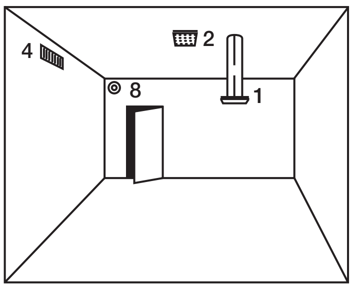
Fig. 26, Direction factor for different placements of sound sources and the relationship between the room volume and equ lent sound-absorption area

Calculation example

In a room with the dimensions L × B × H = 10 m x 7 m x 2,5 m four diffusers are mounted in the ceiling. Each diffuser gives off a sound power level of 29 dB(A). The room is attenuated, which gives an absorption area of A ~ 50 m² Sabine *(Figure 26)*. The sound pressure level needs to calculated 1,5 m above the floor.
Sound power from the four diffusers: $L_W = 29 \otimes 4 = 29 + 6 = 35$ dB(A) *(Figure 25)*
For diffusers mounted in the ceiling the direction factor Q = 2 and consequently becomes *(Figure 27)*.

$\sqrt{n} / \sqrt{Q} = 1,4$

At the height of 1,5 m over the floor the distance to the closest diffuser is r = 1 m, and therefore the room attenuation can be determined to be D = 9 dB via. *Figure 28*.
The sound pressure level in the room: L_A = 35 dB(A) - 9 dB = 26 dB(A).



n	1	2	3	4	5	6	7	8	9	10	15
Q					√n / √Q						
1	1.0	1.4	1.7	2.0	2.2	2.4	2.6	2.8	3.0	3.2	3.9
2	0.7	1.0	1.2	1.4	1.6	1.7	1.9	2.0	2.1	2.2	2.7
4	0.5	0.7	0.9	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.9
8	0.4	0.5	0.6	0.7	0.8	0.9	0.9	1.0	1.1	1.1	1.4

Fig. 27, Direction factor for different placements of sound sources and the ratio between √n / √Q as a function of number of sound sources and direction factor (picture).

Planning of sound level

Theory

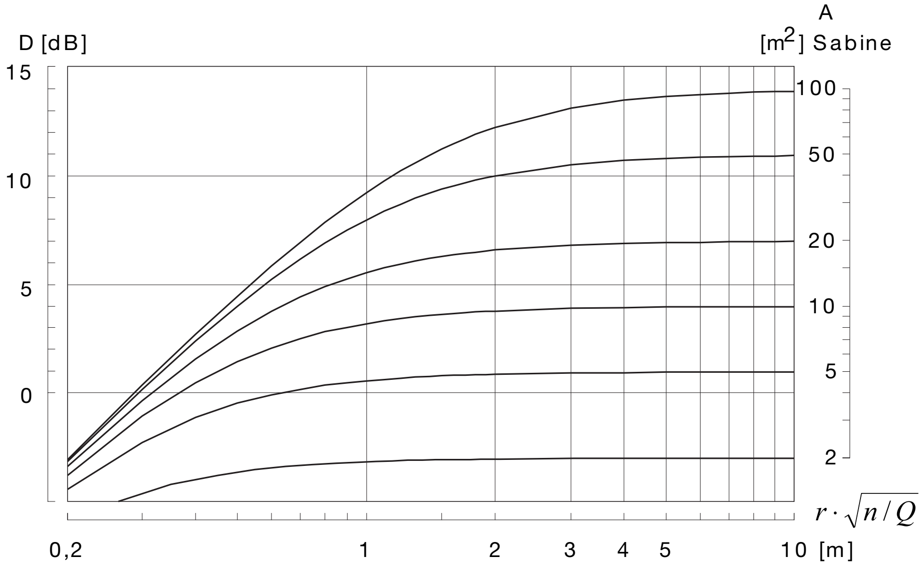


Fig. 28, Room dampening as a function of area of absorption and number of sound sources.

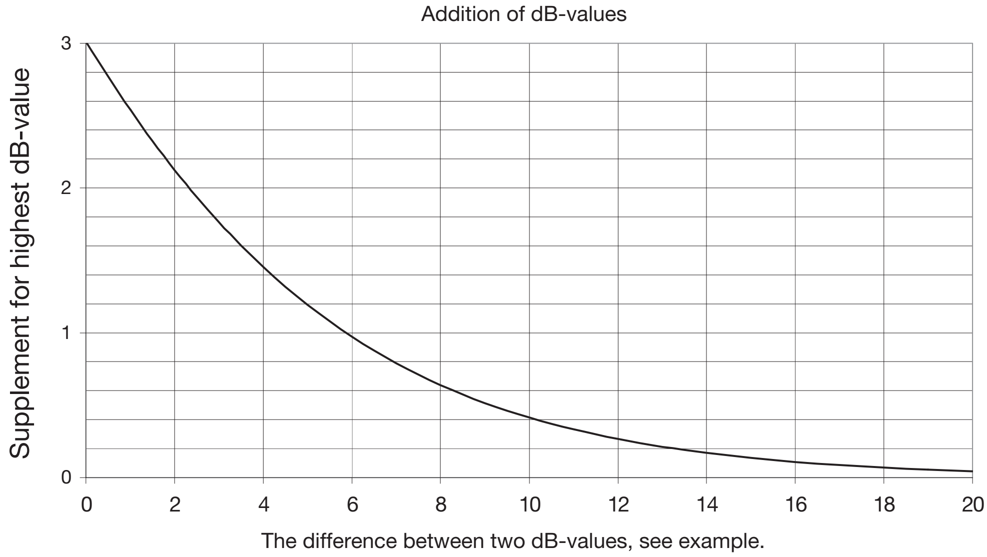


Fig. 29, Addition of sound levels (logarithmic addition of sound effect level or sound pressure level).

E.g. two sources at 41 dB and 47 dB;
difference is 47 - 41 = 6 ;
from graph: 6 on X-axis = 1 on Y-axis;
47 + 1 = 48 dB resultant level.

Multi-cone diffuser FKD

Description

FKD is an adjustable circular multi-cone diffuser, which is typically used for supply air. The diffuser can be switched between horizontal and vertical supply air and is therefore ideal for the supply of both heated and cooled air.
Installing an FKD diffuser up to size 400 in a plenum box type MB can help to achieve a stable airflow to the diffuser as well as realise the potential for individual adjustment.
Damper type B is an unique linear cone damper which allows to use the full operational area (0-100%) and allows to balance with a high pressure drop over the box with low sound generation. Furthermore the construction of the damper gives an accurate and reliable measurement.
Damper type C has a rotating blade damper for supply air. Typically used in applications that don't require a high balancing pressure in the plenum box.

- Suitable for supply air
- Vertical or horizontal supply air pattern
- Plenum box with several damper options

Maintenance

The multi-cone insert can be removed to enable cleaning of internal parts or to gain access to the duct or box. The visible parts of the diffuser can be wiped with a damp cloth.

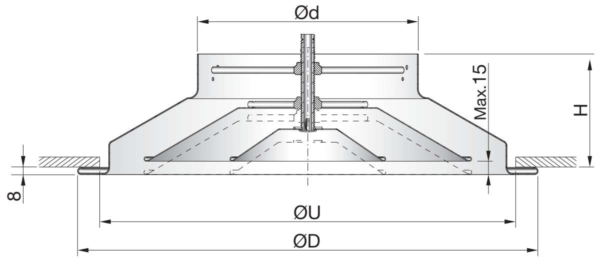
Order code

Product	FKD - aaa
Type	
FKD	
Connection dim.	
Ø160-630	

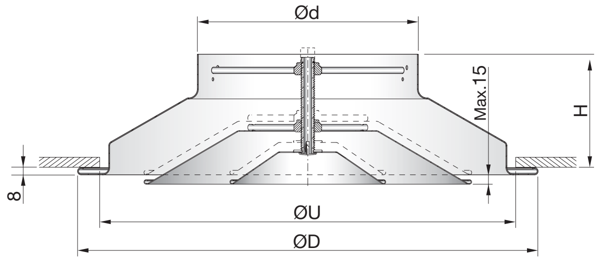
Example: FKD-200

Dimensions

Vertical



Horizontal



FKD Ød mm	ØD mm	H mm	ØU* mm	Free area A Vertical m²	Free area A Horizontal m²	m kg
160	335	97	288	0,0298	0,0304	0,7
200	423	110	370	0,0431	0,0456	0,9
250	517	122	461	0,0622	0,0684	1,2
315	640	138	576	0,091	0,1041	1,8
355	730	177	656	0,1108	0,1293	2,6
400	776	177	700	0,1349	0,1606	3,1
450	825	177	755	0,1637	0,199	3,4
500	917	177	825	0,1948	0,241	4,3
630	1045	177	963	0,285	0,3667	7,4

ØU* = Cutting dimension

Number of cones: size 160–355 : 2
size 400-500 : 3
size 630 : 4

Materials and finish

Material: Aluminium
Standard finish: Powder-coated
Standard colours: RAL 9003 and RAL 9010, gloss 30

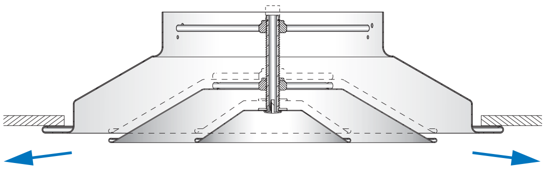
The diffuser is available in other colours. Please contact Lindab's sales department for further information.

Multi-cone diffuser FKD

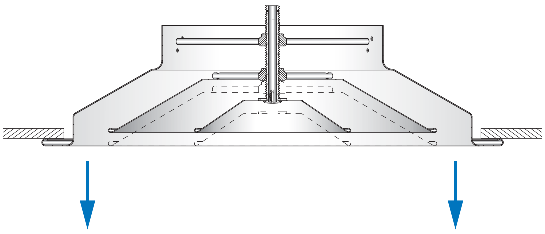
Dispersal patterns

FKD is supplied for vertical supply air as standard. The dispersal pattern can be altered to horizontal supply air by setting the inner part of the diffuser to its lowest position.

Horizontal

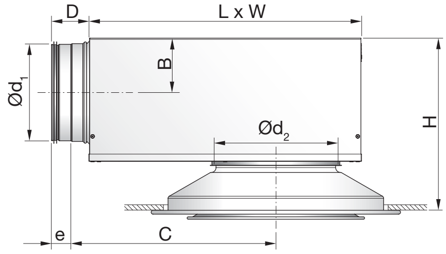


Vertical



Accessories

FKD + MB Plenum box

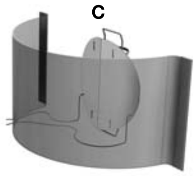


Ød1	Ød2	B	C	D	e	H*	L	W
mm		mm						
100	160	62	245	78	40	221 - 243	310	260
125	160	75	291	78	40	246 - 268	376	310
125	200	75	291	78	40	257 - 281	376	310
160	160	92	352	78	40	280 - 302	459	380
160	200	92	352	78	40	291 - 315	459	380
160	250	92	352	78	40	305 - 327	459	380
200	200	112	425	78	40	332 - 356	565	460
200	250	112	425	78	40	346 - 368	565	460
200	315	112	425	78	40	363 - 384	565	460
250	250	137	514	118	60	396 - 418	698	540
250	315	137	514	118	60	413 - 434	698	540
250	400	137	514	118	60	440 - 473	698	540
315	315	170	675	118	60	478 - 499	858	540
315	400	170	675	118	60	505 - 538	858	540

Damper options

B-S

C



Order code

Product MB a bbb ccc S

Type
MB

Damper
B = Linear cone damper
C = Blade damper supply

Duct connection Ød1
Ø100-315

Diffuser dimension Ød2
Ø160-400

Function (Only for B damper)
S = Supply air

Example 1: FKD-200+MBB-160-200-S
Example 2: FKD-200+MBC-160-200

Multi-cone diffuser

FKD

Technical data

Following FKD+plenum box data are valid for MBB-S.
For MBC data, go to www.lindQST.com .

Capacity

Air flow q_v [l/s] and [m^3/h], total pressure Δp_t [Pa], throw $l_{0.2}$ [m] and sound power level L_{WA} [dB(A)] can be seen in the diagrams.

Throw $l_{0.2}$

Throw $l_{0.2}$ [m] can be seen in the diagram for isothermal air at a speed of 0.2 m/s.

Frequency-related sound power level

The sound power level in the frequency band is defined as $L_{wok} = L_{WA} + K_{ok}$. K_{ok} values are specified in charts beneath the diagrams on the following pages. K_{ok} values for FKD without a box can be found in a separate supplement.

Sound attenuation

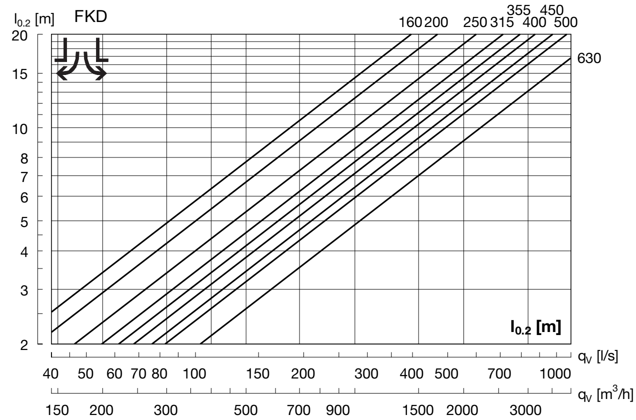
Sound attenuation of the diffuser ΔL from duct to room, including end reflection, see table below.

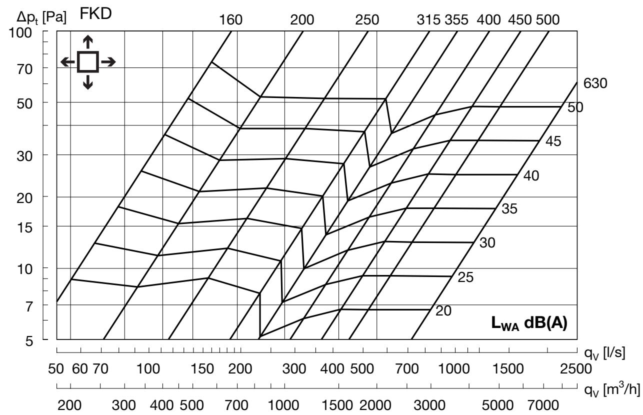
FKD + MBB-S		Centre frequency Hz							
duct Ød$_1$	FKD Ød$_2$	63	125	250	500	1K	2K	4K	8K
100	160	20	16	5	15	17	17	16	19
125	160	13	13	8	19	13	16	16	19
125	200	15	11	6	15	12	14	16	17
160	160	16	17	10	18	17	18	20	21
160	200	15	14	7	19	15	16	18	19
160	250	17	16	4	16	15	16	16	18
200	200	13	10	6	15	18	15	19	17
200	250	13	9	4	12	17	13	17	16
200	315	13	8	3	8	16	14	16	15
250	250	14	8	8	15	17	17	17	18
250	315	13	6	5	13	15	15	16	17
250	400	12	4	3	12	13	14	14	15
315	315	7	9	8	12	17	16	17	21
315	400	7	8	7	11	16	14	16	19

Balancing

Balancing data is contained in a separate brochure.

Horizontal





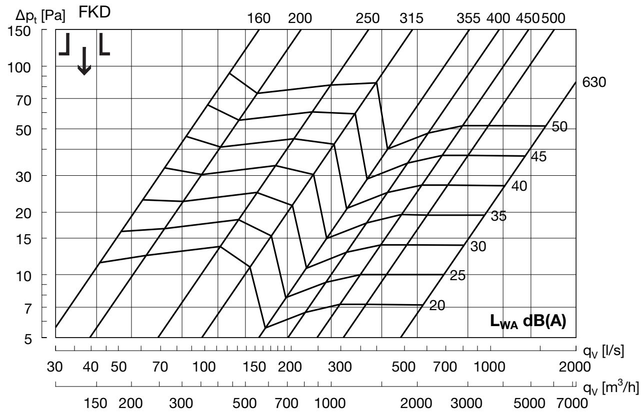
Multi-cone diffuser FKD

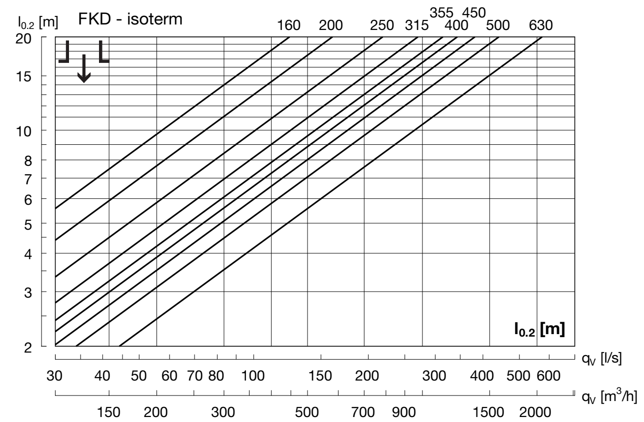
Technical data

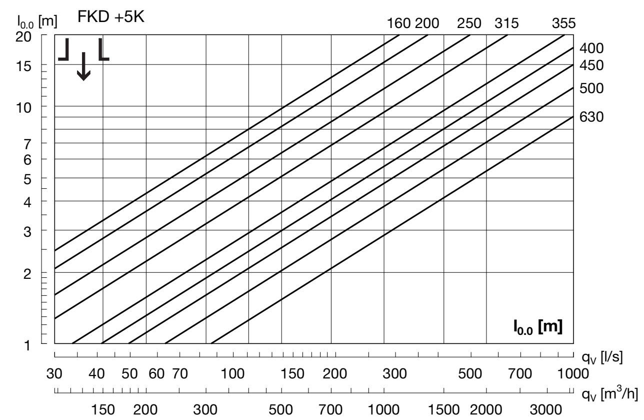
Throw $l_{0.2}$ / turning point $l_{0.0}$

Throws $l_{0.2}$[m] can be seen in the diagrams for isothermal air at a speed of 0.2 m/s. Turning point $l_{0.0}$ [m] can be seen in the diagrams for heated air, +5 K, +10 K respectively.

Vertical



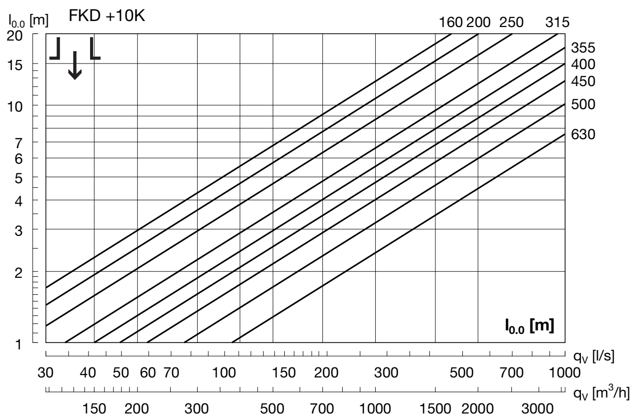




Vertical supply air correction sound power level (L_{WA}) and pressure loss (Δp_t)

On the following pages you can find diagrams for all sizes FKD+MBB-S horizontal supply air. When Vertical supply air values are wanted, use the correction factors in the table below.

FKD + MBB-S		Vertical supply air	
duct	FKD	Correction factor	
$Ød_1$	$Ød_2$	L_{WA}	Δp_t
100	160	3	x 1,2
125	160	1	x 1,2
125	200	1	x 1,1
160	160	5	x 1,5
160	200	3	x 1,3
160	250	0	x 1,1
200	200	1	x 1,3
200	250	5	x 1,2
200	315	0	x 1,1
250	250	1	x 1,3
250	315	2	x 1,3
250	400	1	x 1,1
315	315	4	x 1,4
315	400	3	x 1,2

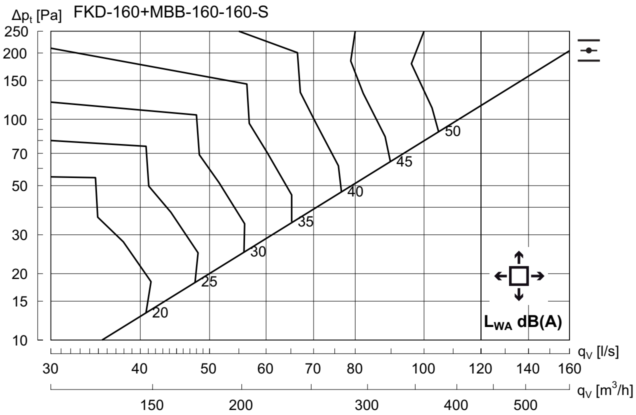


We reserve the right to make changes without prior notice
30-03-2017

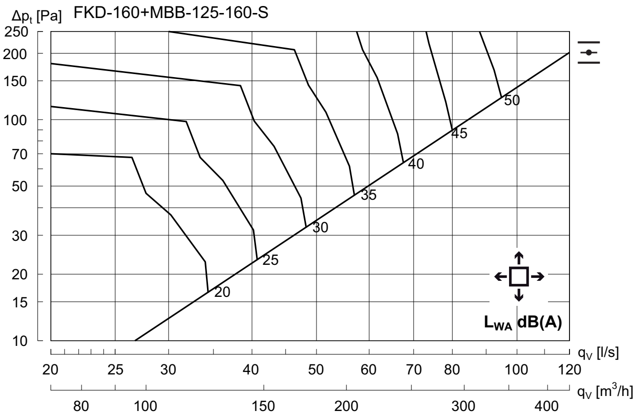
Multi-cone diffuser FKD

Technical data

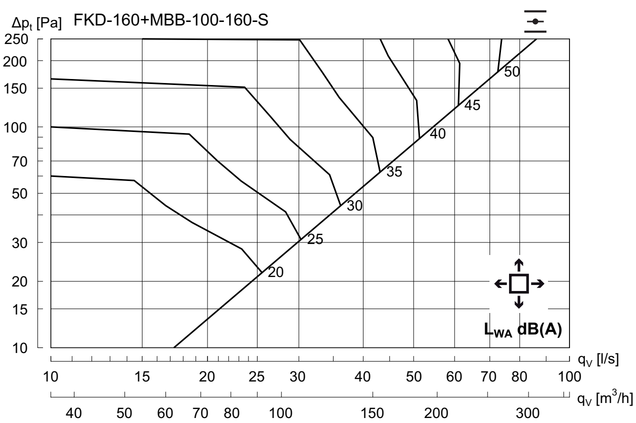
FKD 160 + MBB-S Horizontal



Hz	63	125	250	500	1K	2K	4K	8K
K_{ok}	11	7	0	-6	-4	-9	-22	-31

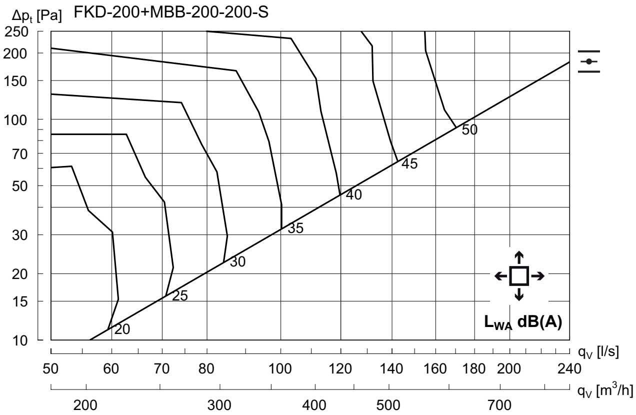


Hz	63	125	250	500	1K	2K	4K	8K
K_{ok}	10	5	2	-5	-5	-9	-18	-25

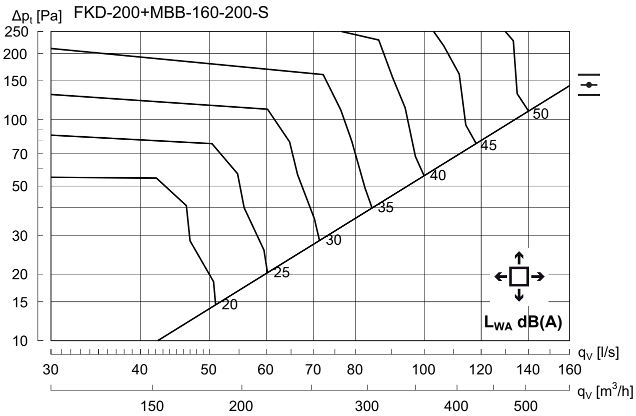


Hz	63	125	250	500	1K	2K	4K	8K
K_{ok}	9	4	2	-3	-5	-9	-16	-22

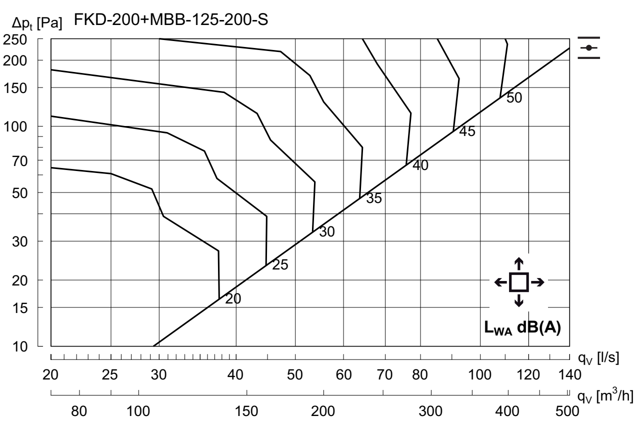
FKD 200 + MBB-S Horizontal



Hz	63	125	250	500	1K	2K	4K	8K
K_{ok}	13	5	-2	-5	-3	-12	-22	-28



Hz	63	125	250	500	1K	2K	4K	8K
K_{ok}	11	5	1	-5	-4	-11	-20	-25

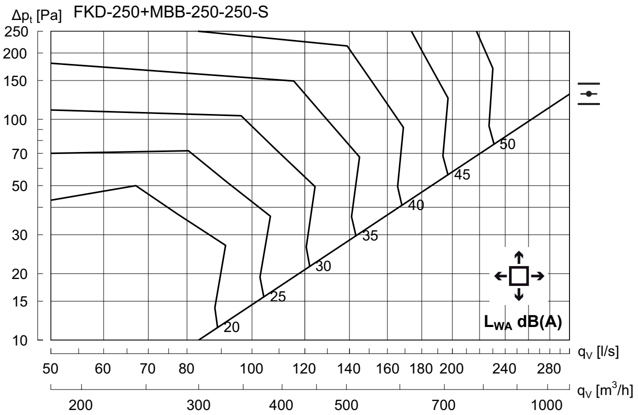


Hz	63	125	250	500	1K	2K	4K	8K
K_{ok}	11	4	1	-4	-4	-10	-16	-23

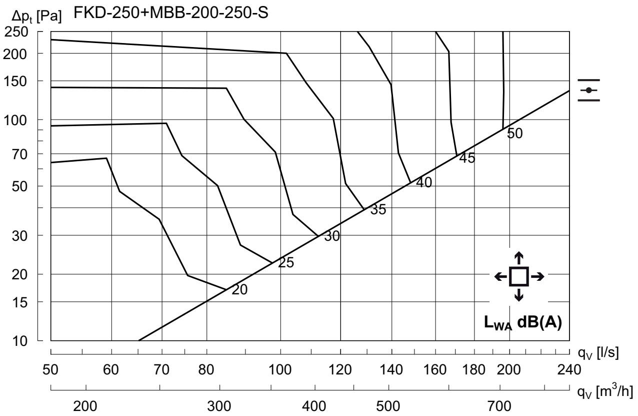
Multi-cone diffuser FKD

Technical data

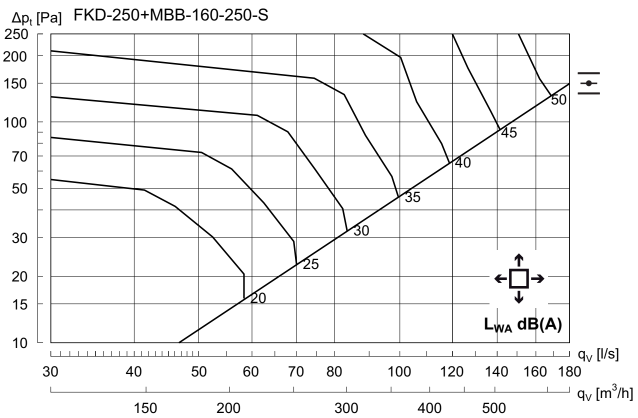
FKD 250 + MBB-S Horizontal



Hz	63	125	250	500	1K	2K	4K	8K
K_{ok}	12	5	-2	-4	-3	-13	-20	-26

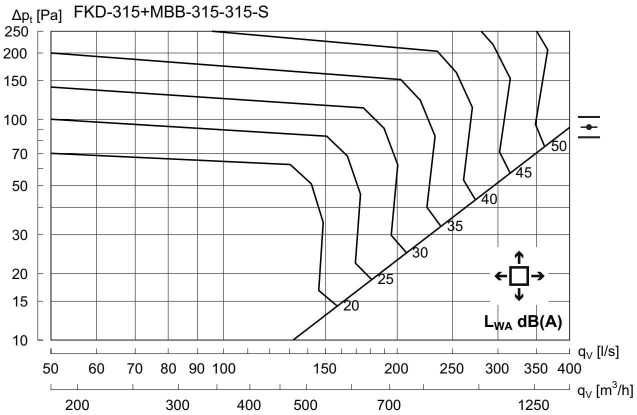


Hz	63	125	250	500	1K	2K	4K	8K
K_{ok}	11	5	-2	-3	-3	-12	-19	-24

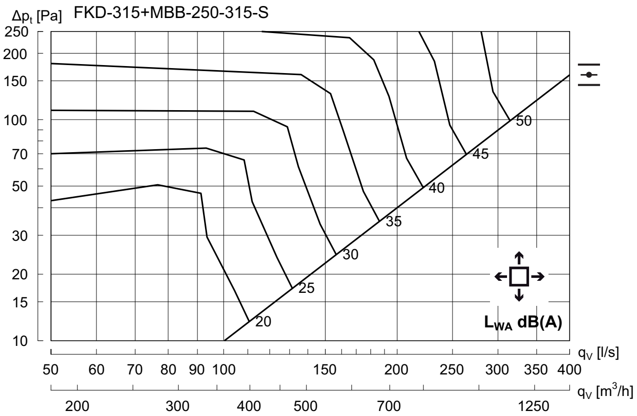


Hz	63	125	250	500	1K	2K	4K	8K
K_{ok}	12	4	0	-3	-4	-12	-18	-24

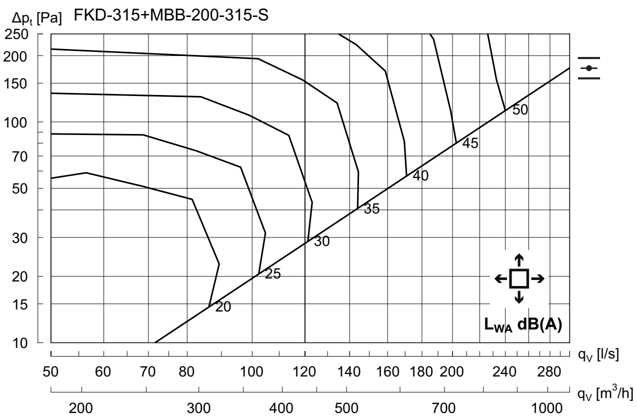
FKD 315 + MBB-S Horizontal



Hz	63	125	250	500	1K	2K	4K	8K
K_{ok}	14	3	0	-2	-4	-14	-20	-26



Hz	63	125	250	500	1K	2K	4K	8K
K_{ok}	12	5	-1	-2	-4	-12	-19	-21

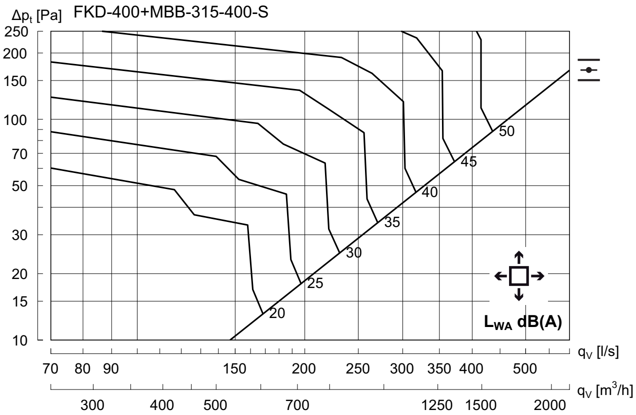


Hz	63	125	250	500	1K	2K	4K	8K
K_{ok}	9	5	-1	-2	-5	-11	-18	-24

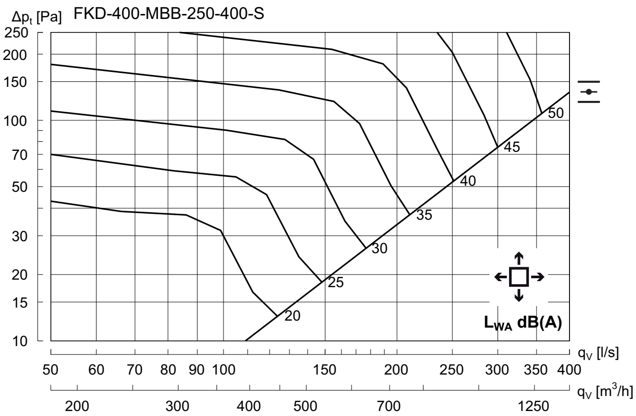
Multi-cone diffuser FKD

Technical data

FKD 400 + MBB-S Horizontal



Hz	63	125	250	500	1K	2K	4K	8K
K_{ok}	11	4	1	-1	-6	-12	-17	-24



Hz	63	125	250	500	1K	2K	4K	8K
K_{ok}	9	4	1	-1	-6	-12	-17	-25

Swirl diffuser RCW

Description

RCW is a rotation diffuser particularly suitable for rooms with a high ceiling.

The diffuser is equipped with adjustable blades, so the supply air pattern can be changed from vertical to horizontal.

The blade settings can be adjusted manually, or the function can be automated using various types of motor. RCW with manual blade adjustment is supplied as standard with a blade setting of 30°.

The motorized models are supplied as standard with a blade setting from 30° to 75°. In the motorized versions, RCW can be supplied with an electric on/off motor, a modulating motor or a thermal actuator, where the supply air pattern is changed in step with the supply air temperature

- Suitable for both cooling and heating
- Horizontal and vertical dispersal pattern
- High induction
- Can be supplied with an electric motor
- Can be supplied with a thermal actuator

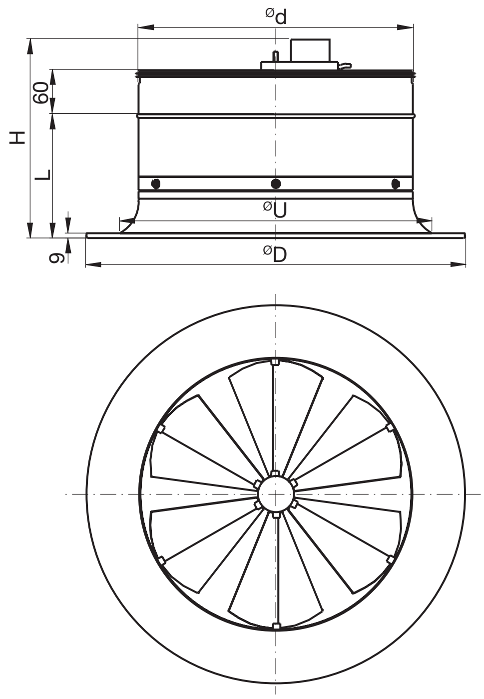
Maintenance

The visible parts of the diffuser can be wiped with a damp cloth. For other maintenance, see installation instructions.

Order code

Product		RCW	a	bbb	A
Type					
Manual	0				
Motorized - modulating	1				
Motorized- on/off	2				
Thermal actuator	3				
Size					
Version					

Dimensions



Ød Size	ØD mm	H mm	L mm	ØU mm	Weight * kg
250	360	240	143	285	2.40
315	460	267	168	365	3.10
400	560	292	178	450	4.40
500	670	341	226	570	6.80
630	870	391	273	740	9.90

* Motorized models weigh approx. 1 kg more than the weight stated in the table above.

Motor type

RCW-1 Ød	Motor
315-400	NM24A-MF-F
500-630	LH24A-MF60

RCW-2 Ød	Motor
250-400	NM24A-F
500-630	LH24A60

Materials and finish

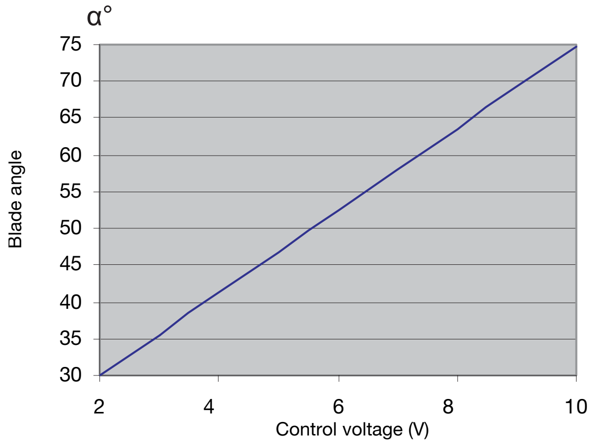
Material: Aluminium & steel
Standard finish: Powder-coated
Standard colour: RAL 9010 Gloss 30

Available in other colours. Please contact Lindab's sales department for further information.
Other blade settings can be supplied on request.

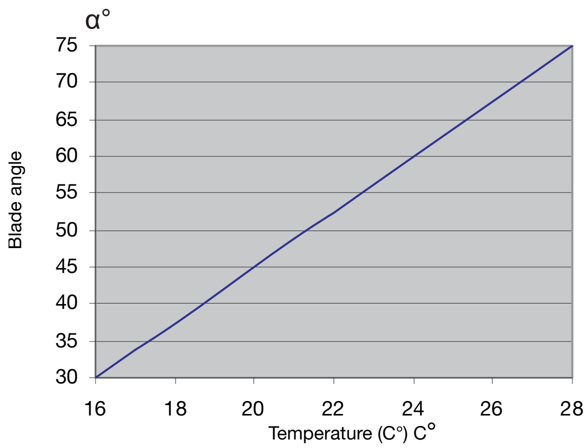
Swirl diffuser RCW

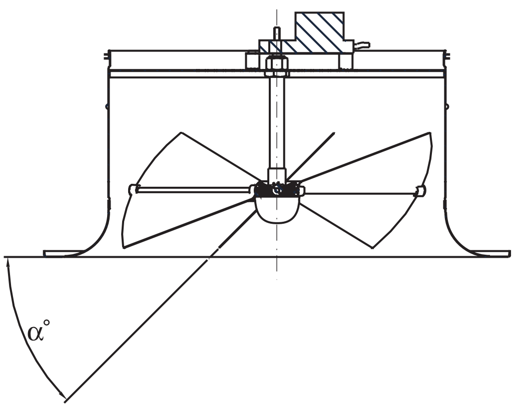
Technical data

RCW with electric modulating motor



RCW with thermal actuator





Capacity

Volume flow q_v [l/s] and [m³/h], total pressure Δp_t [Pa], throw $l_{0.2}$ [m] and sound power level L_{WA} [dB(A)] can be seen in the diagrams.

Throw $l_{0.2}$ / turning point $l_{0.0}$

Throw $l_{0.2}$[m] can be seen in the diagrams for isothermal air at a speed of 0.2 m/s. Turning point $l_{0.0}$ [m] can be seen in the diagrams for heated air, +5 K, +10 K and +15 K respectively.

Frequency-related sound effect level

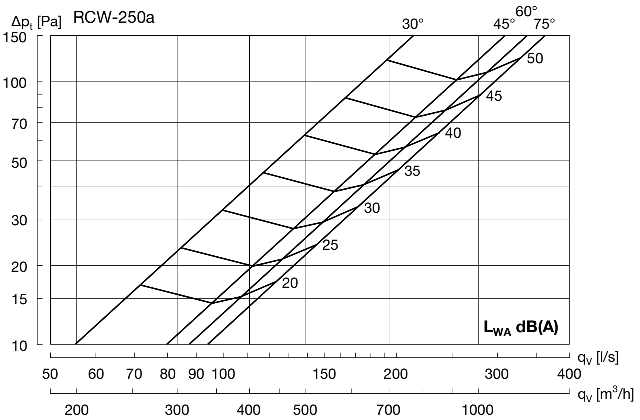
The sound effect level in the frequency band is defined as L_{WA}+K_{ok}. K_{ok} values are specified in charts beneath the diagrams on the following pages.

Quick selection

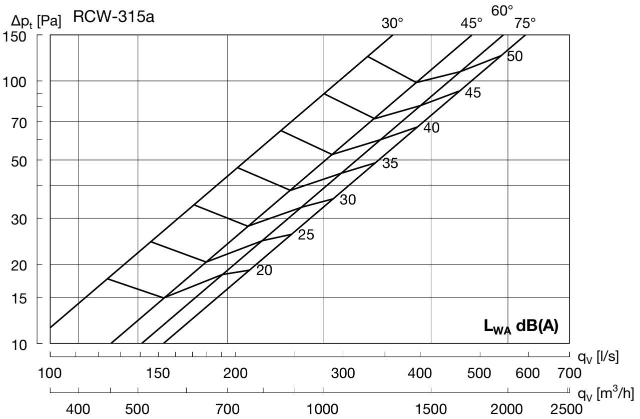
Size	Angle	q_v [l/s]	q_v [m³/h]	P_t [Pa]	$l_{0.2}$ isoterm [m]	$l_{0.0}$ +10K [m]
				L_{WA} = 40		
250	30°	138	498	63	10	
250	75°	138	498	22		5
315	30°	237	854	65	6	
315	75°	237	854	24		6
400	30°	361	1299	60	5	
400	75°	361	1299	22		6
500	30°	453	1630	52	5	
500	75°	453	1630	13		5
630	30°	818	2943	57	6	
630	75°	818	2943	17		7
				L_{WA} = 50		
250	30°	192	692	121	13	
250	75°	192	692	42		7
315	30°	329	1183	124	8	
315	75°	329	1183	46		8
400	30°	513	1846	122	7	
400	75°	513	1846	44		8
500	30°	636	2290	103	6	
500	75°	636	2290	25		6
630	30°	1136	4088	110	8	
630	75°	1136	4088	32		9
				L_{WA} = 60		
250	30°	267	962	234	18	
250	75°	267	962	81		10
315	30°	455	1638	238	10	
315	75°	455	1638	88		11
400	30°	729	2623	247	11	
400	75°	729	2623	89		12
500	30°	893	3216	203	8	
500	75°	893	3216	49		9
630	30°	1577	5679	213	11	
630	75°	1577	5679	62		12

Swirl diffuser RCW

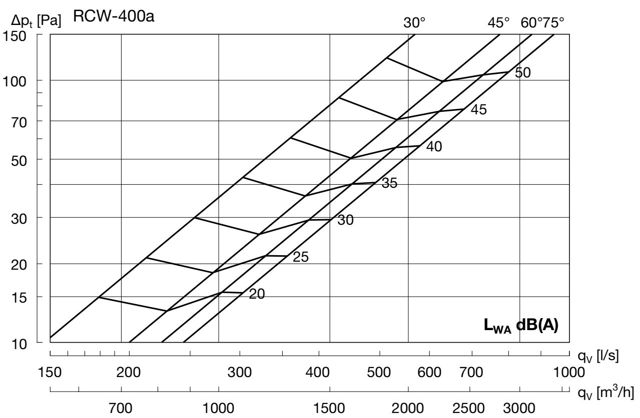
Technical data



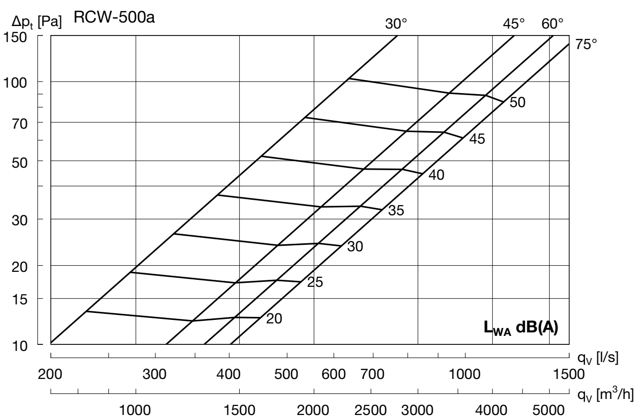
Hz	63	125	250	500	1K	2K	4K	8K
K_{ok}	7	1	-2	-2	-4	-9	-18	-21



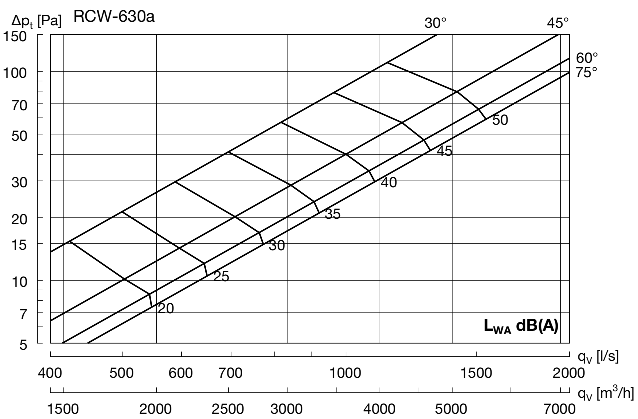
Hz	63	125	250	500	1K	2K	4K	8K
K_{ok}	10	2	-1	-3	-4	-10	-17	-21



Hz	63	125	250	500	1K	2K	4K	8K
K_{ok}	12	1	-2	-2	-3	-13	-20	-23



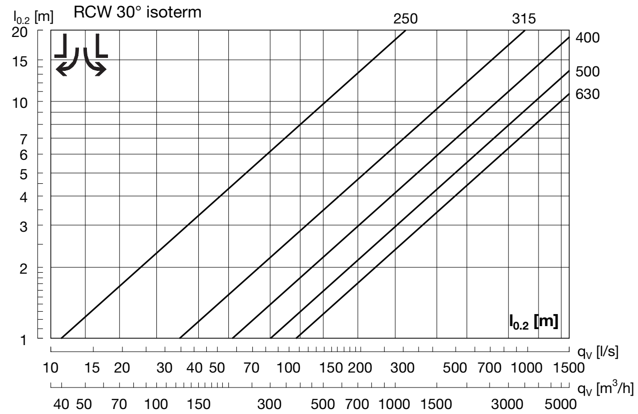
Hz	63	125	250	500	1K	2K	4K	8K
K_{ok}	12	1	-2	-1	-4	-12	-20	-22



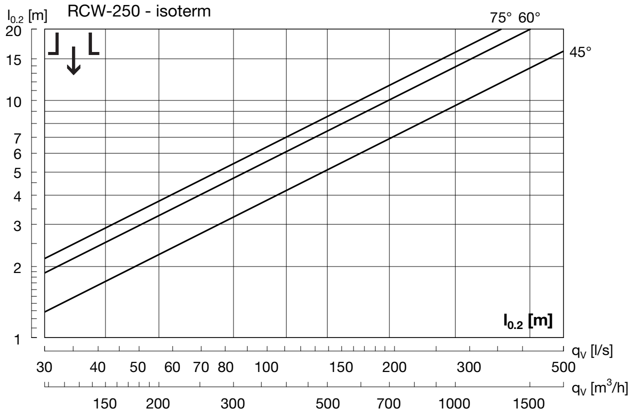
Hz	63	125	250	500	1K	2K	4K	8K
K_{ok}	15	5	0	-2	-5	-12	-18	-22

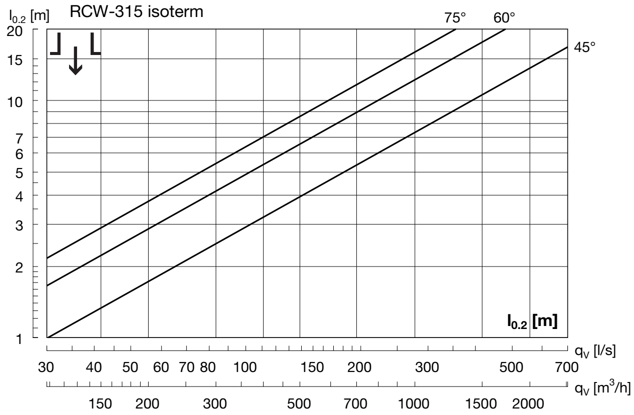
Throw $l_{0.2}$ horizontal

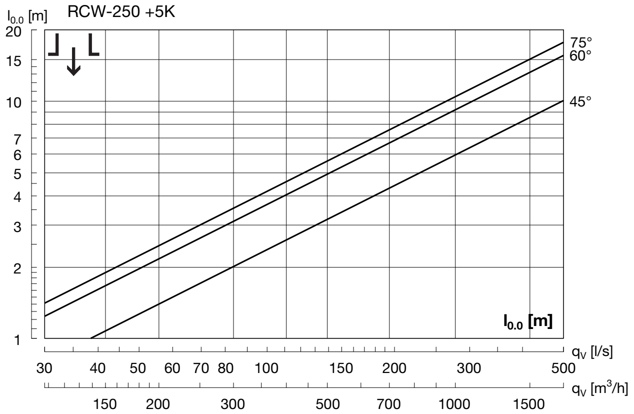
Horizontal throw $l_{0.2}$ is specified for free suspension. If the diffuser is installed < 300 mm from the ceiling, the value must be multiplied by 1.4.

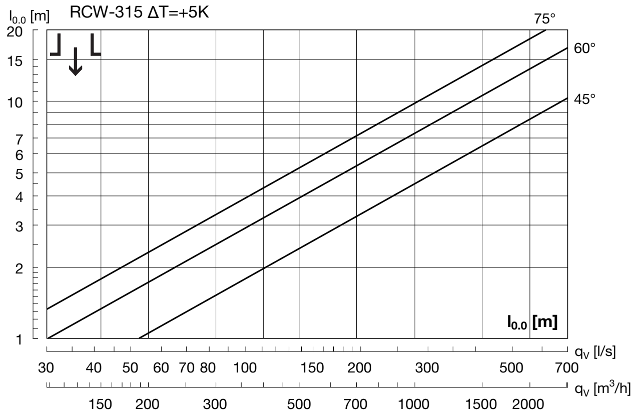


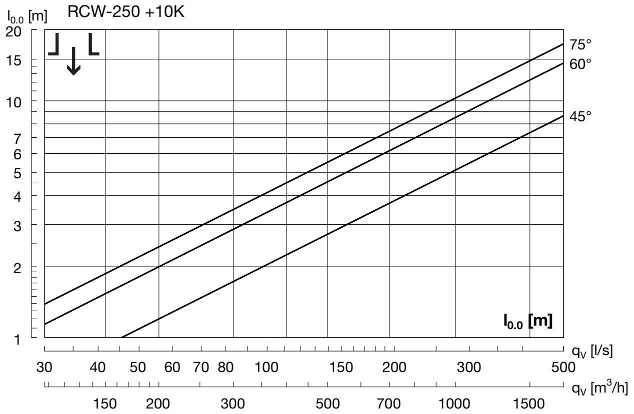
Swirl diffuser RCW

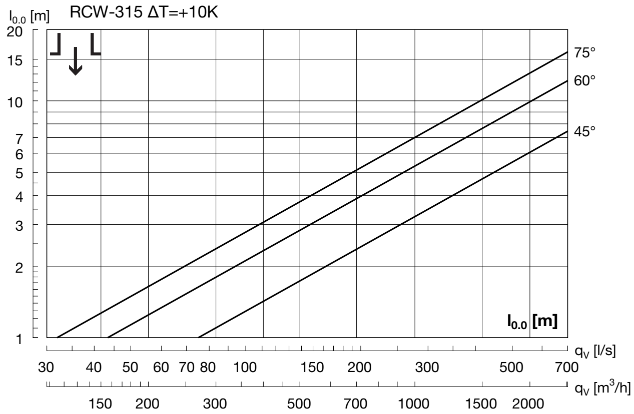


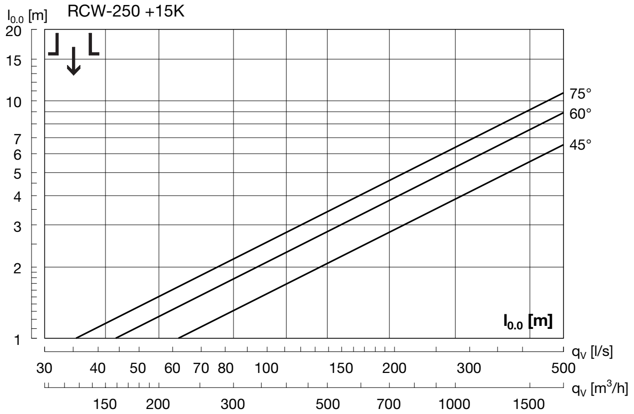


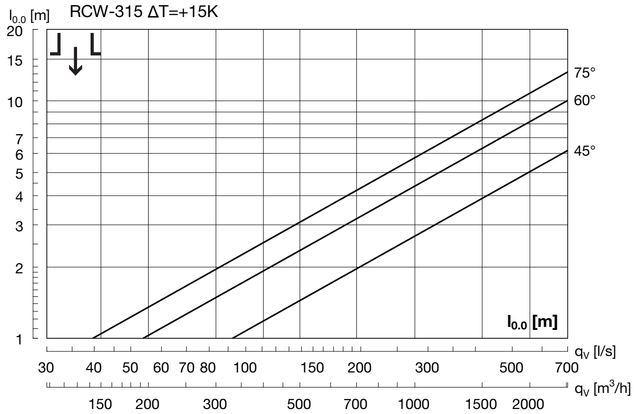




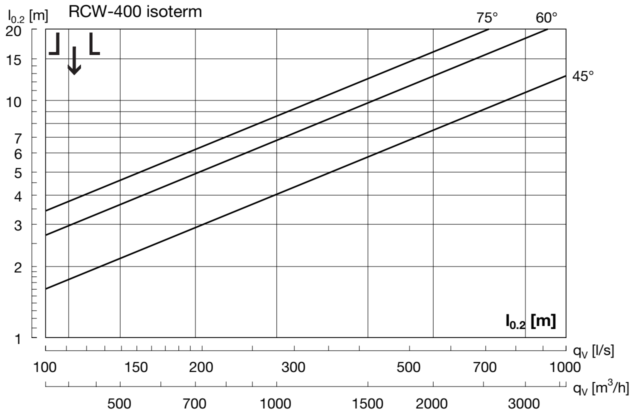


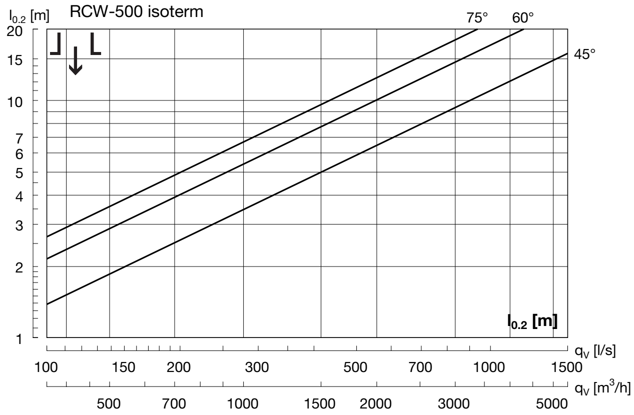


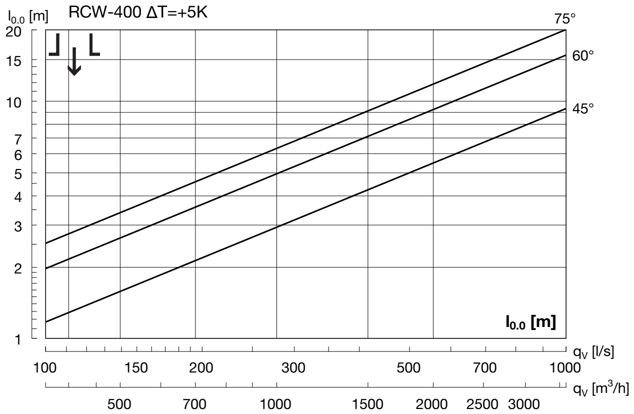


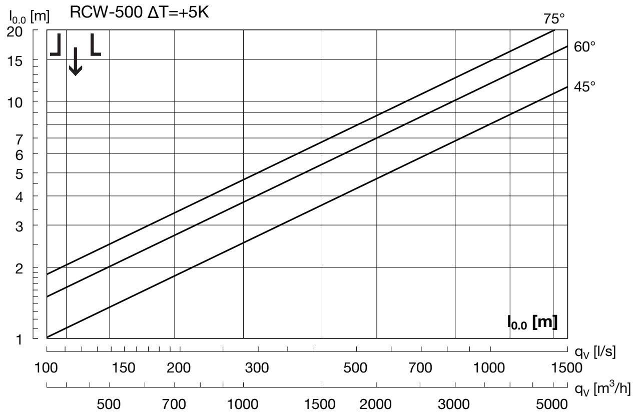


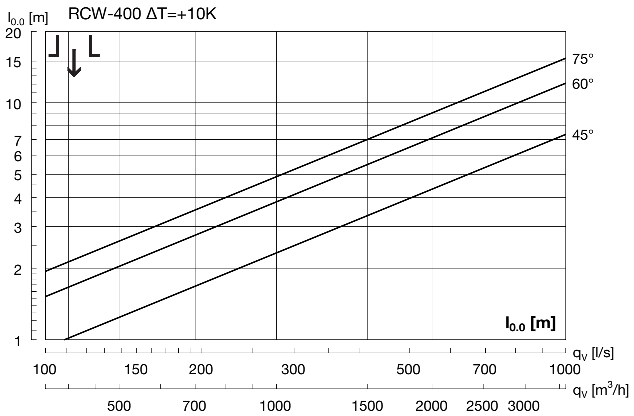
Swirl diffuser RCW

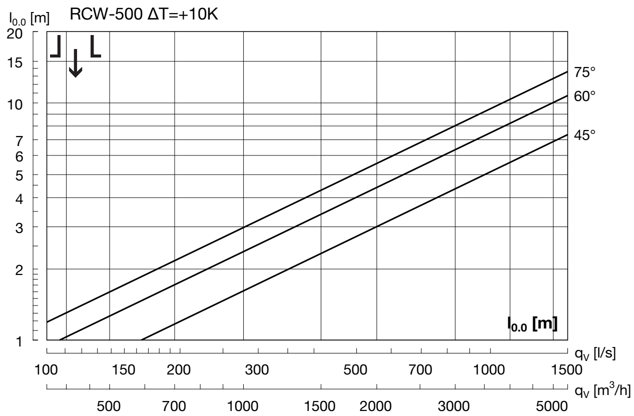


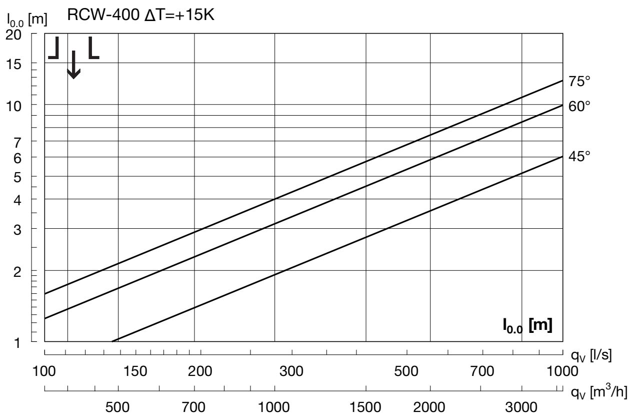


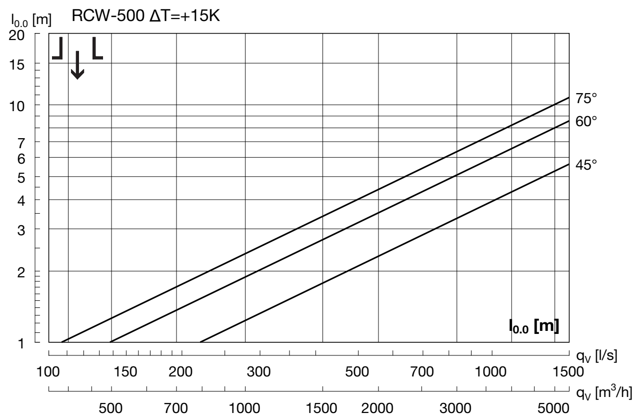




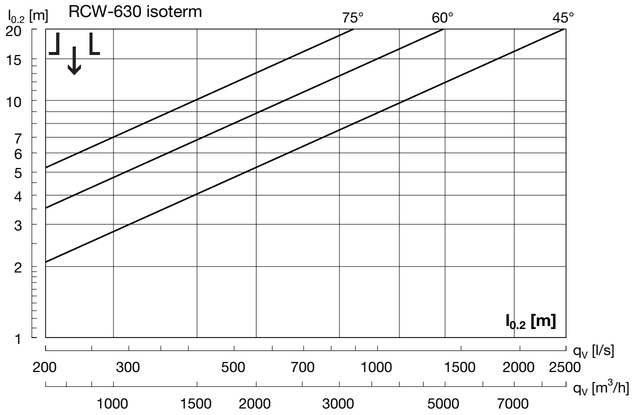


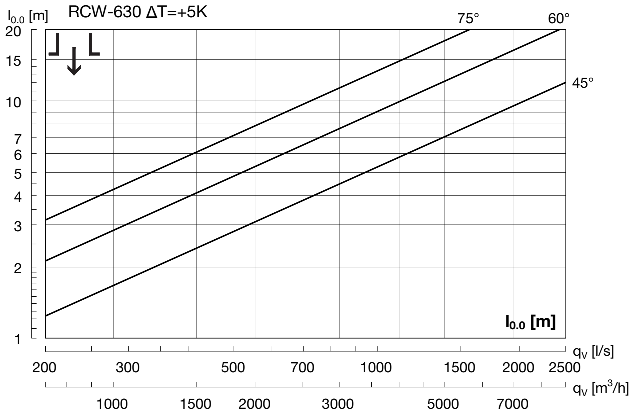


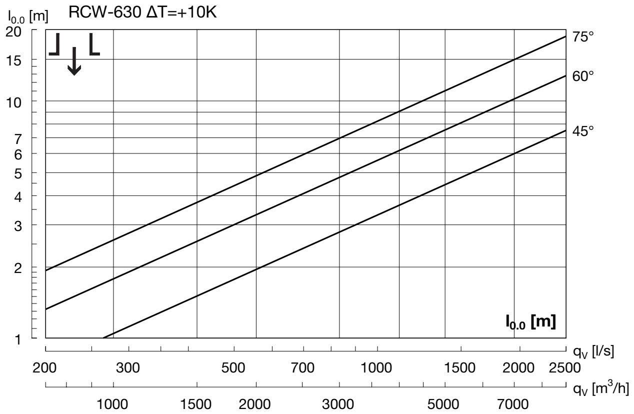


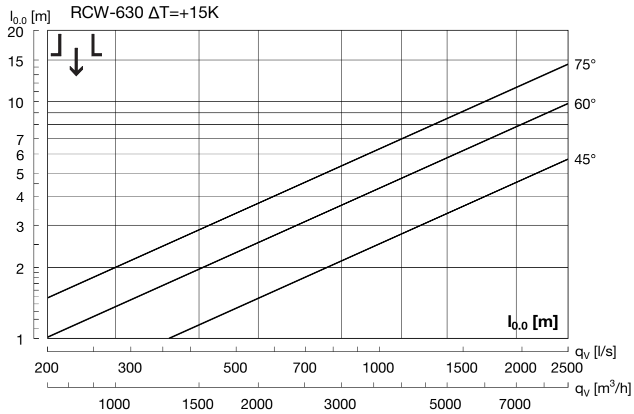


Swirl diffuser RCW









Swirl diffuser RCWB

Description

RCWB is a rotation diffuser (RCW) with integral box, particularly suitable for rooms with a high ceiling.

The diffuser is equipped with adjustable blades, so the supply air pattern can be changed from vertical to horizontal. The blade settings can be adjusted manually, or the function can be automated using various types of motor.

RCWB with manual blade adjustment is supplied as standard with a blade setting of 30°.

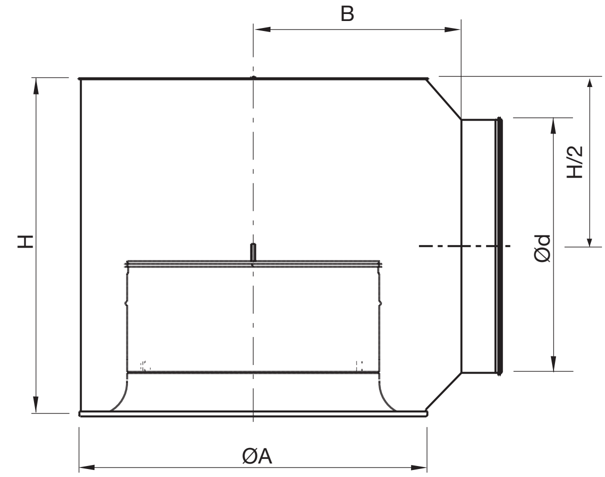
The motorized models are supplied as standard with a blade setting from 30° to 75°. In the motorized versions, RCWB can be supplied with an electric on/off motor, a modulating motor or a thermal actuator, where the supply air pattern is changed in step with the supply air temperature.

- Suitable for both cooling and heating
- Horizontal and vertical dispersal patterns
- High induction
- Can be supplied with an electric motor
- Can be supplied with a thermal actuator

Order code

Product	RCWB	a	bbb	c	A
Type					
Manual	0				
Motorized - modulating	1				
Motorized- on/off	2				
Thermal actuator	3				
Galvanised box	0				
Box RAL 9010	1				
Size					
Version					

Dimensions



Ød Size	ØA mm	H mm	B mm	Weight * kg
250	360	415	250	5.70
315	460	480	300	8.20
400	560	570	350	11.8
500	670	670	412	17.2
630	870	800	500	25.7

* Motorized models weigh approx. 1 kg more than the weight stated in the table above.

Motor type

RCWB-1 Ød	Motor
315-400	NM24A-MF-F
500-630	LH24A-MF60

RCWB-2 Ød	Motor
250-400	NM24A-F
500-630	LH24A60

Maintenance

The visible parts of the diffuser can be wiped with a damp cloth. For other maintenance, see installation instructions.

Materials and finish

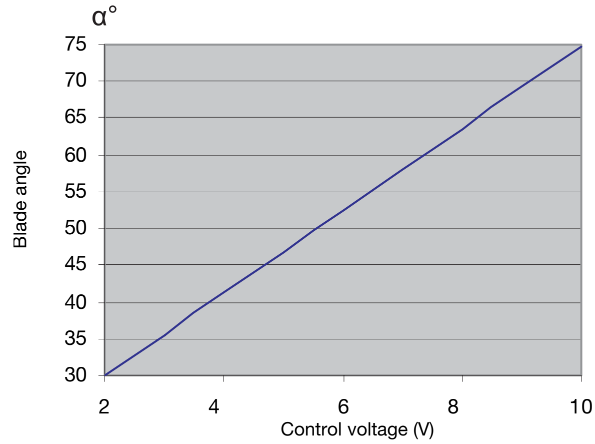
Material:	Aluminium & steel
Standard finish:	Powder-coated
Standard colour:	RAL 9010 Gloss 30
Box:	Hot-galvanised steel

Available in other colours. Please contact Lindab's sales department for further information.

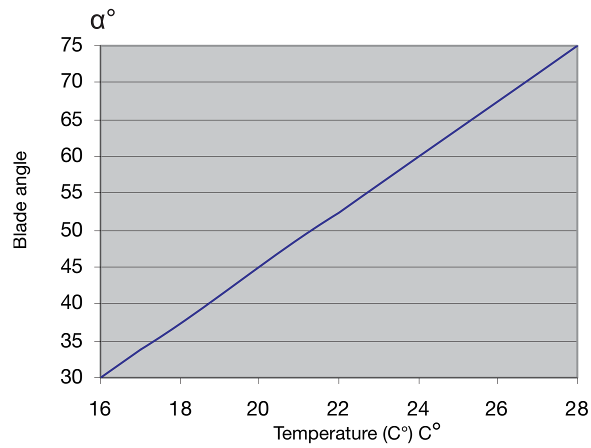
Swirl diffuser RCWB

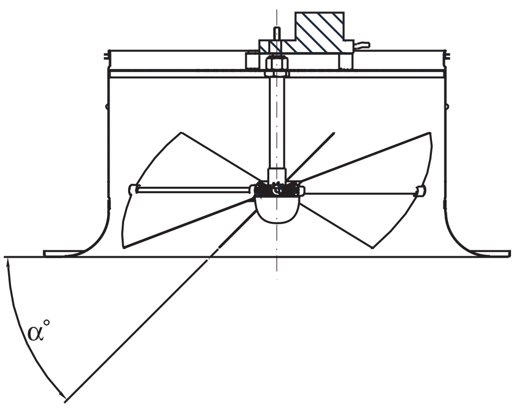
Technical data

RCWB with electric modulating motor



RCWB with thermal actuator





Capacity

Volume flow q_v [l/s] and [m³/h], total pressure Δp_t [Pa], throw $l_{0.2}$ [m] and sound power level L_{WA} [dB(A)] can be seen in the diagrams.

Throw $l_{0.2}$ / turning point $l_{0.0}$

Throw $l_{0.2}$[m] can be seen in the diagrams for isothermal air at a speed of 0.2 m/s. Turning point $l_{0.0}$ [m] can be seen in the diagrams for heated air, +5 K, +10 K and +15 K respectively.

Frequency-related sound effect level

The sound effect level in the frequency band is defined as $L_{WA}+K_{ok}$. K_{ok} values are specified in charts beneath the diagrams on the following pages.

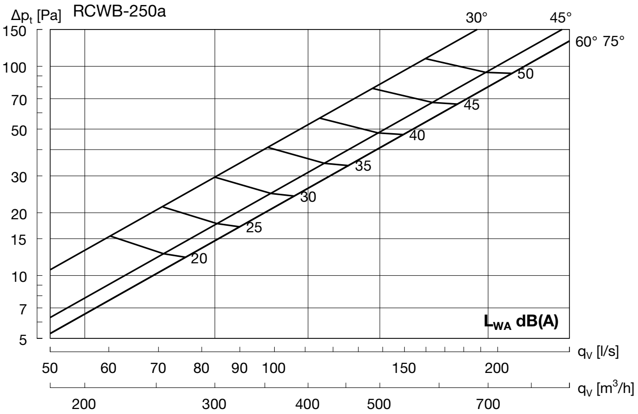
Quick selection

Size	Angle	q_v [l/s]	q_v [m³/h]	P_t [Pa]	$l_{0.2}$ isoterm [m]	$l_{0.0}$ +10K [m]
			L_{WA} = 40			
250	30°	115	415	57	8	
250	75°	115	415	28		5
315	30°	187	672	53	5	
315	75°	187	672	29		5
400	30°	290	1043	49	4	
400	75°	290	1043	27		5
500	30°	403	1451	47	4	
500	75°	403	1451	22		4
630	30°	605	2178	39	5	
630	75°	605	2178	19		5
			L_{WA} = 50			
250	30°	160	575	108	11	
250	75°	160	575	54		6
315	30°	257	924	101	6	
315	75°	257	924	54		7
400	30°	397	1428	91	6	
400	75°	397	1428	50		7
500	30°	565	2034	91	6	
500	75°	565	2034	43		6
630	30°	861	3098	80	7	
630	75°	861	3098	39		7
			L_{WA} = 60			
250	30°	221	796	208	15	
250	75°	221	796	103		8
315	30°	353	1271	190	8	
315	75°	353	1271	103		9
400	30°	543	1954	170	8	
400	75°	543	1954	93		9
500	30°	792	2851	180	8	
500	75°	792	2851	85		8
630	30°	1224	4407	161	9	
630	75°	1224	4407	78		10

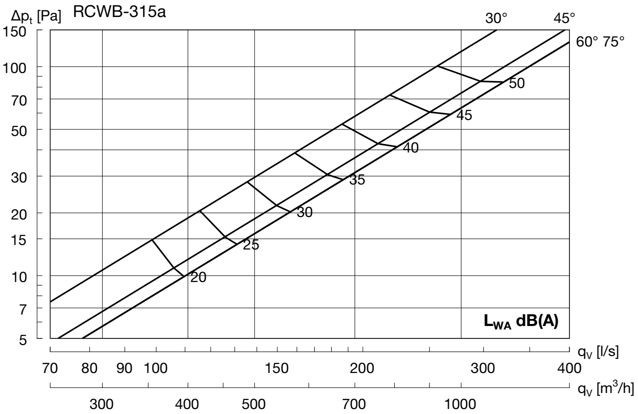
Lindab

Swirl diffuser RCWB

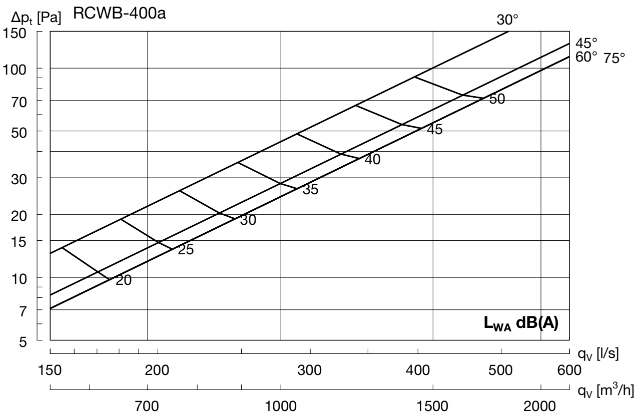
Technical data



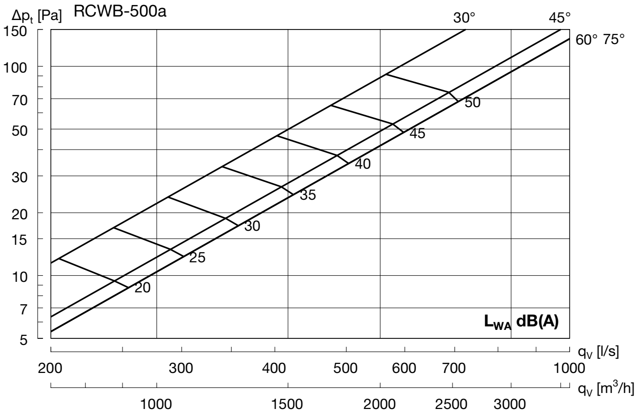
Hz	63	125	250	500	1K	2K	4K	8K
K_{ok}	5	0	-5	-4	-3	-9	-17	-26



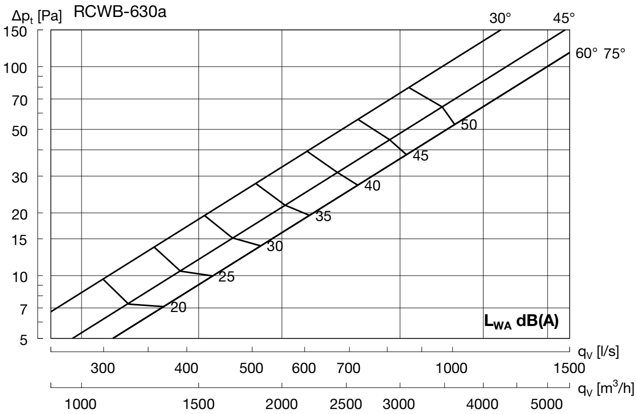
Hz	63	125	250	500	1K	2K	4K	8K
K_{ok}	7	-1	-4	-3	-3	-10	-19	-27



Hz	63	125	250	500	1K	2K	4K	8K
K_{ok}	8	0	-5	-2	-3	-11	-20	-28



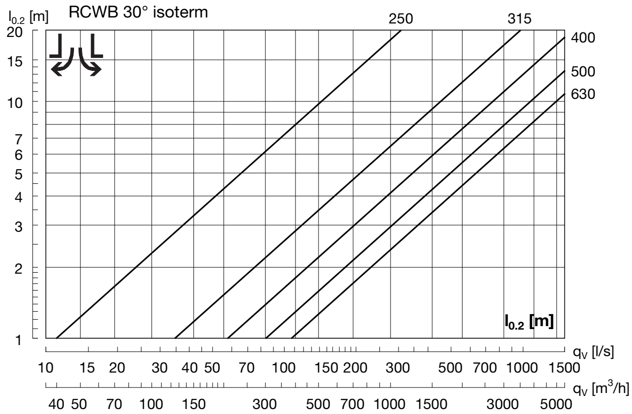
Hz	63	125	250	500	1K	2K	4K	8K
K_{ok}	8	2	-3	-2	-4	-11	-21	-30



Hz	63	125	250	500	1K	2K	4K	8K
K_{ok}	7	-1	-3	-1	-4	-13	-24	-33

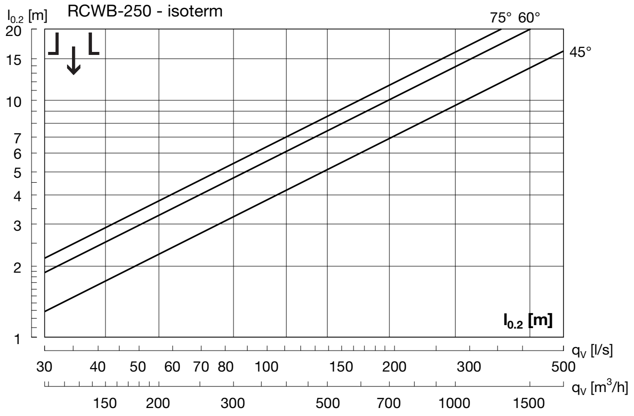
Throw $l_{0.2}$ horizontal

Horizontal throw $l_{0.2}$ is specified for free suspension. If the diffuser is installed < 300 mm from the ceiling, the value must be multiplied by 1.4.

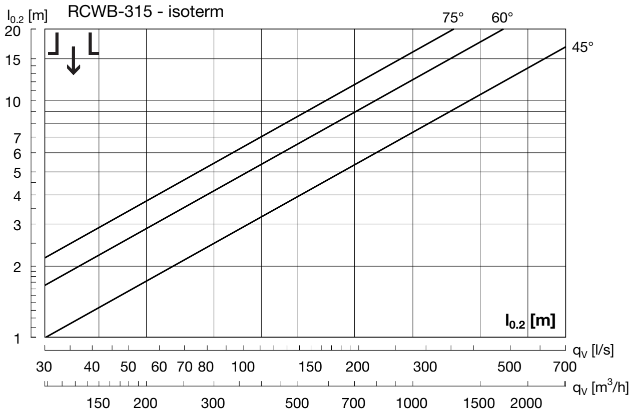


Swirl diffuser RCWB

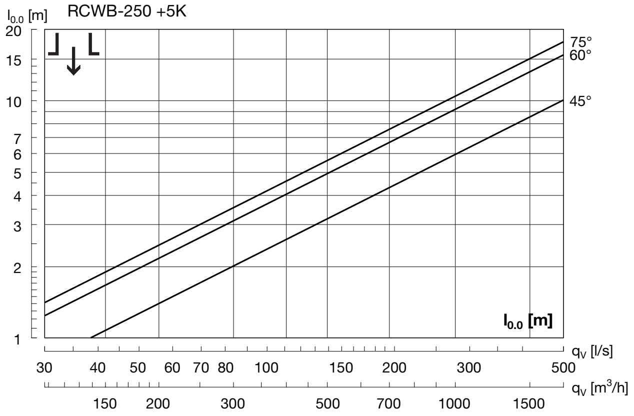
RCWB-250 - isoterm



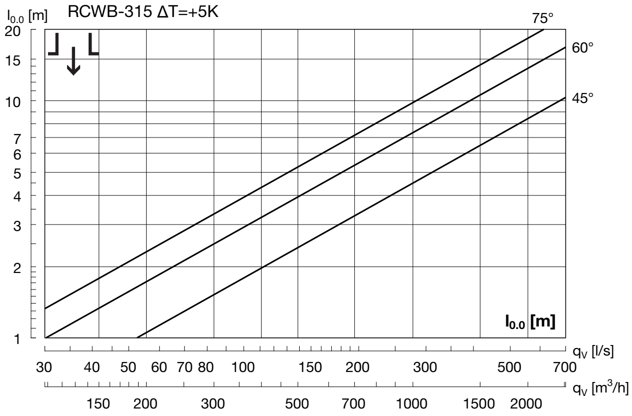
RCWB-315 - isoterm



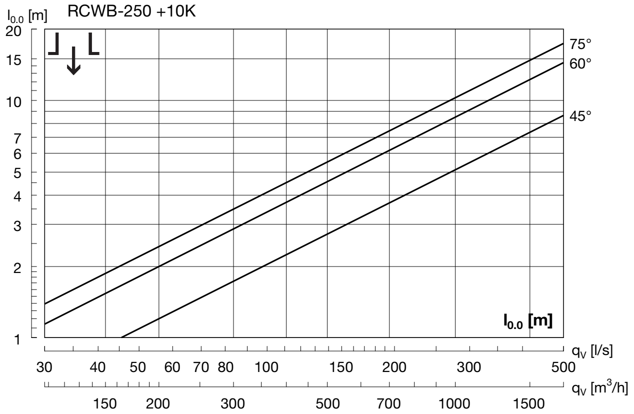
RCWB-250 +5K



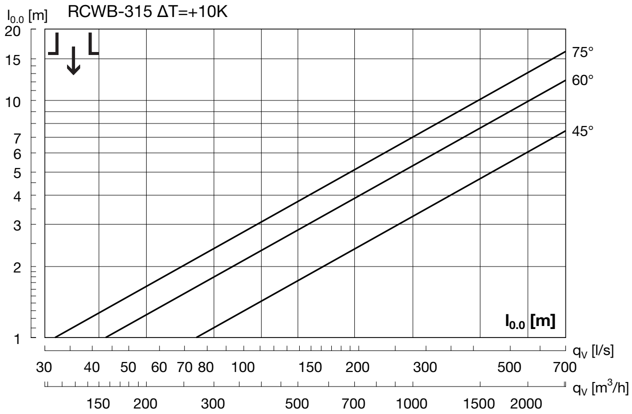
RCWB-315 ΔT=+5K



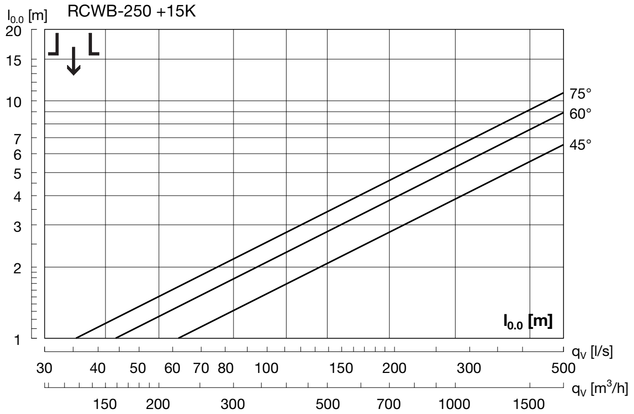
RCWB-250 +10K



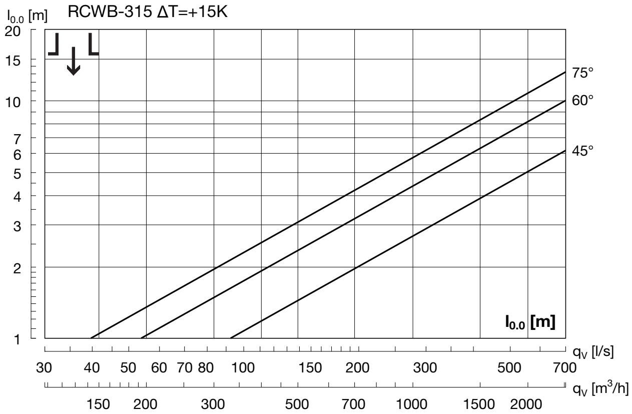
RCWB-315 ΔT=+10K



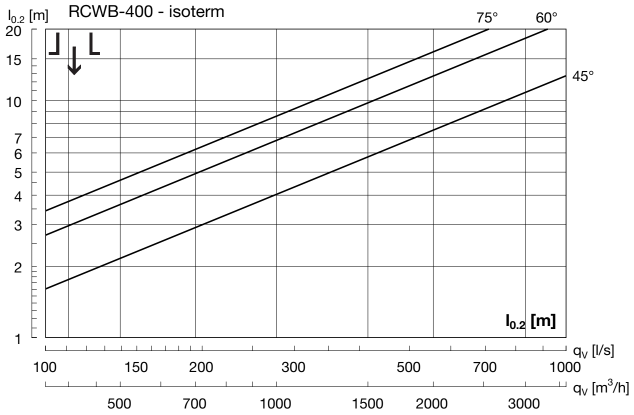
RCWB-250 +15K

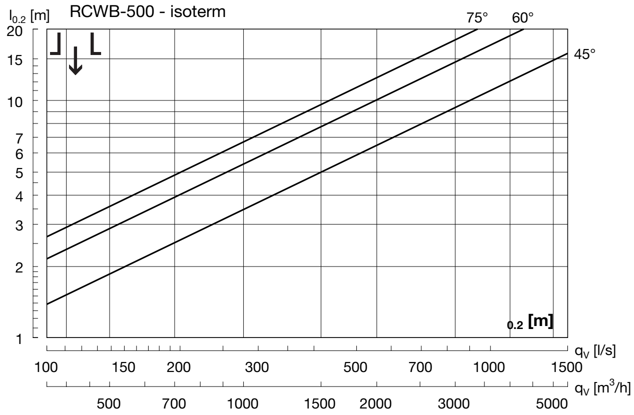


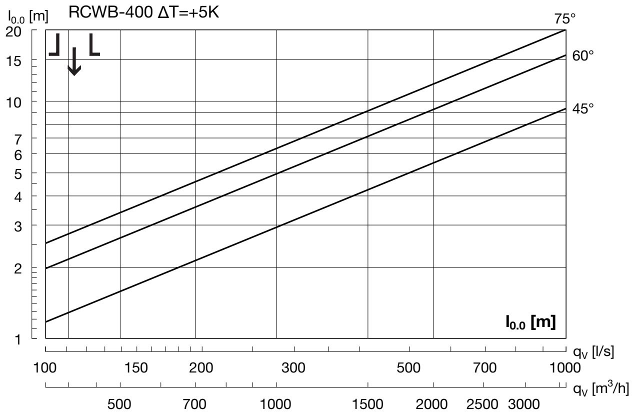
RCWB-315 ΔT=+15K

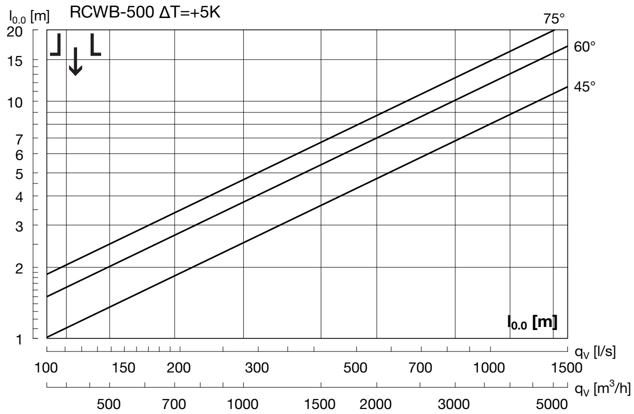


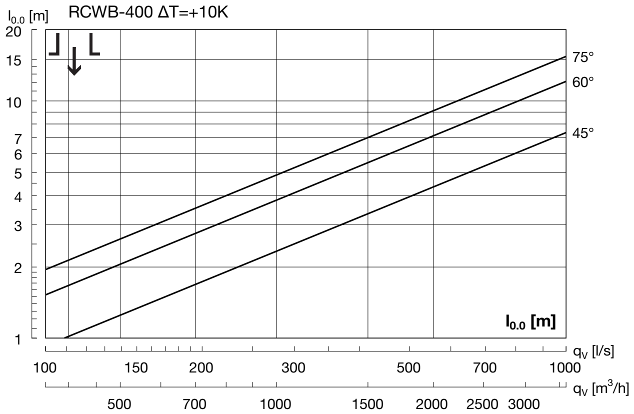
Swirl diffuser RCWB

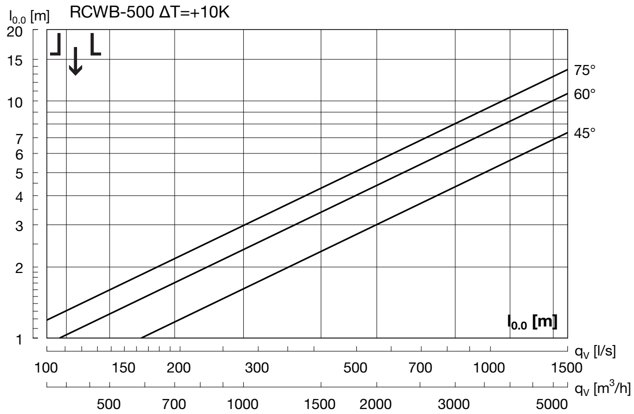


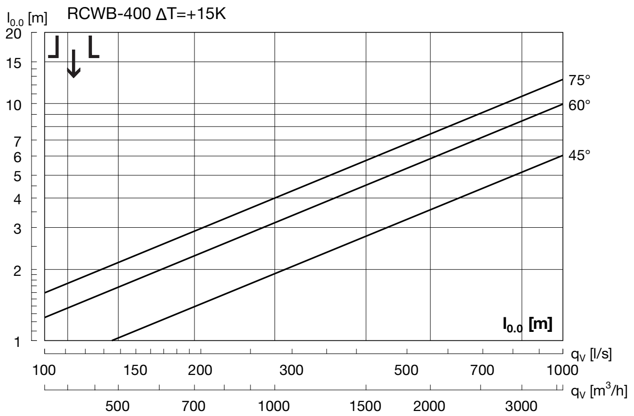


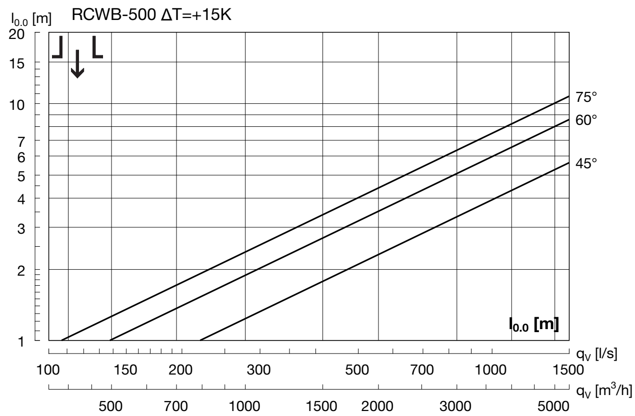






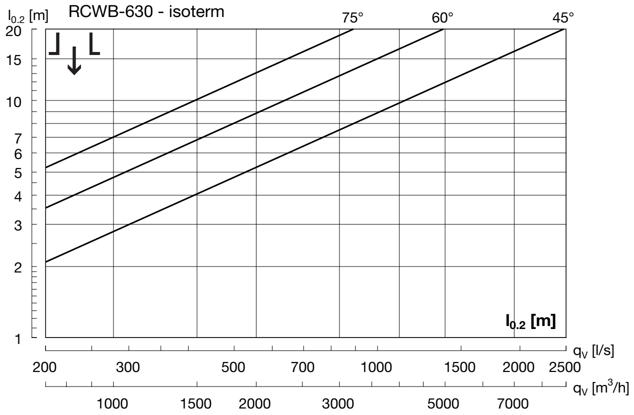


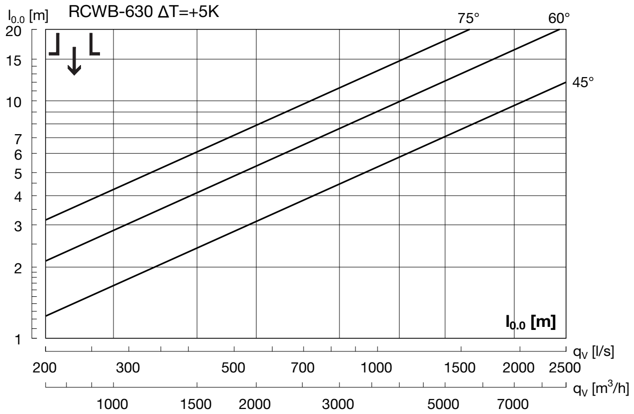


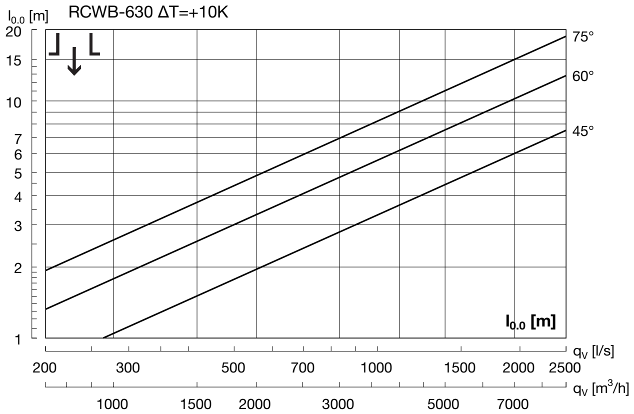


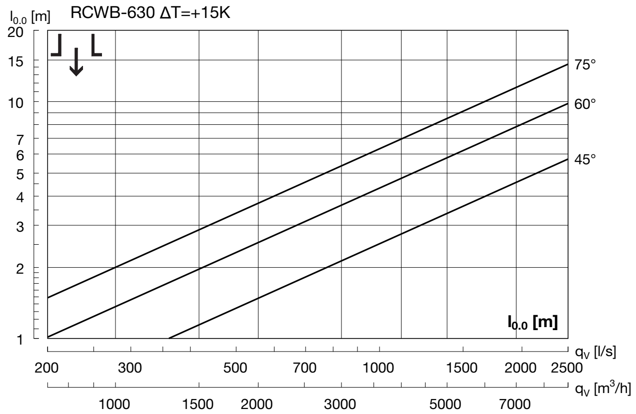
Swirl diffuser

RCWB









Plain diffuser CRL

Description

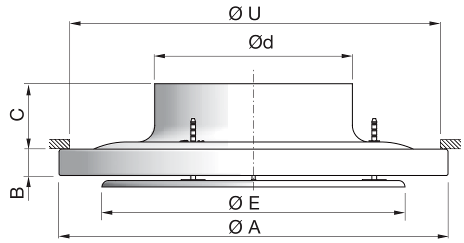
CRL is a circular diffuser with an unperforated adjustable face plate and can be used for both supply and extract air. The diffuser can be switched between horizontal and vertical supply air, and is therefore suitable for the horizontal supply of cooled air or vertical supply of heated air. The CRL can be equipped with accessories of various types in order to achieve optimal function.
Installing a CRL diffuser in a plenum box type MB can help to achieve a stable airflow to the diffuser as well as realise the potential for individual adjustment.
Damper type B is an unique linear cone damper which allows to use the full operational area (0-100%) and allows to balance with a high pressure drop over the box with low sound generation. Furthermore the construction of the damper gives an accurate and reliable measurement.
Damper type C and E are with rotating blade dampers for respectively supply and extract. Typically used in applications that don't require a high balancing pressure in the plenum box.

- Suitable for both supply and extract air
- Suitable for horizontal or vertical supply air patterns
- Plenum box with several damper options

Maintenance

The face plate can be removed to enable cleaning of internal parts or to gain access to the duct or plenum box. The visible parts off the diffuser can be wiped with a damp cloth.

Dimensions

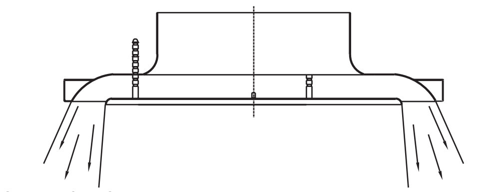


CRL Ød mm	ØA mm	B mm	C mm	ØE mm	ØU* mm	m kg
100	188	15	60	146	170	0.30
125	238	20	65	180	210	0.50
160	288	25	65	220	255	0.60
200	388	28	72	300	355	1.10
250	488	33	82	380	390	1.60
315	588	33	97	490	465	2.50
400	720	40	100	590	670	3.80

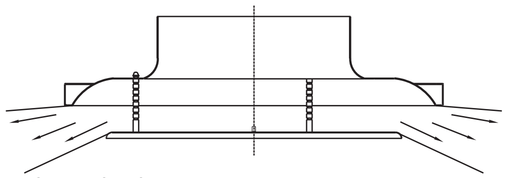
* ØU = Ceiling grid opening

Dispersal patterns

CRL is supplied with vertical supply air as standard.
The dispersal pattern can be changed to horizontal supply air by moving the face plate.



Vertical supply air.



Horizontal supply air.

Order code

Product **CRL** **aaa**
Type
CRL
Connection dim. Ød
Ød 100-400

Example: CRL-200

Materials and finish:

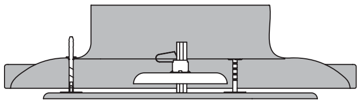
Grille box: Aluminium
Face plate: Galvanised steel
Standard finish: Powder-coated
Standard colours: RAL 9003 and RAL 9010, gloss 30

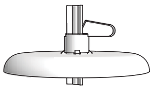
The diffuser is available in other colours. Please contact Lindab's sales department for further information.

Plain diffuser CRL

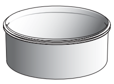
Accessories

CAZ - Balancing damper

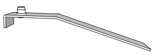


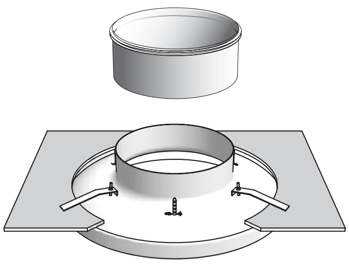


MBZ - Extension piece



DCZ - Mounting brackets (set)



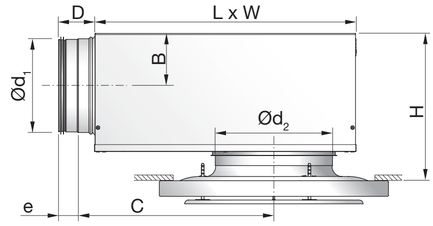


Order code - accessories

Product	aaa	bbb
Type		
Size		

Example: CAZ-125

CRL + MB plenum box



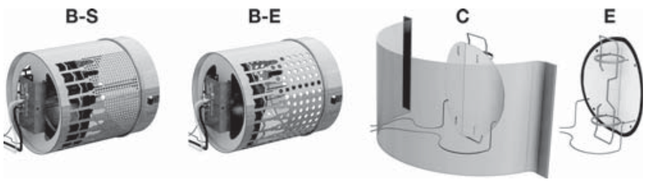
Ød$_1$	Ød$_2$	B	C	D	e	H*	L	W
mm		mm						
100	100	62	245	78	40	175 - 210	310	260
100	125	62	245	78	40	175 - 205	310	260
100	160	62	245	78	40	175 - 205	310	260
125	125	75	291	78	40	200 - 230	376	310
125	160	75	291	78	40	200 - 230	376	310
125	200	75	291	78	40	210 - 245	376	310
160	160	92	352	78	40	235 - 265	459	380
160	200	92	352	78	40	245 - 280	459	380
160	250	92	352	78	40	250 - 290	459	380
200	200	112	425	78	40	285 - 320	565	460
200	250	112	425	78	40	290 - 332	565	460
200	315	112	425	78	40	290 - 345	565	460
250	250	137	514	118	60	340 - 380	698	540
250	315	137	514	118	60	340 - 395	698	540
250	400	137	514	118	60	370 - 400	698	540
315	315	170	675	118	60	405 - 460	858	540
315	400	170	675	118	60	435 - 465	858	540

USING CRL + MBB => ALWAYS USE MBZ

* Using accessory MBZ the H dimension will increase:

Ød$_2$ = 100 - 200 mm => H +40 mm
Ød$_2$ = 250 - 315 mm => H +60 mm
Ød$_2$ = 400 mm => H +80 mm

Damper options



Order code

Product	MB	a	bbb	ccc	d
Type					
MB					
Damper					
B = Linear cone damper					
C = Blade damper supply					
E = Blade damper extract					
Duct connection Ød$_1$					
Ø100-315					
Diffuser dimension Ød$_2$					
Ø100-400					
Function (Only for B damper)					
S = Supply air E = Extract					

Example 1: CRL-200+MBB-160-200-S
Example 2: CRL-200+MBC-125-200

Plain diffuser CRL

Technical data

Following CRL+plenum box data are valid for MBB-S/-E. For MBC and MBE data, go to www.lindQST.com .

Capacity
Air flow q_v [l/s] and [m³/h], total pressure Δp_t [Pa], throw $l_{0.2}$ [m] and sound power level L_{WA} [dB(A)] can be seen in the diagrams.

Frequency-related sound power level
The sound power level in the frequency band is defined as $L_{WA}+K_{ok}$. K_{ok} values are specified in charts beneath the diagrams on the following pages.

Quick selection, supply air

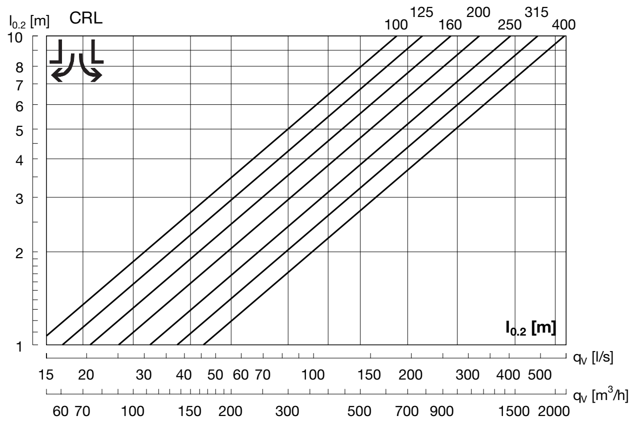
CRL + MBB-S		$\Delta p_t \geq 50$ Pa		$\Delta p_t \geq 50$ Pa	
duct	CRL	30 dB(A)		35 dB(A)	
Ød$_1$	Ød$_2$	l/s	m³/h	l/s	m³/h
100	100	26	94	31	112
100	125	35	126	42	151
100	160	42	151	50	180
125	125	46	166	54	194
125	160	58	209	68	245
125	200	62	223	75	270
160	160	67	241	81	292
160	200	86	310	105	378
160	250	96	346	121	436
200	200	107	385	127	457
200	250	135	486	160	576
200	315	146	526	177	637
250	250	151	544	183	659
250	315	161	580	215	774
250	400	185	666	252	907
315	315	206	742	263	947
315	400	227	817	309	1112

Sound attenuation
Sound attenuation of the diffuser ΔL from duct to room, including end reflection, see table below.

CRL + MBB-S/-E									
duct	CRL	Centre frequency Hz							
Ød$_1$	Ød$_2$	63	125	250	500	1K	2K	4K	8K
100	100	20	17	7	20	19	20	20	22
100	125	21	16	6	18	19	18	19	21
100	160	21	16	5	15	17	18	18	18
125	125	18	13	7	20	12	19	19	20
125	160	15	14	8	19	12	17	17	19
125	200	14	12	6	16	14	16	17	16
160	160	18	17	10	18	16	18	21	20
160	200	15	14	7	19	17	18	19	19
160	250	15	15	4	15	13	14	16	18
200	200	14	10	7	14	19	16	20	17
200	250	15	9	5	14	19	16	17	16
200	315	13	8	4	11	16	15	16	15
250	250	16	8	7	16	18	18	18	17
250	315	11	7	6	16	17	17	16	16
250	400	15	6	5	10	14	16	15	15
315	315	8	10	9	14	18	18	17	21
315	400	8	8	8	11	16	17	16	19

Throw $l_{0.2}$

The throw is specified at a terminal velocity of 0.2 m/s. Diagram below shows throw $l_{0.2}$ for horizontal supply air.

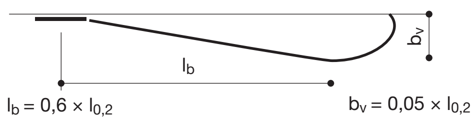


Correction throw $l_{0.2}$ for vertical supply air

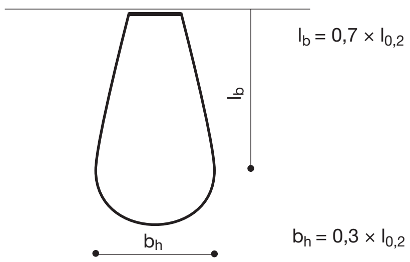
CRL Ød	Correction factor
100	3,1
125	2,7
160	2,7
200	2,7
250	2,6
315	2,4
400	2,3

Air jet distribution
l_b = Distance from the diffuser to the point where there is maximum dispersal.
b_v = Depth of the air jet on a vertical plane.
b_h = Width of the air jet on a horizontal plane

Horizontal supply air pattern



Vertical supply air pattern

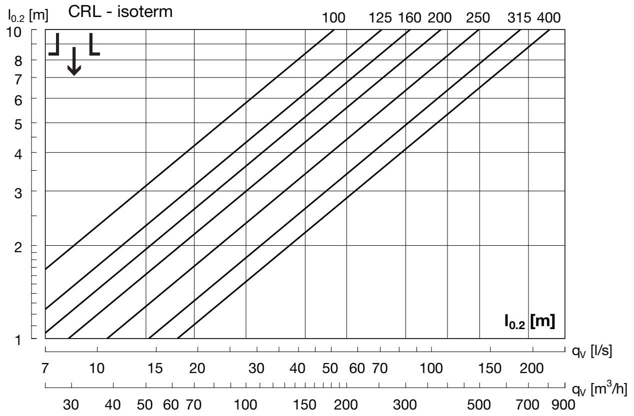


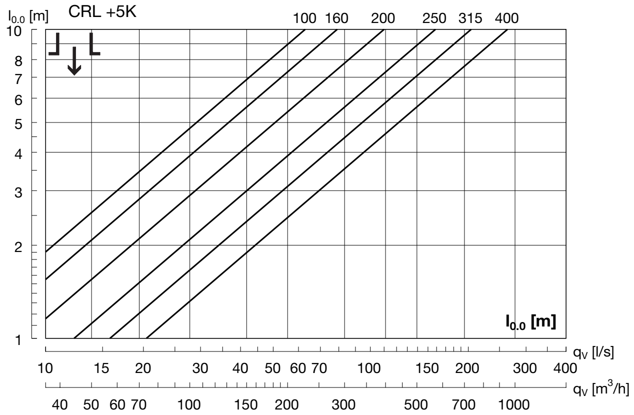
Plain diffuser CRL

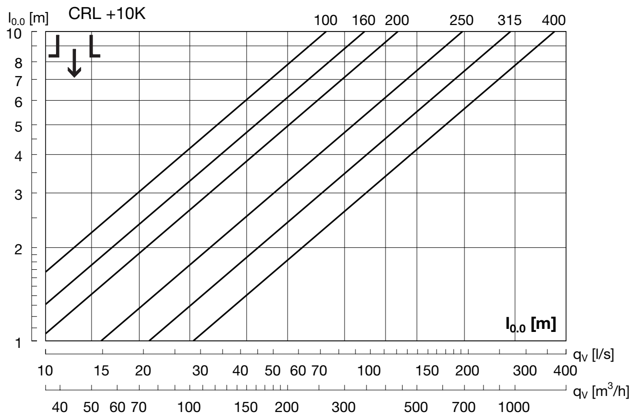
Technical data

Throw $l_{0.2}$ / turning point $l_{0.0}$

Throw $l_{0.2}$ [m] is specified at a speed of 0.2 m/s. Turning point $l_{0.0}$ [m] is specified for +5 K, +10 K respectively.

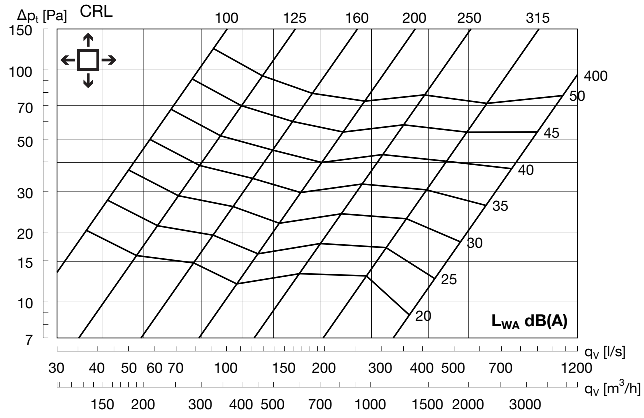




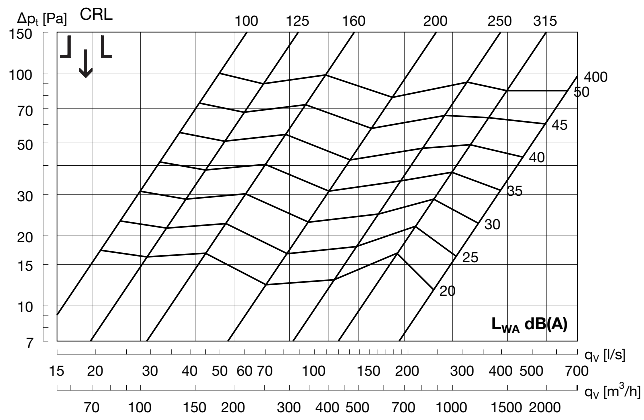


CRL without box - Supply air

Supply air - horizontal



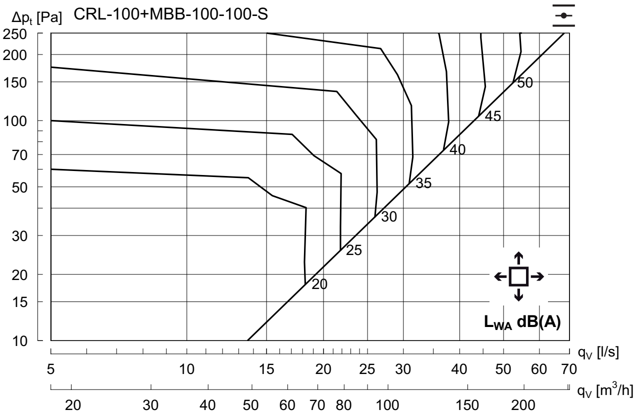
Supply air - vertical



Plain diffuser CRL

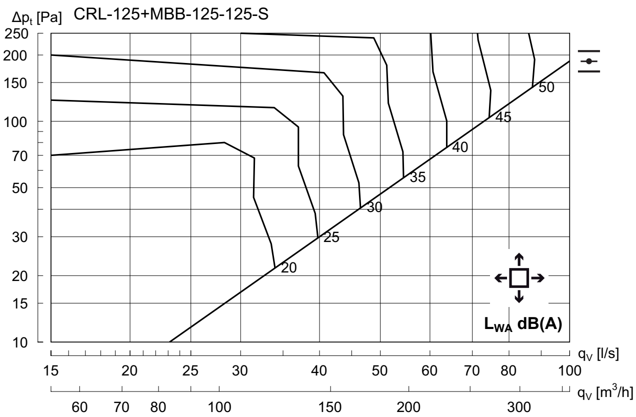
Technical data

CRL 100 + MBB-S - Supply air

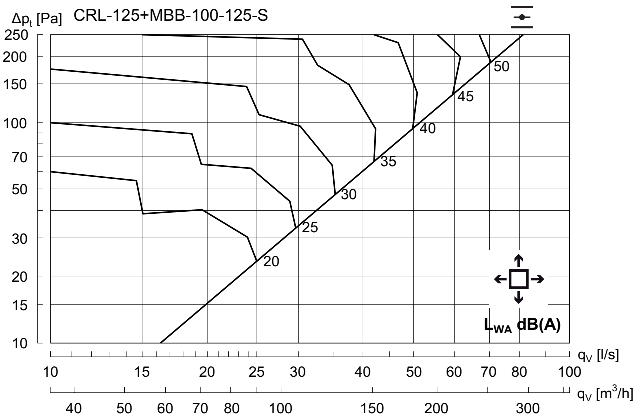


Hz	63	125	250	500	1K	2K	4K	8K
K_{ok}	12	8	5	-7	-8	-14	-17	-22

CRL 125 + MBB-S - Supply air



Hz	63	125	250	500	1K	2K	4K	8K
K_{ok}	11	9	3	-5	-6	-14	-20	-24

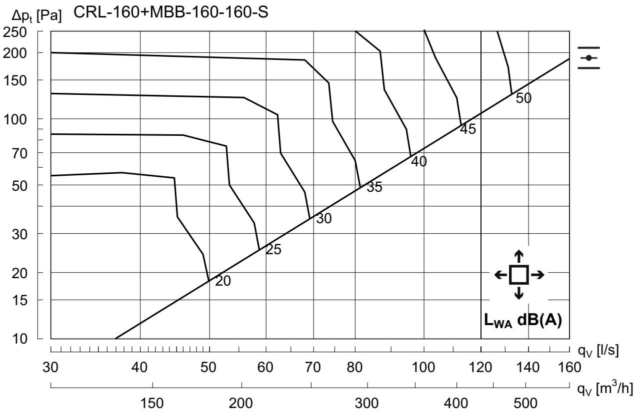


Hz	63	125	250	500	1K	2K	4K	8K
K_{ok}	13	8	3	-5	-7	-11	-15	-19

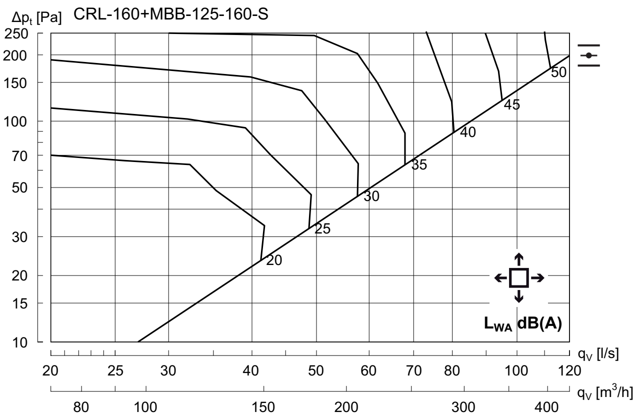
Plain diffuser CRL

Technical data

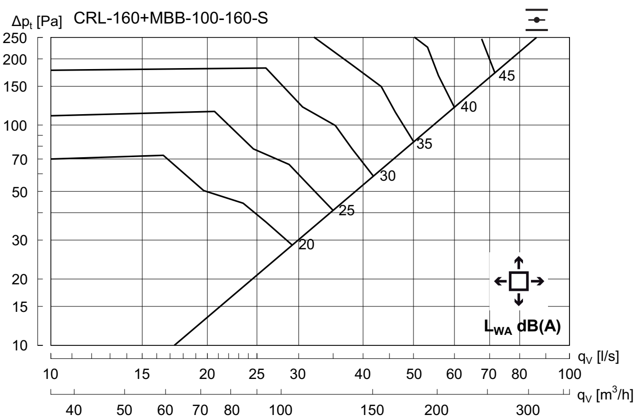
CRL 160 + MBB-S - Supply air



Hz	63	125	250	500	1K	2K	4K	8K
K_{ok}	11	12	3	-7	-7	-15	-20	-23

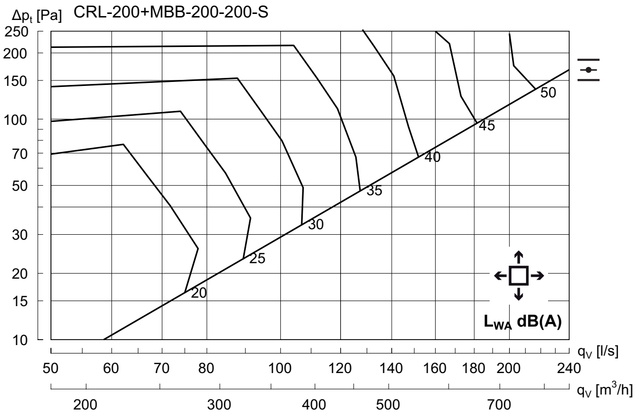


Hz	63	125	250	500	1K	2K	4K	8K
K_{ok}	12	8	3	-5	-6	-11	-17	-22

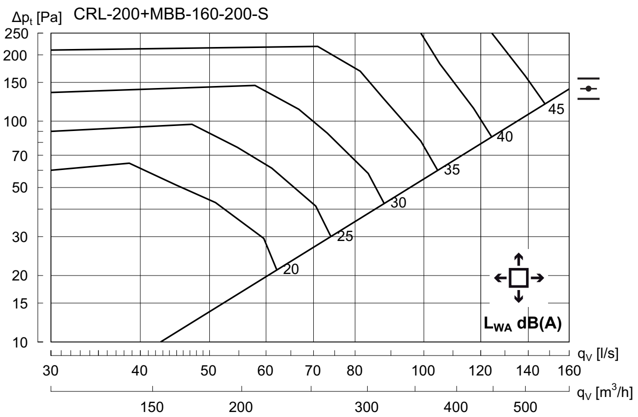


Hz	63	125	250	500	1K	2K	4K	8K
K_{ok}	9	3	1	-3	-5	-9	-15	-19

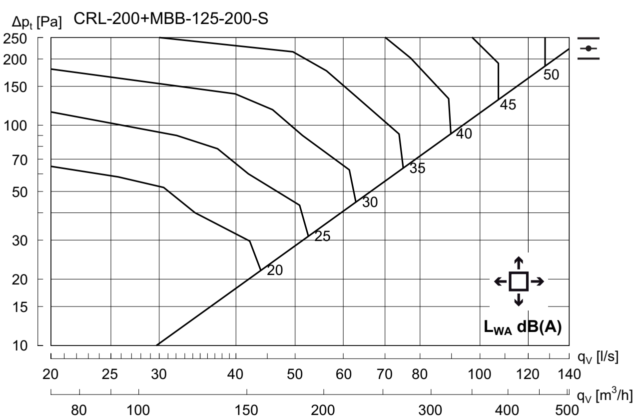
CRL 200 + MBB-S - Supply air



Hz	63	125	250	500	1K	2K	4K	8K
K_{ok}	12	11	1	-3	-7	-15	-20	-24



Hz	63	125	250	500	1K	2K	4K	8K
K_{ok}	12	8	1	-4	-5	-10	-18	-22



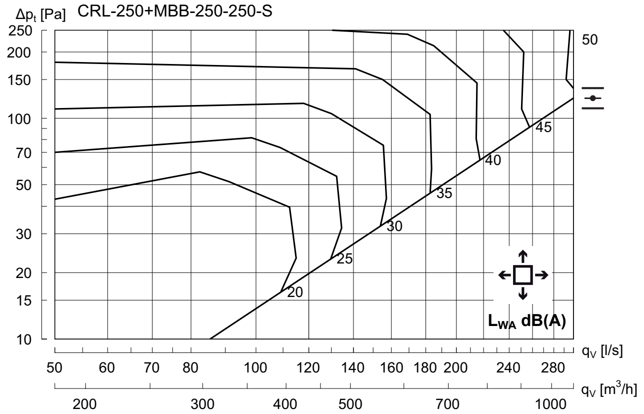
Hz	63	125	250	500	1K	2K	4K	8K
K_{ok}	10	5	1	-4	-5	-10	-16	-20

25-04-2017

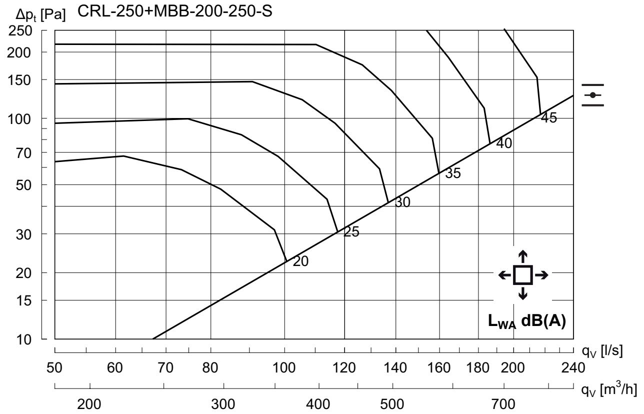
Plain diffuser CRL

Technical data

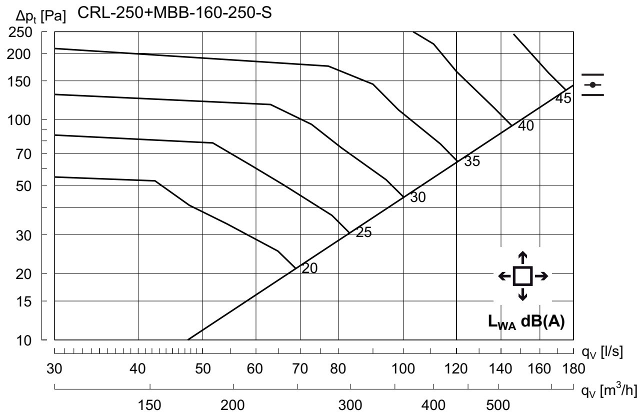
CRL 250+ MBB-S - Supply air



Hz	63	125	250	500	1K	2K	4K	8K
K_{ok}	15	7	0	-2	-6	-12	-16	-21

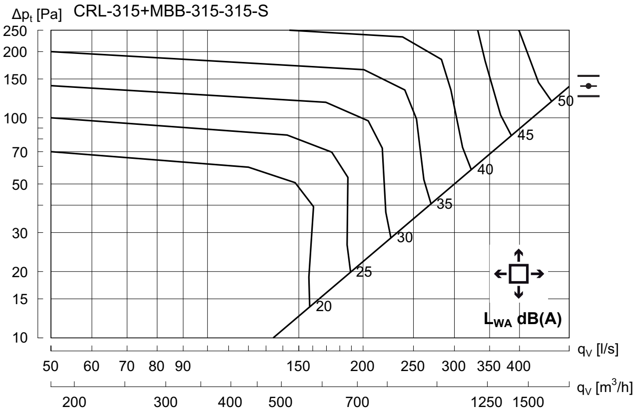


Hz	63	125	250	500	1K	2K	4K	8K
K_{ok}	11	7	-1	-2	-5	-12	-17	-22

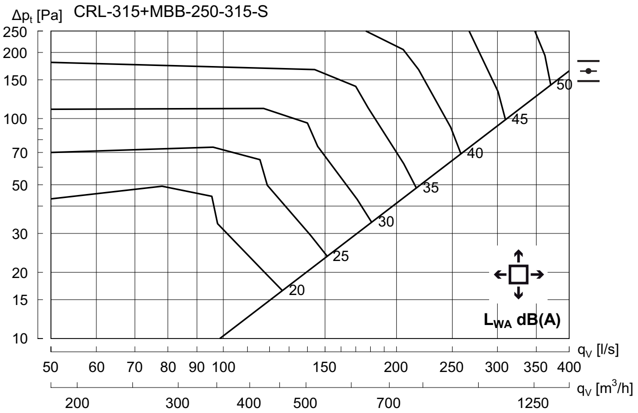


Hz	63	125	250	500	1K	2K	4K	8K
K_{ok}	11	6	1	-3	-5	-10	-15	-21

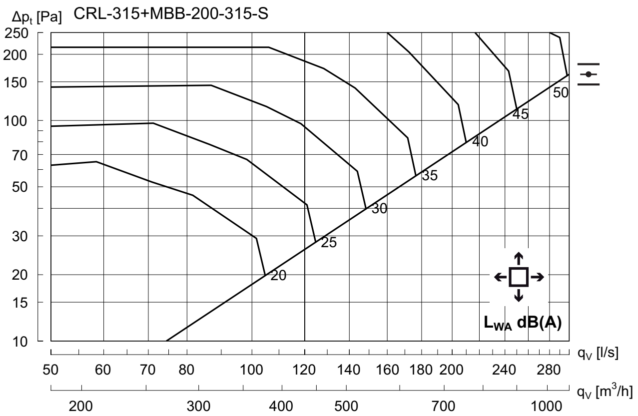
CRL 315 + MBB-S - Supply air



Hz	63	125	250	500	1K	2K	4K	8K
K_{ok}	15	4	1	-2	-6	-13	-17	-16



Hz	63	125	250	500	1K	2K	4K	8K
K_{ok}	13	6	-1	-2	-5	-12	-17	-23

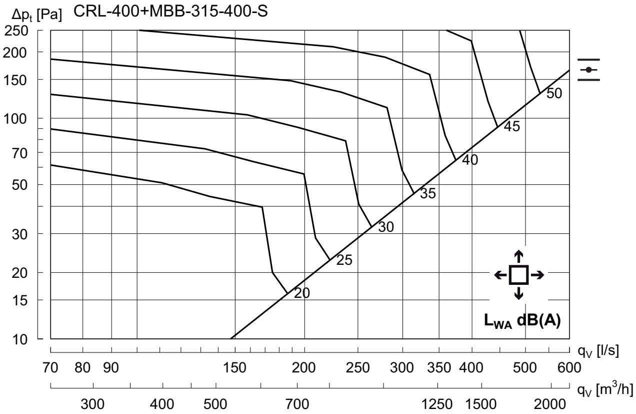


Hz	63	125	250	500	1K	2K	4K	8K
K_{ok}	11	7	0	-3	-6	-10	-16	-21

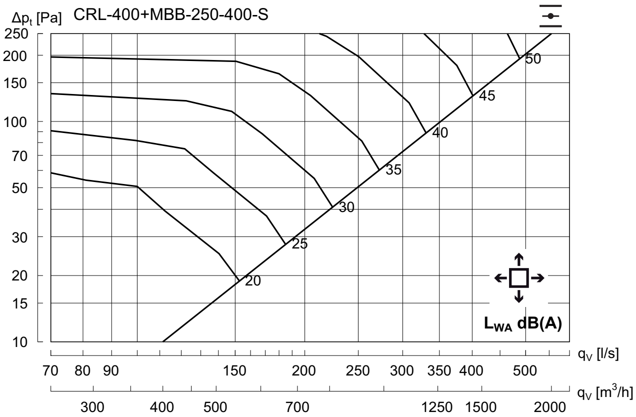
Plain diffuser CRL

Technical data

CRL 400+ MBB-S - Supply air



Hz	63	125	250	500	1K	2K	4K	8K
K_{ok}	11	3	0	-3	-5	-10	-14	-23



Hz	63	125	250	500	1K	2K	4K	8K
K_{ok}	8	4	-1	-3	-4	-10	-14	-20

CRL + MBB-S - Supply air

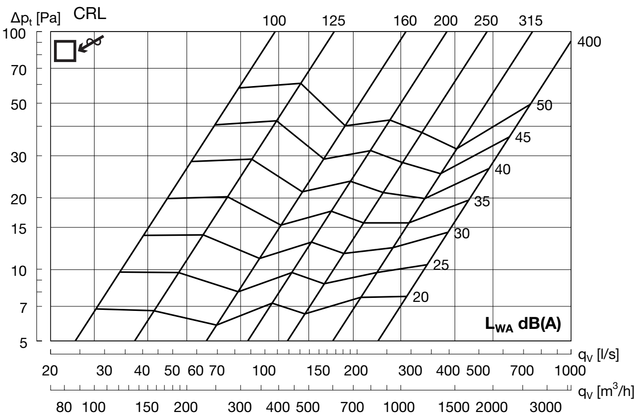
Correction vertical supply air, sound power level (L_{WA}) and pressure loss (Δp_t)

CRL + MBB-S		Correction factor	
duct	CRL	Vertical supply air	
$Ød_1$	$Ød_2$	L_{WA}	Δp_t
100	100	+ 6	x 1,3
100	125	+ 8	x 1,3
100	160	+ 3	x 1,1
125	125	+ 1	x 1
125	160	+ 8	x 1,2
125	200	+ 1	x 1
160	160	+ 10	x 1,5
160	200	+ 3	x 1,1
160	250	+ 0	x 1
200	200	+ 7	x 1,3
200	250	+ 0	x 1
200	315	+ 1	x 1
250	250	+ -2	x 1
250	315	+ 0	x 1
250	400	+ 0	x 1,1
315	315	+ -2	x 1,1
315	400	+ 3	x 1,2

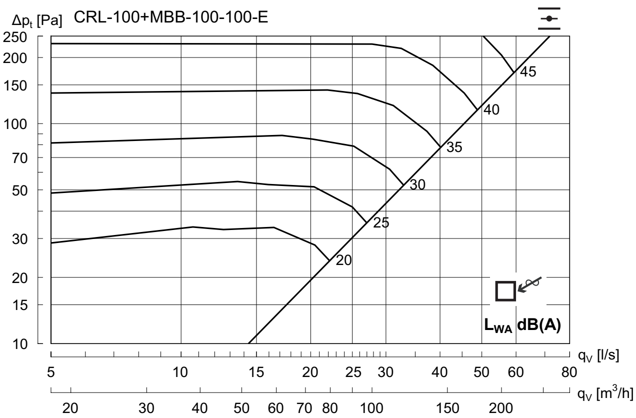
Plain diffuser CRL

Technical data

CRL without box - Extract air



CRL 100 + MBB-E - Extract air

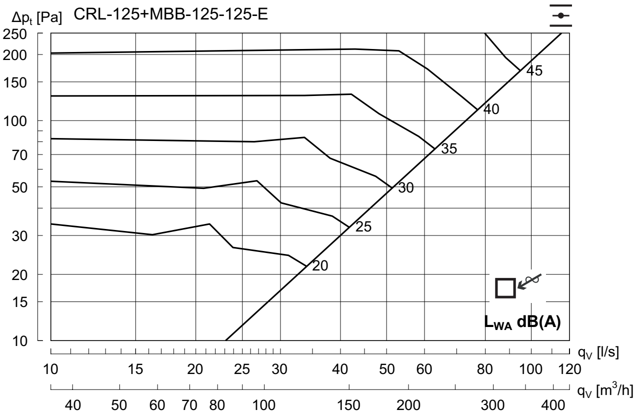


Hz	63	125	250	500	1K	2K	4K	8K
K_{ok}	11	0	2	-2	-6	-11	-15	-22

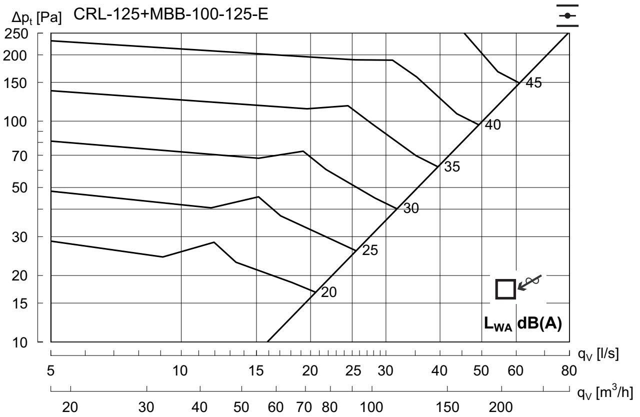
Plain diffuser CRL

Technical data

CRL 125 + MBB-E - Extract air

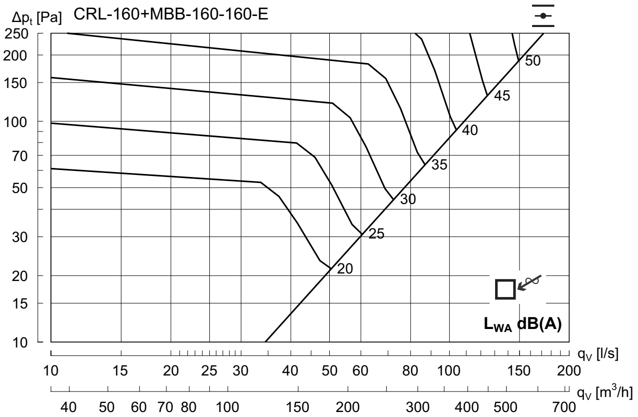


Hz	63	125	250	500	1K	2K	4K	8K
K_{ok}	14	5	-1	-3	-4	-12	-15	-21

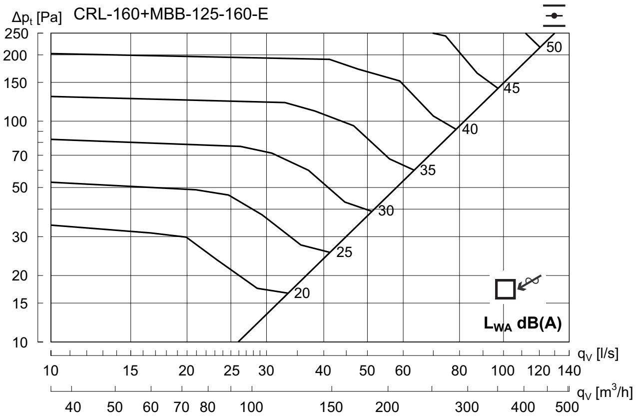


Hz	63	125	250	500	1K	2K	4K	8K
K_{ok}	13	0	4	-3	-8	-11	-17	-22

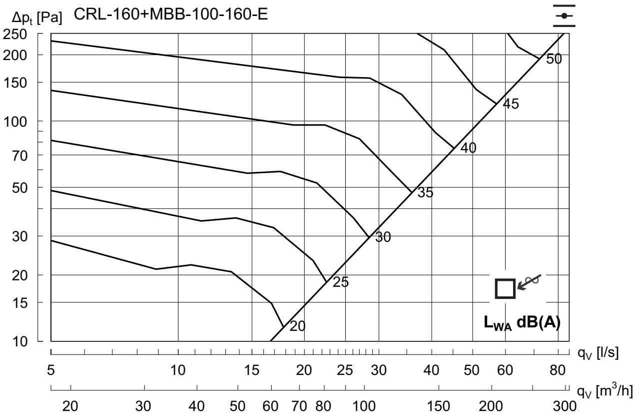
CRL 160 + MBB-E - Extract air



Hz	63	125	250	500	1K	2K	4K	8K
K_{ok}	14	4	-1	-4	-4	-10	-16	-24



Hz	63	125	250	500	1K	2K	4K	8K
K_{ok}	13	6	1	-3	-5	-12	-15	-21



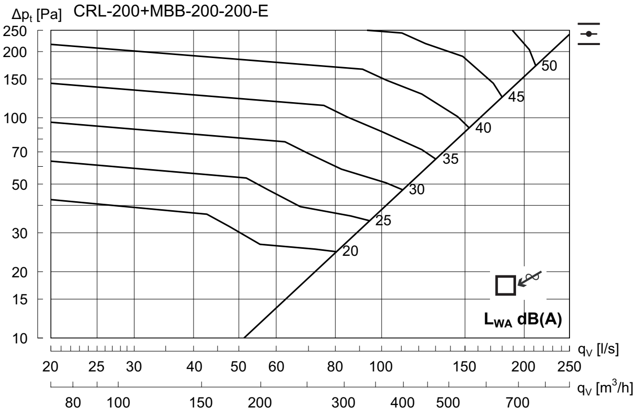
Hz	63	125	250	500	1K	2K	4K	8K
K_{ok}	13	0	5	-3	-9	-12	-19	-23

Plain diffuser CRL

Technical data

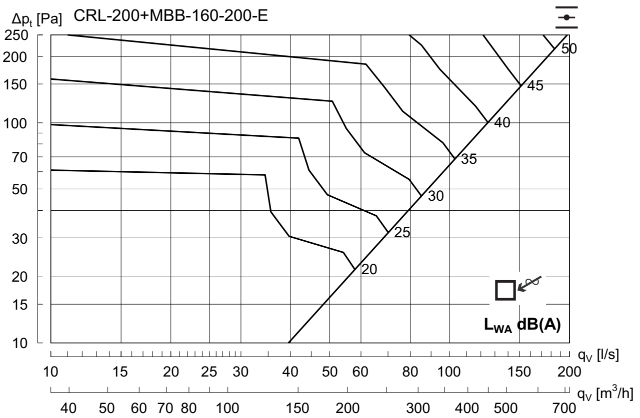
CRL 200 + MBB-E - Extract air

Δpt [Pa] CRL-200+MBB-200-200-E



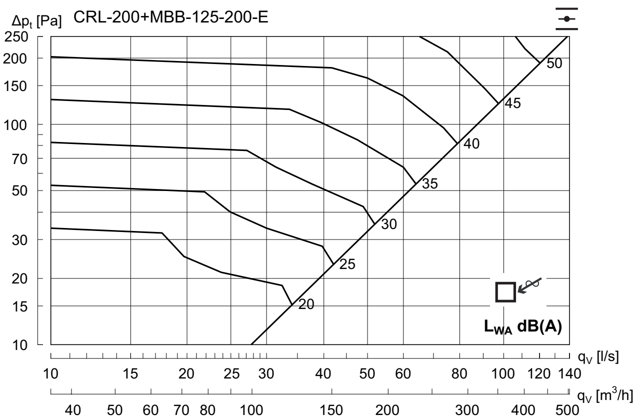
Hz	63	125	250	500	1K	2K	4K	8K
Kok	15	5	-1	-3	-6	-9	-16	-25

Δpt [Pa] CRL-200+MBB-160-200-E



Hz	63	125	250	500	1K	2K	4K	8K
Kok	14	5	0	-3	-5	-9	-15	-20

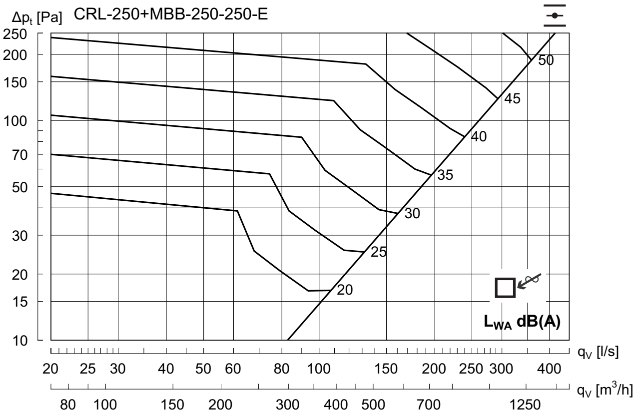
Δpt [Pa] CRL-200+MBB-125-200-E



Hz	63	125	250	500	1K	2K	4K	8K
Kok	9	2	1	-2	-5	-9	-14	-19

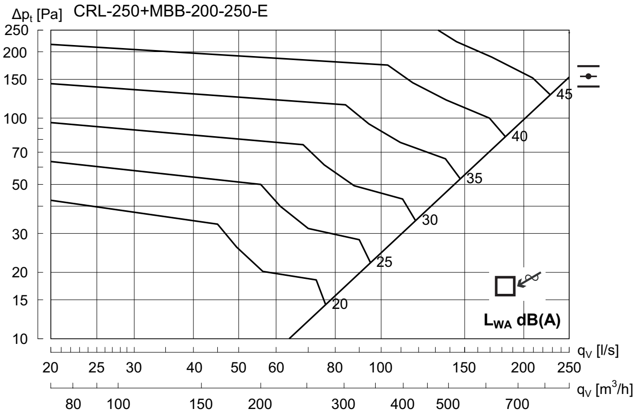
CRL 250 + MBB-E - Extract air

Δpt [Pa] CRL-250+MBB-250-250-E



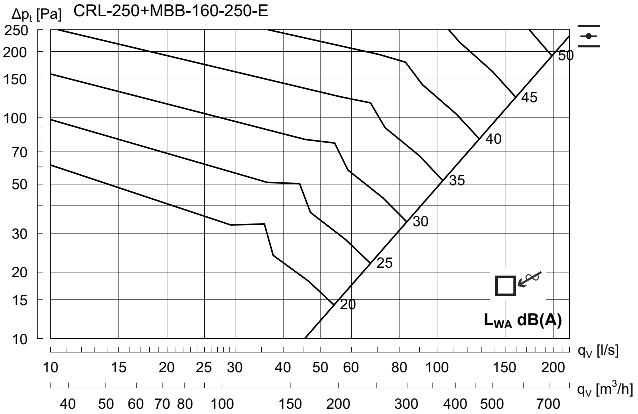
Hz	63	125	250	500	1K	2K	4K	8K
Kok	11	6	2	-2	-7	-11	-15	-24

Δpt [Pa] CRL-250+MBB-200-250-E



Hz	63	125	250	500	1K	2K	4K	8K
Kok	13	5	1	-3	-6	-10	-13	-22

Δpt [Pa] CRL-250+MBB-160-250-E



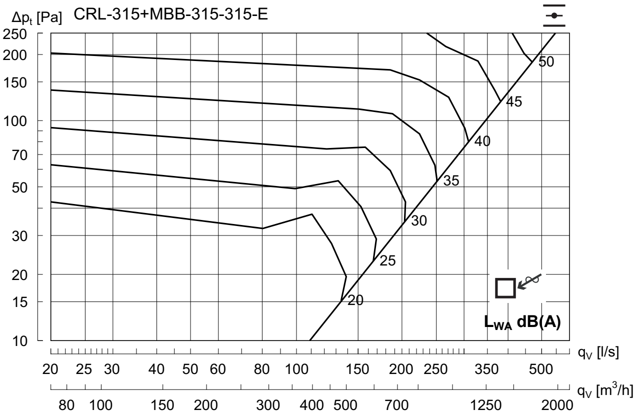
Hz	63	125	250	500	1K	2K	4K	8K
Kok	13	5	1	-3	-5	-11	-14	-20

Plain diffuser

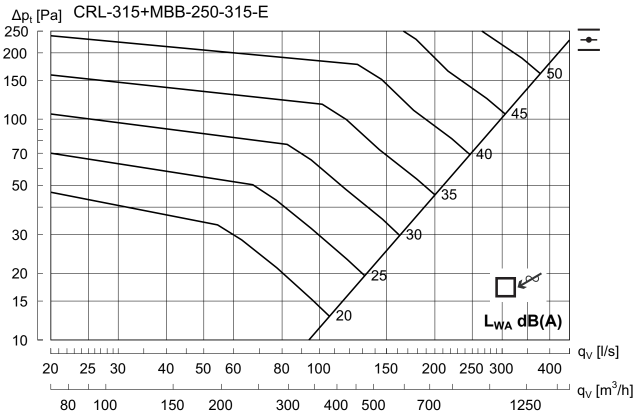
CRL

Technical data

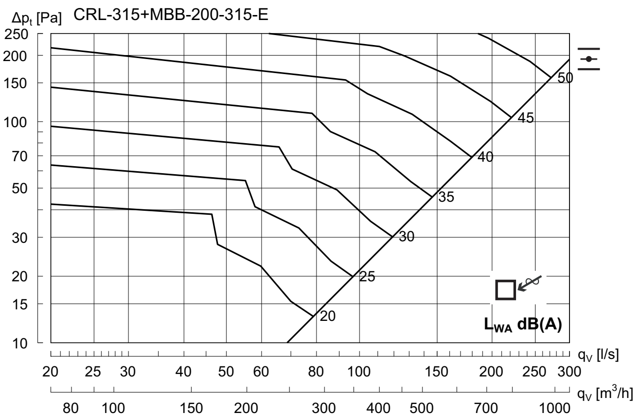
CRL 315 + MBB-E - Extract air



Hz	63	125	250	500	1K	2K	4K	8K
K_{ok}	13	5	2	-3	-6	-10	-15	-25

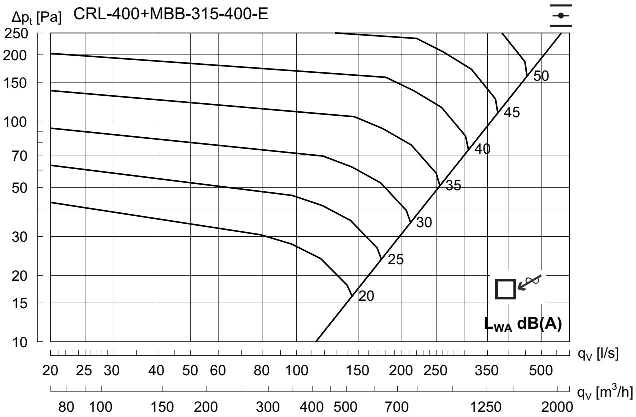


Hz	63	125	250	500	1K	2K	4K	8K
K_{ok}	9	5	2	-3	-6	-10	-16	-22

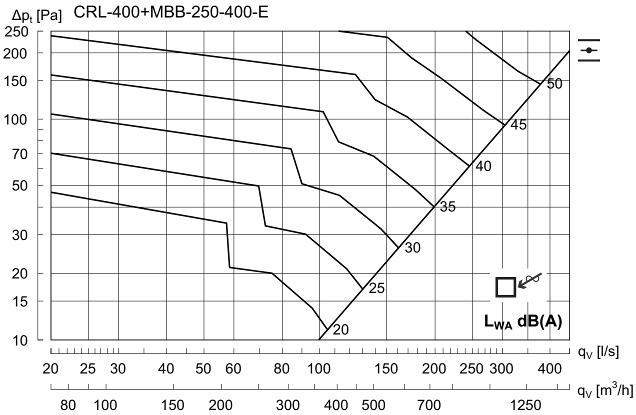


Hz	63	125	250	500	1K	2K	4K	8K
K_{ok}	13	5	0	-3	-5	-10	-15	-22

CRL 400 + MBB-E - Extract air



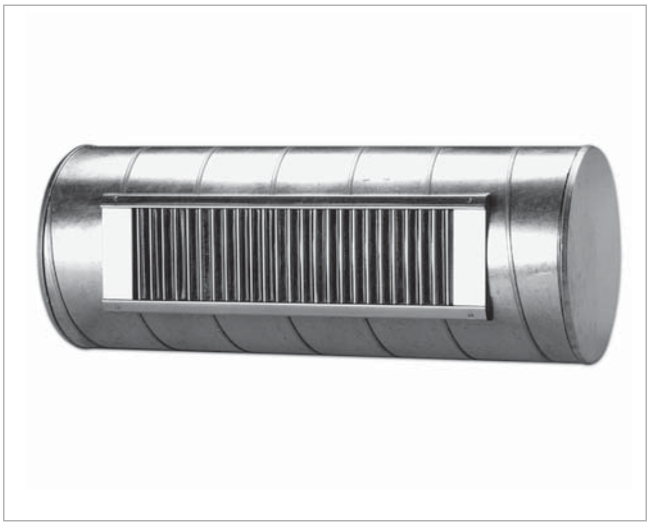
Hz	63	125	250	500	1K	2K	4K	8K
K_{ok}	11	5	2	-2	-7	-11	-15	-25



Hz	63	125	250	500	1K	2K	4K	8K
K_{ok}	9	6	2	-2	-6	-12	-16	-24

Circular duct grille

RGS



Description

RGS is a rectangular ventilation grille with vertical adjustable bars for direct installation in circular ducts. The grille can be used for both supply and exhaust air. The grille can be supplied with horizontal directional bars, straight or slanting sliding damper or blade damper. The grille is designed so that the grille flanges always fit tight to the duct regardless of the duct diameter. RGS is made of hot-galvanised steel plate and is put together without welding. This means that the grille can be used without further surface treatment. The exterior of the grille thus matches the duct surface.

- Can be used for both supply and exhaust air
- Installed directly in circular duct
- Can be fitted with many types of accessory

Maintenance

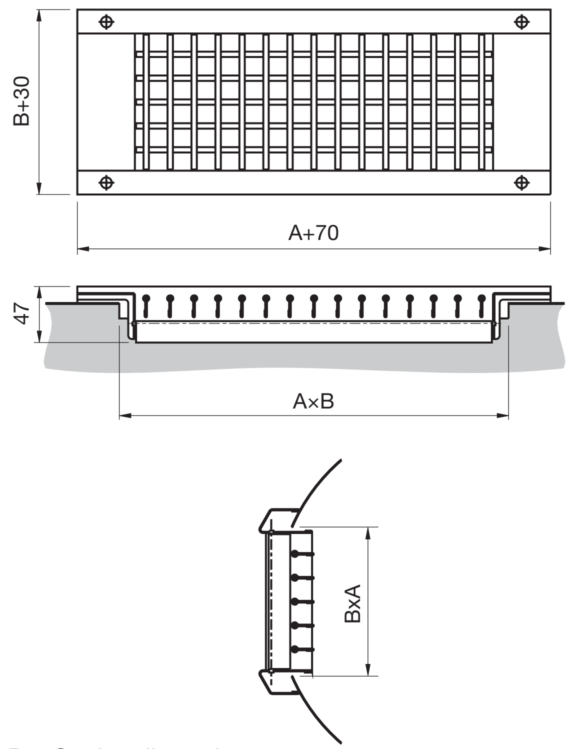
The grille should be removed to gain access to the duct.

Order code

Product	RGS	a	bbb	ccc
Type				
Accessories				
A - measure				
B - measure				

A x B = Cutting dimension

Dimensions



A x B = Cutting dimension

Screws included.

Materials and finish

Grille: Hot-galvanised steel
Sliding damper: Electro-galvanised steel
Blade damper: Electro-galvanised steel

The diffuser is available in other colours. Please contact Lindab's sales department for further information.

Circular duct grille

RGS

Dimensions

Measure A	x	B	Min duct measure mm	Free area $F(m^2)$	C - Measure mm	RGS 1 Weight kg
325	X	75	160	0.017	106	1.10
325	X	75	160	0.017	106	1.10
325	X	150	315	0.034	106	1.40
325	X	225	500	0.056	106	2.20
425	X	75	160	0.023	116	1.40
425	X	125	250	0.037	116	1.80
425	X	150	315	0.045	116	1.90
425	X	225	500	0.074	116	3,00
525	X	75	160	0.028	126	1.70
525	X	125	250	0.047	126	2,00
525	X	150	315	0.056	126	2.30
525	X	225	500	0.093	126	3.40
625	X	75	160	0.034	131	1.90
625	X	125	250	0.056	131	2.40
625	X	150	315	0.068	131	2.60
625	X	225	500	0.112	131	3.70
825	X	75	160	0.045	151	2.40
825	X	125	250	0.074	151	3.10
825	X	150	315	0.093	151	3.50
825	X	225	500	0.148	151	5.10
1025	X	75	200	0.056	186	2.90
1225	X	75	200	0.068	186	3.20
1225	X	125	250	0.112	186	4,00
1225	X	150	315	0.136	186	4.40
1225	X	225	500	0.224	186	6.30

Use

RGS-2
Suitable for supply and exhaust air. The grille is equipped with a single adjustment damper and has a lower sound level than RGS-6.

RGS-3
As RGS-2 with horizontal directional bars specifically for supply air.

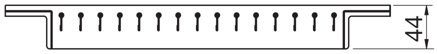
RGS-4
The grille is suitable for exhaust only.

RGS-6 Slanting sliding damper
Suitable for supply and exhaust air. The grille is equipped with a slanting sliding damper, which means the air is distributed evenly over the whole grille.

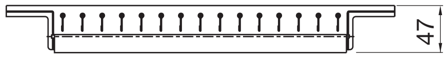
RGS-7
As RGS-6 with horizontal directional bars specifically for supply air.

Accessories

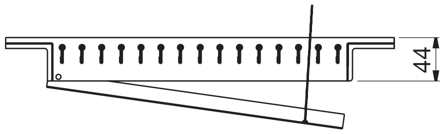
RGS-0, without accessories.



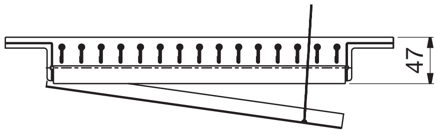
RGS-1, With directional bars.



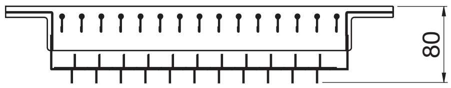
RGS-2, With blade damper.



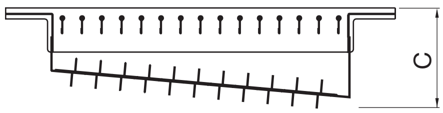
RGS-3, With directional bars and blade damper.



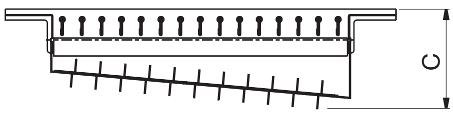
RGS-4, With straight sliding damper.



RGS-6, With slanting sliding damper.



RGS-7, With directional bars and slanting sliding damper.



Circular duct grille — RGS

Technical data

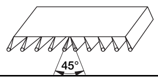
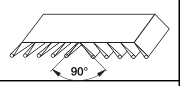
Effective speed v_0

The diagram for throw (see next page) specifies effective speed v_0 [m/s] as a function of the volume flow q [m^3/h, l/s] for each grille size with 0º bar setting.

Throw $l_{0.2}$

The diagram for throw (see next page) specifies the throw $l_{0.2}$ [m] at an average terminal velocity of 0.2 m/s, 0º bar setting without ceiling effect. (Distance from grille to ceiling greater than 800 mm.)

Table 1: Correction for dispersal:

Bar setting		
Correction factor V_0	1,1	1,2
Correction factor $l_{0,2}$	0,8	0,5

Ceiling effect

If the distance from grille to ceiling is less than 300 mm, the throw $l_{0.2}$ must be multiplied by 1.4.

Total pressure p_t

The diagram "Pressure – sound level" page 414 states the grille's total pressure p_t [Pa].

Sound effect level L_{WA}

The diagram "Pressure – sound level" states the grille's sound effect level L_{WA} [dB(A)] at a free area of 0.05 m^2.

Table 2: Correction for free area:

Correction free area											
F [m^2]	0,02	0,025	0,03	0,04	0,05	0,06	0,08	0,1	0,13	0,17	0,2
correction [dB]	-4	-3	-2	-1	0	+1	+2	+3	+4	+5	+6

Duct speed v_k

Pressure and sound effect level are stated for different duct speeds v_k [m/s].

For duct speeds v_k < 1 m/s, the sound values L_{WA} must be corrected by -7 dB.

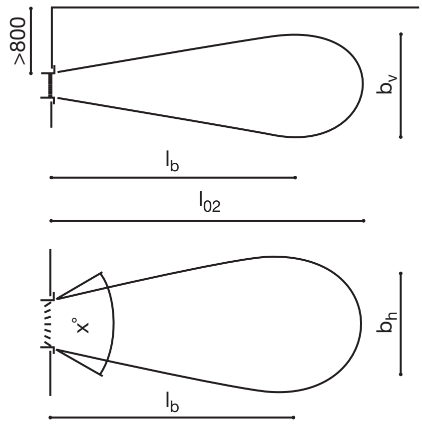
The diagrams on the following pages are in table form. See dimensioning tables.

The values apply to grilles with 0º dispersal.

Table 3: Correction for dispersal:

Bar setting	45º	90º
Pressure	x1,15	x1,3
Sound power level	+1	+2

Air jet dispersal



$b_v = 0{,}1 \times l_{0,2}$
$l_b = 0{,}5 \times l_{0,2}$

X = 0º : $b_h = 0.3 \times l_{0.2}$ $l_b = 0.5 \times l_{0.2}$
X = 45º : $b_h = 0.4 \times l_{0.2}$ $l_b = 0.5 \times l_{0.2}$
X = 90º : $b_h = 0.6 \times l_{0.2}$ $l_b = 0.5 \times l_{0.2}$

$l_{0.2}$: catalogue values

Sample calculation 1

Room width: W = 6 m,	Room height: H = 2.6 m
Volume flow per grille:	300 m^3/h
Duct speed	v_k = 4 m/s
Speed in the occupied zone:	< 0.25 m/s

From next page:

$$v_x = \frac{l_{0,2}}{B + C} \times 0{,}2 \qquad C = H - 1{,}8 = 0{,}8 \text{ m}$$

$$v_x = \leq 0{,}25 \text{ m/s} \qquad B + C = 6{,}8 \text{ m}$$

$$l_{0,2} \leq (B + C) \times \frac{v_x}{0{,}2} \leq 6{,}8 \times \frac{0{,}25}{0{,}20} \leq 8{,}5 \text{ m}$$

The diagram "Effective speed v_o- Throw $l_{0.2}$" (next pages):

Grille 625 x 75: $l_{0.2}$ = 8.0 m
v_o = 2.5 m/s

Pressure loss and sound effect level:
The diagram "Pressure – Sound level": 100% open damper

v_0 = 2.5 m/s v_k = 4.0 m/s
p_t = 23 Pa
L_{WA} = 44 dB(A)

Free area: 0.034 m^2
Correction table 2: - 2

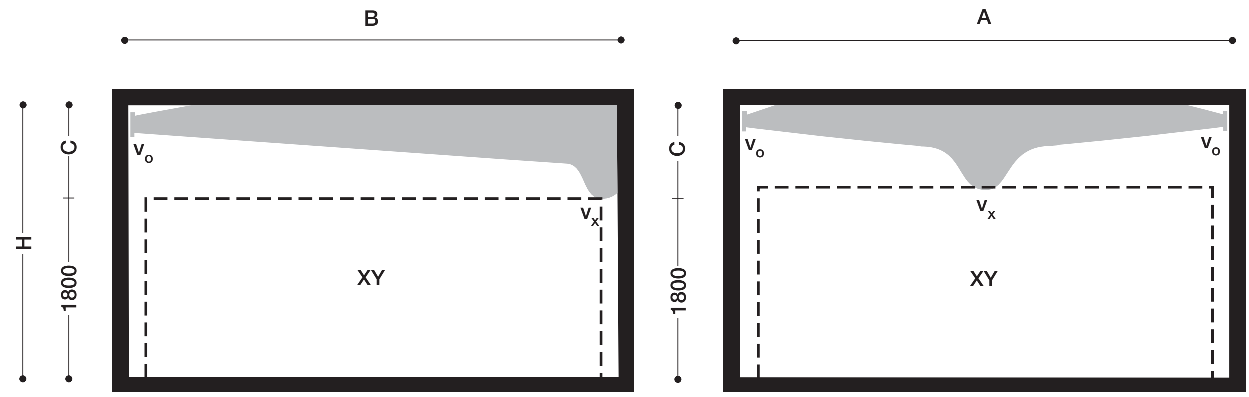
L_{WA} = 44 - 2 = 42 dB(A)

The diagram "Pressure – Sound level": 50% open damper:

p_t = 42 Pa
L_{WA} = 50 - 2 = 48 dB(A)

Circular duct grille RGS

Technical data - Supply air



XY = occupied zone

Final velocities

The speed in occupied zone v_X:

$$v_x = \frac{l_{0,2}}{B + C} \text{ x } 0,2 \text{ m/s} \qquad v_x = \frac{l_{0,2}}{\frac{A}{2} + C} \text{ x } 0,2 \text{ m/s}$$

Terminal velocity v_X at distance X:

$$v_x = \frac{l_{0,2} \text{ x } 0,2}{X}$$

Other terminal velocities v_X:
The distance to the point where the speed has decreased to

v_X is:

$X = K \text{ x } l_{0.2}$

Table 4:

v_x	0,15	0,2	0,25	0,3	0,35	0,4
K	1,33	1,0	0,8	0,67	0,57	0,5

Sample calculation 2

Room: Width: W = 7 m, Height: 2.7 m

C = 2.7 – 1.8 = 0.9 m

Grille: 825 x 75 Volume flow: 400 m^3/h

Throw according to the diagram on the next page:

$l_{0.2}$ = 9.0 m

The speed in the occupied zone:

$$v_x = \frac{l_{0,2}}{B + C} \text{ x } 0,2 = \frac{9,0}{7,9} \text{ x } 0,2 = 0,23 \text{ m/s}$$

The speed 4 m from the grille is:

$$v_X = \frac{l_{0,2} \text{ x } 0,2}{B + C} = \frac{9 \text{ x } 0,2}{4} = 0,45 \text{ m/s}$$

The distance to the point where the speed has decreased to 0,3 m/s is:

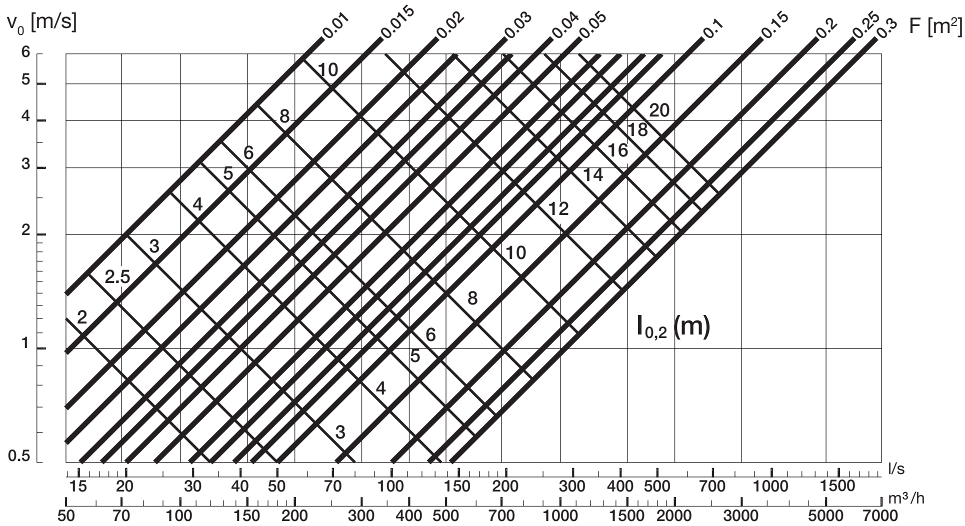
0,67 x $l_{0,2}$ = 0,67 x 9 = 6,0 m

Circular duct grille

RGS

Technical data - Supply and exhaust air

Effective speed v_0 - Throw $l_{0.2}$



Sample calculation 3

Grille 1025 x 75

Volume flow: 500 m^3/h

Supply air speed: v_0 = 2.7 m/s

Throw: $l_{0.2}$ = 10.0 m

With 90º dispersal: (See table 1, previous page)

v_0 = 1.2 x 2.7 = 3.2 m/s

$l_{0.2}$ = 0.5 x 10.0 = 5.0 m.

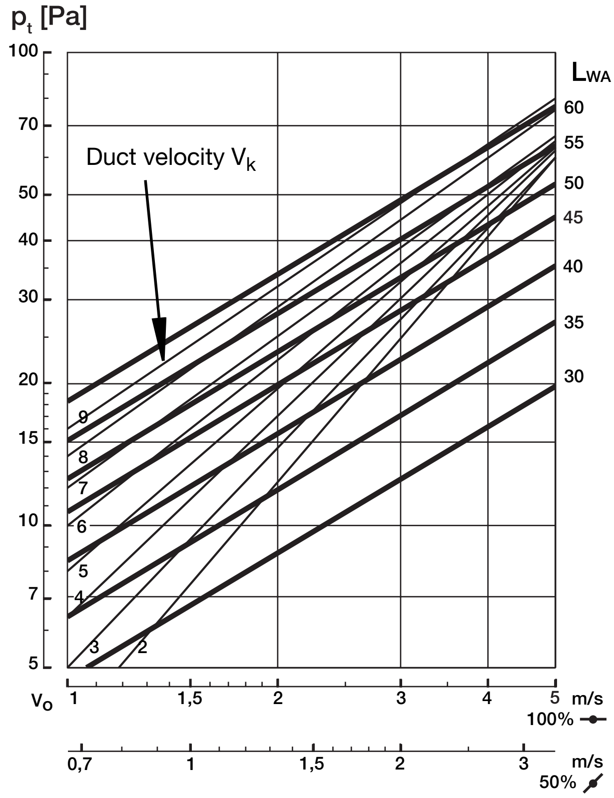
Circular duct grille RGS

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

Technical data- - Supply and exhaust air

Pressure - Sound level

RGS with accessories 4, 6 and 7



Correction

Correction for RGS with accessories 2 and 3.

Table 5:

Total pressure p_t	x 0,75	Pa
Sound power level L_{WA}	-3	dB(A)

Table 6: Correction for free area.:

Correction free area											
F [m²]	0,02	0,025	0,03	0,04	0,05	0,06	0,08	0,1	0,13	0,17	0,2
correction [dB]	-4	-3	-2	-1	0	+1	+2	+3	+4	+5	+6

Sample calculation 4

RGS-6 625 x 75 Area: 0.034 m²

Volume flow: 250 m³/h

Supply air speed: $v_0 = 2.0$ m/s

Duct speed: $v_k = 4$ m/s

100% open damper:

$p_t = 17$ Pa
$L_{WA} = 42$ dB

Table 6:

0.03 m²: -2 dB
$L_{WA} = 42 - 2 = 40$ dB

50% open damper:

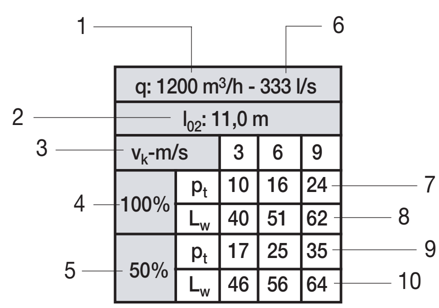
$p_t = 30$ Pa
$L_{WA} = 47 - 2 = 45$ dB

Dimensioning tables for RGS

The following pages contain dimensioning tables for RGS with accessories 4, 6 and 7.
Correction for RGS with accessories 2 and 3 - see table 5.

Explanation for dimensioning tables

1. Volume of air (m³/h)
2. Throw
3. Duct speed
4. 100% open damper
5. 50% open damper
6. Volume of air (l/s)
7. Pressure loss
8. Sound level
9. Pressure loss
10. Sound level



Circular duct grille RGS

Technical data-Supply and exhaust air

Dimensioning table with accessories 4, 6 and 7

B dimension: 75 mm

325×75 0,017 m^2	**q: 75 m^3/h - 21 l/s $l_{0,2}$: 2,0 m**					**q: 100 m^3/h - 28 l/s $l_{0,2}$: 3,0 m**					**q: 150 m^3/h - 42 l/s $l_{0,2}$: 4,5 m**					**q: 200 m^3/h - 56 l/s $l_{0,2}$: 7,0 m**					**q: 250 m^3/h - 69 l/s $l_{0,2}$: 9,0 m**				
	v_k-m/s		3	6	9	v_k-m/s		3	6	9	v_k-m/s		3	6	9	v_k-m/s		3	6	9	v_k-m/s		3	6	9
	100%	p_t	7	12	20	100%	p_t	11	17	26	100%	p_t	20	28	38	100%	p_t	30	38	52	100%	p_t	43	51	62
		L_W	29	41	49		L_W	32	43	54		L_W	37	46	55		L_W	41	49	56		L_W	45	50	56
	50%	p_t	12	21	30	50%	p_t	21	28	40	50%	p_t	38	45	60	50%	p_t	60	65	81	50%	p_t	83	92	104
		L_W	34	44	54		L_W	38	46	55		L_W	44	50	56		L_W	49	51	58		L_W	54	57	60
425×75 0,023 m^2	**q: 100 m^3/h - 28 l/s $l_{0,2}$: 2,5 m**					**q: 150 m^3/h - 42 l/s $l_{0,2}$: 4,5 m**					**q: 200 m^3/h - 56 l/s $l_{0,2}$: 5,5 m**					**q: 250 m^3/h - 69 l/s $l_{0,2}$: 7,0 m**					**q: 300 m^3/h - 83 l/s $l_{0,2}$: 9,0 m**				
	v_k-m/s		3	6	9	v_k-m/s		3	6	9	v_k-m/s		3	6	9	v_k-m/s		3	6	9	v_k-m/s		3	6	9
	100%	p_t	7	12	20	100%	p_t	12	20	29	100%	p_t	20	28	38	100%	p_t	27	35	48	100%	p_t	36	44	56
		L_W	29	42	50		L_W	34	44	53		L_W	38	47	56		L_W	41	49	56		L_W	44	51	56
	50%	p_t	12	21	30	50%	p_t	26	31	43	50%	p_t	38	45	60	50%	p_t	51	56	74	50%	p_t	70	79	90
		L_W	35	45	55		L_W	40	49	56		L_W	45	51	57		L_W	49	51	58		L_W	53	57	60
525×75 0,028 m^2	**q: 150 m^3/h - 42 l/s $l_{0,2}$: 3,9 m**					**q: 200 m^3/h - 56 l/s $l_{0,2}$: 5,5 m**					**q: 250 m^3/h - 69 l/s $l_{0,2}$: 7,5 m**					**q: 300 m^3/h - 83 l/s $l_{0,2}$: 9,0 m**					**q: 350 m^3/h - 97 l/s $l_{0,2}$: 10,0 m**				
	v_k-m/s		3	6	9	v_k-m/s		3	6	9	v_k-m/s		3	6	9	v_k-m/s		3	6	9	v_k-m/s		3	6	9
	100%	p_t	11	16	25	100%	p_t	14	22	32	100%	p_t	21	28	38	100%	p_t	25	35	48	100%	p_t	35	43	55
		L_W	33	44	55		L_W	36	46	56		L_W	39	48	57		L_W	41	50	57		L_W	45	52	58
	50%	p_t	20	28	38	50%	p_t	28	37	47	50%	p_t	38	47	60	50%	p_t	47	55	68	50%	p_t	69	78	89
		L_W	39	47	56		L_W	42	50	57		L_W	46	52	58		L_W	49	53	59		L_W	54	58	61
625×75 0,034 m^2	**q: 200 m^3/h - 56 l/s $l_{0,2}$: 5,0 m**					**q: 250 m^3/h - 69 l/s $l_{0,2}$: 6,5 m**					**q: 300 m^3/h - 83 l/s $l_{0,2}$: 8,5 m**					**q: 350 m^3/h - 97 l/s $l_{0,2}$: 9,5 m**					**q: 400 m^3/h - 111 l/s $l_{0,2}$: 10,5 m**				
	v_k-m/s		3	6	9	v_k-m/s		3	6	9	v_k-m/s		3	6	9	v_k-m/s		3	6	9	v_k-m/s		3	6	9
	100%	p_t	11	16	25	100%	p_t	14	22	32	100%	p_t	21	28	38	100%	p_t	25	35	48	100%	p_t	30	38	52
		L_W	34	45	54		L_W	37	47	57		L_W	40	49	58		L_W	42	51	58		L_W	44	52	59
	50%	p_t	20	30	40	50%	p_t	28	37	47	50%	p_t	38	47	60	50%	p_t	48	57	67	50%	p_t	60	65	81
		L_W	40	48	57		L_W	43	51	58		L_W	47	53	59		L_W	50	54	60		L_W	52	54	61
825×75 0,045 m^2	**q: 250 m^3/h - 69 l/s $l_{0,2}$: 5,2 m**					**q: 300 m^3/h - 83 l/s $l_{0,2}$: 7,0 m**					**q: 400 m^3/h - 111 l/s $l_{0,2}$: 9,0 m**					**q: 500 m^3/h - 139 l/s $l_{0,2}$: 10,5 m**					**q: 600 m^3/h - 167 l/s $l_{0,2}$: 12,0 m**				
	v_k-m/s		3	6	9	v_k-m/s		3	6	9	v_k-m/s		3	6	9	v_k-m/s		3	6	9	v_k-m/s		3	6	9
	100%	p_t	10	16	24	100%	p_t	12	20	29	100%	p_t	21	28	38	100%	p_t	27	35	48	100%	p_t	37	46	57
		L_W	35	46	57		L_W	37	47	56		L_W	41	50	59		L_W	44	52	59		L_W	48	55	60
	50%	p_t	17	25	35	50%	p_t	26	31	43	50%	p_t	38	47	60	50%	p_t	51	56	74	50%	p_t	72	82	93
		L_W	40	50	58		L_W	43	52	59		L_W	48	54	60		L_W	52	54	61		L_W	57	60	63
1025×75 0,056 m^2	**q: 300 m^3/h - 83 l/s $l_{0,2}$: 6,0 m**					**q: 400 m^3/h - 111 l/s $l_{0,2}$: 8,5 m**					**q: 500 m^3/h - 139 l/s $l_{0,2}$: 10,0 m**					**q: 600 m^3/h - 167 l/s $l_{0,2}$: 11,5 m**					**q: 700 m^3/h - 194 l/s $l_{0,2}$: 13,0 m**				
	v_k-m/s		3	6	9	v_k-m/s		3	6	9	v_k-m/s		3	6	9	v_k-m/s		3	6	9	v_k-m/s		3	6	9
	100%	p_t	10	16	24	100%	p_t	14	22	32	100%	p_t	21	28	38	100%	p_t	27	35	48	100%	p_t	35	43	55
		L_W	36	47	58		L_W	39	49	59		L_W	42	51	60		L_W	45	53	60		L_W	48	55	61
	50%	p_t	17	25	35	50%	p_t	28	37	47	50%	p_t	38	47	60	50%	p_t	51	56	74	50%	p_t	69	78	89
		L_W	41	51	59		L_W	45	53	60		L_W	49	55	61		L_W	53	55	61		L_W	57	61	64
1225×75 0,068 m^2	**q: 400 m^3/h - 111 l/s $l_{0,2}$: 7,0 m**					**q: 500 m^3/h - 139 l/s $l_{0,2}$: 9,0 m**					**q: 600 m^3/h - 167 l/s $l_{0,2}$: 10,5 m**					**q: 700 m^3/h - 194 l/s $l_{0,2}$: 11,5 m**					**q: 800 m^3/h - 222 l/s $l_{0,2}$: 13,0 m**				
	v_k-m/s		3	6	9	v_k-m/s		3	6	9	v_k-m/s		3	6	9	v_k-m/s		3	6	9	v_k-m/s		3	6	9
	100%	p_t	11	17	26	100%	p_t	14	22	32	100%	p_t	21	28	38	100%	p_t	25	35	48	100%	p_t	30	38	52
		L_W	37	48	59		L_W	40	50	60		L_W	43	52	61		L_W	45	54	61		L_W	47	55	62
	50%	p_t	20	28	38	50%	p_t	28	37	47	50%	p_t	38	47	60	50%	p_t	48	57	68	50%	p_t	60	65	81
		L_W	43	51	60		L_W	46	52	61		L_W	50	54	62		L_W	53	57	63		L_W	55	57	64

Circular duct grille

RGS

Technical data- Supply and exhaust air

Dimensioning table with accessories 4, 6 and 7

B dimension: 125 mm

Size	q	$l_{0,2}$			v_k-m/s 3	6	9
325×125 0,028 m²	150 m³/h - 42 l/s	3,9 m	100%	p_t	11	16	25
			100%	L_W	33	44	55
			50%	p_t	20	28	38
			50%	L_W	39	47	56
	200 m³/h - 56 l/s	5,5 m	100%	p_t	14	22	32
			100%	L_W	36	46	56
			50%	p_t	28	37	47
			50%	L_W	42	50	57
	250 m³/h - 69 l/s	7,5 m	100%	p_t	21	28	38
			100%	L_W	39	48	57
			50%	p_t	38	47	60
			50%	L_W	46	52	58
	300 m³/h - 83 l/s	9,0 m	100%	p_t	25	35	48
			100%	L_W	41	50	57
			50%	p_t	47	55	68
			50%	L_W	49	53	59
	350 m³/h - 97 l/s	10,0 m	100%	p_t	35	43	55
			100%	L_W	45	52	58
			50%	p_t	69	78	89
			50%	L_W	54	58	61
425×125 0,037 m²	200 m³/h - 56 l/s	4,5 m	100%	p_t	10	16	24
			100%	L_W	34	45	56
			50%	p_t	17	25	35
			50%	L_W	39	49	57
	250 m³/h - 69 l/s	6,0 m	100%	p_t	12	20	28
			100%	L_W	36	46	55
			50%	p_t	26	35	46
			50%	L_W	42	49	57
	300 m³/h - 83 l/s	7,5 m	100%	p_t	19	26	36
			100%	L_W	40	49	57
			50%	p_t	34	44	56
			50%	L_W	46	52	59
	350 m³/h - 97 l/s	9,0 m	100%	p_t	22	29	39
			100%	L_W	40	50	59
			50%	p_t	43	52	62
			50%	L_W	47	53	59
	400 m³/h - 111 l/s	10,0 m	100%	p_t	27	35	48
			100%	L_W	43	51	58
			50%	p_t	51	56	74
			50%	L_W	51	53	59
525×125 0,047 m²	250 m³/h - 69 l/s	5,2 m	100%	p_t	10	16	24
			100%	L_W	35	46	57
			50%	p_t	17	25	35
			50%	L_W	40	50	58
	300 m³/h - 83 l/s	7,0 m	100%	p_t	12	20	29
			100%	L_W	37	47	56
			50%	p_t	26	31	43
			50%	L_W	43	52	59
	400 m³/h - 111 l/s	9,0 m	100%	p_t	21	28	38
			100%	L_W	41	50	59
			50%	p_t	38	47	60
			50%	L_W	48	54	60
	500 m³/h - 139 l/s	10,5 m	100%	p_t	27	35	48
			100%	L_W	44	52	59
			50%	p_t	51	56	74
			50%	L_W	52	54	61
	600 m³/h - 167 l/s	12,0 m	100%	p_t	37	46	57
			100%	L_W	48	55	60
			50%	p_t	72	82	93
			50%	L_W	57	60	63
625×125 0,056 m²	300 m³/h - 83 l/s	6,0 m	100%	p_t	10	16	24
			100%	L_W	36	47	58
			50%	p_t	17	25	35
			50%	L_W	41	51	59
	400 m³/h - 111 l/s	8,5 m	100%	p_t	14	22	32
			100%	L_W	39	49	59
			50%	p_t	28	37	47
			50%	L_W	45	53	60
	500 m³/h - 139 l/s	10,0 m	100%	p_t	21	28	38
			100%	L_W	42	51	60
			50%	p_t	38	47	60
			50%	L_W	49	55	61
	600 m³/h - 167 l/s	11,5 m	100%	p_t	27	35	48
			100%	L_W	45	53	60
			50%	p_t	51	56	74
			50%	L_W	53	55	61
	700 m³/h - 194 l/s	13,0 m	100%	p_t	35	43	55
			100%	L_W	48	55	61
			50%	p_t	69	78	89
			50%	L_W	57	61	64
825×125 0,074 m²	400 m³/h - 111 l/s	7,5 m	100%	p_t	10	16	24
			100%	L_W	36	47	58
			50%	p_t	17	25	35
			50%	L_W	42	52	60
	500 m³/h - 139 l/s	9,0 m	100%	p_t	12	20	28
			100%	L_W	39	49	58
			50%	p_t	26	35	46
			50%	L_W	45	52	60
	600 m³/h - 167 l/s	11,0 m	100%	p_t	19	26	36
			100%	L_W	43	52	60
			50%	p_t	34	44	56
			50%	L_W	49	55	61
	700 m³/h - 194 l/s	11,5 m	100%	p_t	22	29	39
			100%	L_W	43	53	62
			50%	p_t	43	52	62
			50%	L_W	50	56	62
	800 m³/h - 222 l/s	13,0 m	100%	p_t	27	35	48
			100%	L_W	46	54	62
			50%	p_t	51	56	74
			50%	L_W	54	56	62
1025×125 0,093 m²	500 m³/h - 139 l/s	8,0 m	100%	p_t	10	16	24
			100%	L_W	37	48	59
			50%	p_t	17	25	35
			50%	L_W	43	53	61
	600 m³/h - 167 l/s	9,5 m	100%	p_t	12	20	29
			100%	L_W	40	50	59
			50%	p_t	26	31	43
			50%	L_W	46	55	62
	700 m³/h - 194 l/s	10,5 m	100%	p_t	16	23	33
			100%	L_W	40	52	61
			50%	p_t	29	39	50
			50%	L_W	48	56	63
	800 m³/h - 222 l/s	12,0 m	100%	p_t	20	28	38
			100%	L_W	44	53	62
			50%	p_t	38	45	60
			50%	L_W	51	57	63
	1000 m³/h - 278 l/s	14,0 m	100%	p_t	27	35	48
			100%	L_W	47	55	63
			50%	p_t	51	56	74
			50%	L_W	55	57	63
1225×125 0,112 m²	600 m³/h - 167 l/s	9,0 m	100%	p_t	10	16	24
			100%	L_W	38	49	60
			50%	p_t	17	25	35
			50%	L_W	44	54	62
	700 m³/h - 194 l/s	10,0 m	100%	p_t	12	19	27
			100%	L_W	41	51	62
			50%	p_t	21	30	41
			50%	L_W	46	55	63
	800 m³/h - 222 l/s	11,5 m	100%	p_t	14	22	32
			100%	L_W	42	52	62
			50%	p_t	28	37	47
			50%	L_W	52	58	63
	1000 m³/h - 278 l/s	13,0 m	100%	p_t	21	28	38
			100%	L_W	45	54	63
			50%	p_t	38	47	60
			50%	L_W	52	58	64
	1200 m³/h - 333 l/s	15,0 m	100%	p_t	27	35	48
			100%	L_W	48	56	64
			50%	p_t	51	56	74
			50%	L_W	56	58	64

Circular duct grille RGS

Technical data- Supply and exhaust air

Dimensioning table with accessories 4, 6 and 7

B dimension: 150 mm

325×150, 0,034 m²

q	$l_{0,2}$			v_k-m/s 3	6	9
200 m³/h - 56 l/s	5,0 m	100%	p_t	11	16	25
			L_W	34	45	54
		50%	p_t	20	30	40
			L_W	40	48	57
250 m³/h - 69 l/s	6,5 m	100%	p_t	14	22	32
			L_W	37	47	57
		50%	p_t	28	37	47
			L_W	43	51	58
300 m³/h - 83 l/s	8,5 m	100%	p_t	21	28	38
			L_W	40	49	58
		50%	p_t	38	47	60
			L_W	47	53	59
350 m³/h - 97 l/s	9,5 m	100%	p_t	25	35	48
			L_W	42	51	58
		50%	p_t	48	57	67
			L_W	50	54	60
400 m³/h - 111 l/s	10,5 m	100%	p_t	30	38	52
			L_W	44	52	59
		50%	p_t	60	65	81
			L_W	52	54	61

425×150, 0,045 m²

q	$l_{0,2}$			v_k-m/s 3	6	9
250 m³/h - 69 l/s	5,2 m	100%	p_t	10	16	24
			L_W	35	46	57
		50%	p_t	17	25	35
			L_W	40	50	58
300 m³/h - 83 l/s	7,0 m	100%	p_t	12	20	29
			L_W	37	47	56
		50%	p_t	26	31	43
			L_W	43	52	59
400 m³/h - 111 l/s	9,0 m	100%	p_t	21	28	38
			L_W	41	50	59
		50%	p_t	38	47	60
			L_W	48	54	60
500 m³/h - 139 l/s	10,5 m	100%	p_t	27	35	48
			L_W	44	52	59
		50%	p_t	51	56	74
			L_W	52	54	61
600 m³/h - 167 l/s	12,0 m	100%	p_t	37	46	57
			L_W	48	55	60
		50%	p_t	72	82	93
			L_W	57	60	63

525×150, 0,056 m²

q	$l_{0,2}$			v_k-m/s 3	6	9
300 m³/h - 83 l/s	6,0 m	100%	p_t	10	16	24
			L_W	36	47	58
		50%	p_t	17	25	35
			L_W	41	51	59
400 m³/h - 111 l/s	8,5 m	100%	p_t	14	22	32
			L_W	39	49	59
		50%	p_t	28	37	47
			L_W	45	53	60
500 m³/h - 139 l/s	10,0 m	100%	p_t	21	28	38
			L_W	42	51	60
		50%	p_t	38	47	60
			L_W	49	55	61
600 m³/h - 167 l/s	11,5 m	100%	p_t	27	35	48
			L_W	45	53	60
		50%	p_t	51	56	74
			L_W	53	55	61
700 m³/h - 194 l/s	13,0 m	100%	p_t	35	43	55
			L_W	48	55	61
		50%	p_t	69	78	89
			L_W	57	61	64

625×150, 0,068 m²

q	$l_{0,2}$			v_k-m/s 3	6	9
400 m³/h - 111 l/s	7,0 m	100%	p_t	11	17	26
			L_W	37	48	59
		50%	p_t	20	28	38
			L_W	43	51	60
500 m³/h - 139 l/s	9,0 m	100%	p_t	14	22	32
			L_W	40	50	60
		50%	p_t	28	37	47
			L_W	46	54	61
600 m³/h - 167 l/s	10,5 m	100%	p_t	21	28	38
			L_W	43	52	61
		50%	p_t	38	47	60
			L_W	50	52	62
700 m³/h - 194 l/s	11,5 m	100%	p_t	25	35	48
			L_W	45	54	61
		50%	p_t	48	57	68
			L_W	53	57	63
800 m³/h - 222 l/s	130 m	100%	p_t	30	38	52
			L_W	47	55	62
		50%	p_t	60	65	81
			L_W	55	57	64

825×150, 0,093 m²

q	$l_{0,2}$			v_k-m/s 3	6	9
500 m³/h - 139 l/s	8,0 m	100%	p_t	10	16	24
			L_W	37	48	59
		50%	p_t	17	25	35
			L_W	43	53	61
600 m³/h - 167 l/s	9,5 m	100%	p_t	12	20	29
			L_W	40	50	59
		50%	p_t	26	31	43
			L_W	46	55	62
700 m³/h - 194 l/s	10,5 m	100%	p_t	16	23	33
			L_W	40	52	61
		50%	p_t	29	39	50
			L_W	48	56	63
800 m³/h - 222 l/s	12,0 m	100%	p_t	20	28	38
			L_W	44	53	62
		50%	p_t	38	45	60
			L_W	51	57	63
1000 m³/h - 278 l/s	14,0 m	100%	p_t	27	35	48
			L_W	47	55	63
		50%	p_t	51	56	74
			L_W	55	57	63

1025×150, 0,112 m²

q	$l_{0,2}$			v_k-m/s 3	6	9
600 m³/h - 167 l/s	9,0 m	100%	p_t	10	16	24
			L_W	38	49	60
		50%	p_t	17	25	35
			L_W	44	54	62
700 m³/h - 194 l/s	10,0 m	100%	p_t	12	19	27
			L_W	41	51	62
		50%	p_t	21	30	41
			L_W	46	55	63
800 m³/h - 222 l/s	11,0 m	100%	p_t	14	22	32
			L_W	42	52	62
		50%	p_t	28	37	47
			L_W	48	56	63
1000 m³/h - 278 l/s	13,0 m	100%	p_t	21	28	38
			L_W	45	54	63
		50%	p_t	38	47	60
			L_W	52	58	64
1200 m³/h - 333 l/s	15,0 m	100%	p_t	27	35	48
			L_W	48	56	64
		50%	p_t	51	56	74
			L_W	56	58	64

1225×150, 0,136 m²

q	$l_{0,2}$			v_k-m/s 3	6	9
700 m³/h - 222 l/s	8,5 m	100%	p_t	8	15	22
			L_W	39	49	61
		50%	p_t	16	23	33
			L_W	41	53	62
800 m³/h - 278 l/s	10,0 m	100%	p_t	11	16	25
			L_W	39	50	61
		50%	p_t	20	28	38
			L_W	45	53	62
1000 m³/h - 333 l/s	11,5 m	100%	p_t	14	22	32
			L_W	42	52	62
		50%	p_t	28	37	47
			L_W	48	56	63
1200 m³/h - 389 l/s	13,0 m	100%	p_t	21	28	38
			L_W	45	54	63
		50%	p_t	38	47	60
			L_W	52	58	64
1400 m³/h - 444 l/s	15,0 m	100%	p_t	25	35	48
			L_W	47	56	63
		50%	p_t	48	57	67
			L_W	55	59	65

Circular duct grille

RGS

Technical data-Supply and exhaust air

Dimensioning table with accessories 4, 6 og 7

B dimension: 225 mm

325×225 0,056 m^2			q: 300 m^3/h - 83 l/s $l_{0,2}$: 6,0 m			q: 400 m^3/h - 111 l/s $l_{0,2}$: 8,5 m			q: 500 m^3/h - 139 l/s $l_{0,2}$: 10,0 m			q: 600 m^3/h - 167 l/s $l_{0,2}$: 11,5 m			q: 700 m^3/h - 194 l/s $l_{0,2}$: 13,0 m		
	v_k-m/s		3	6	9	3	6	9	3	6	9	3	6	9	3	6	9
	100%	p_t	10	16	24	14	22	32	21	28	38	27	35	48	35	43	55
		L_W	36	47	58	39	49	59	42	51	60	45	53	60	48	55	61
	50%	p_t	17	25	35	28	37	47	38	47	60	51	56	74	69	78	89
		L_W	41	51	59	45	53	60	49	55	61	53	55	61	57	61	64

425×225 0,074 m^2			q: 400 m^3/h - 111 l/s $l_{0,2}$: 7,5 m			q: 500 m^3/h - 139 l/s $l_{0,2}$: 9,0 m			q: 600 m^3/h - 167 l/s $l_{0,2}$: 11,0 m			q: 700 m^3/h - 194 l/s $l_{0,2}$: 11,5 m			q: 800 m^3/h - 222 l/s $l_{0,2}$: 13,0 m		
	v_k-m/s		3	6	9	3	6	9	3	6	9	3	6	9	3	6	9
	100%	p_t	10	16	24	12	20	28	19	26	36	22	29	39	27	35	48
		L_W	36	47	58	39	49	58	43	52	60	43	53	62	46	54	62
	50%	p_t	17	25	35	26	35	46	34	44	56	43	52	62	51	56	74
		L_W	42	52	60	45	52	60	49	55	61	50	56	62	54	56	62

525×225 0,093 m^2			q: 500 m^3/h - 139 l/s $l_{0,2}$: 8,0 m			q: 600 m^3/h - 167 l/s $l_{0,2}$: 9,5 m			q: 700 m^3/h - 194 l/s $l_{0,2}$: 10,5 m			q: 800 m^3/h - 222 l/s $l_{0,2}$: 12,0 m			q: 1000 m^3/h - 278 l/s $l_{0,2}$: 14,0 m		
	v_k-m/s		3	6	9	3	6	9	3	6	9	3	6	9	3	6	9
	100%	p_t	10	16	24	12	20	29	16	23	33	20	28	38	27	35	48
		L_W	37	48	59	40	50	59	40	52	61	44	53	62	47	55	63
	50%	p_t	17	25	35	26	31	43	29	39	50	38	45	60	51	56	74
		L_W	43	53	61	46	55	62	48	56	63	51	57	63	55	57	63

625×225 0,112 m^2			q: 600 m^3/h - 167 l/s $l_{0,2}$: 9,0 m			q: 700 m^3/h - 194 l/s $l_{0,2}$: 10,0 m			q: 800 m^3/h - 222 l/s $l_{0,2}$: 11,0 m			q: 1000 m^3/h - 278 l/s $l_{0,2}$: 13,0 m			q: 1200 m^3/h - 333 l/s $l_{0,2}$: 15,0 m		
	v_k-m/s		3	6	9	3	6	9	3	6	9	3	6	9	3	6	9
	100%	p_t	10	16	24	12	19	27	14	22	32	21	28	38	27	35	48
		L_W	38	49	60	41	51	62	42	52	62	45	54	63	48	56	64
	50%	p_t	17	25	35	21	30	41	28	37	47	38	47	60	51	56	74
		L_W	44	54	62	46	55	63	48	56	63	52	58	64	56	58	64

825×225 0,148 m^2			q: 800 m^3/h - 222 l/s $l_{0,2}$: 9,5 m			q: 1000 m^3/h - 278 l/s $l_{0,2}$: 11,5 m			q: 1200 m^3/h - 333 l/s $l_{0,2}$: 13,0 m			q: 1400 m^3/h - 389 l/s $l_{0,2}$: 15,0 m			q: 1600 m^3/h - 444 l/s $l_{0,2}$: 17,0 m		
	v_k-m/s		3	6	9	3	6	9	3	6	9	3	6	9	3	6	9
	100%	p_t	10	16	24	12	20	28	19	26	36	22	30	40	27	35	48
		L_W	39	50	61	42	52	61	46	55	63	46	56	64	49	57	65
	50%	p_t	17	25	35	27	35	45	34	44	56	43	52	62	51	56	74
		L_W	45	55	63	48	55	63	52	58	65	53	59	65	57	59	65

1025×225 0,186 m^2			q: 1000 m^3/h - 278 l/s $l_{0,2}$: 11,0 m			q: 1200 m^3/h - 333 l/s $l_{0,2}$: 12,0 m			q: 1400 m^3/h - 389 l/s $l_{0,2}$: 13,5 m			q: 1600 m^3/h - 444 l/s $l_{0,2}$: 15,0 m			q: 1800 m^3/h - 500 l/s $l_{0,2}$: 17,0 m		
	v_k-m/s		3	6	9	3	6	9	3	6	9	3	6	9	3	6	9
	100%	p_t	10	16	24	12	20	30	16	23	33	20	27	37	23	31	42
		L_W	40	51	62	43	53	62	43	55	64	47	56	65	48	57	66
	50%	p_t	17	25	35	26	31	43	30	41	49	38	45	60	44	52	64
		L_W	46	56	64	49	58	65	51	59	66	54	60	66	56	61	66

1225×225 0,224 m^2			q: 1200 m^3/h - 333 l/s $l_{0,2}$: 11,0 m			q: 1400 m^3/h - 389 l/s $l_{0,2}$: 12,0 m			q: 1600 m^3/h - 444 l/s $l_{0,2}$: 14,0 m			q: 1800 m^3/h - 500 l/s $l_{0,2}$: 15,5 m			q: 2000 m^3/h - 556 l/s $l_{0,2}$: 17,0 m		
	v_k-m/s		3	6	9	3	6	9	3	6	9	3	6	9	3	6	9
	100%	p_t	10	16	24	12	19	27	14	22	32	18	25	35	21	28	38
		L_W	40	51	62	43	53	64	44	54	64	47	56	64	47	56	65
	50%	p_t	17	25	35	21	30	41	28	37	47	34	44	56	38	47	60
		L_W	46	56	64	48	57	65	50	58	66	53	59	66	54	60	66

Nozzle diffuser GTI

Description

GTI is a flexible supply air nozzle that is suitable for ventilation of large areas. The nozzle can be used for both heated and cooled air and can be adjusted from diffused to concentrated supply air patterns. The supply air pattern can be adjusted by turning the insert in relation to the central line of the nozzle. The nozzle is equipped with Lindab Safe and can be installed directly into a circular duct, fitting, wall or duct side.

- Flexible nozzle for cooling and heating
- Adjustable dispersal pattern
- Simple installation

Maintenance

The visible parts of the diffuser can be wiped with a damp cloth.

Materials and finish

Insert:	Steel
Connection:	Galvanised steel
Standard finish:	Powder-coated
Standard colour:	RAL 9010, gloss 30

The diffuser is available in other colours. Please contact Lindab's sales department for further information.

Order code

Product GTI aaa A

Type
GTI

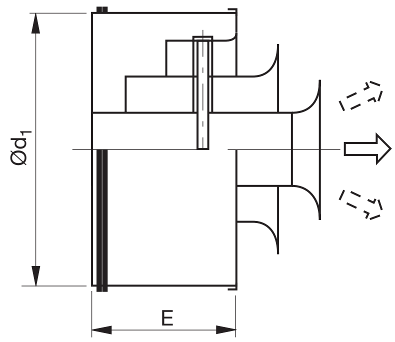
Size
200 - 400

Version
A

Example: GTI - 250 - A

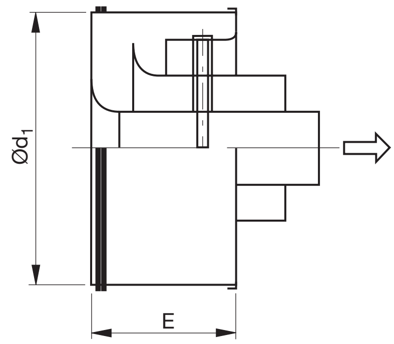
Dimensions

Installation 0



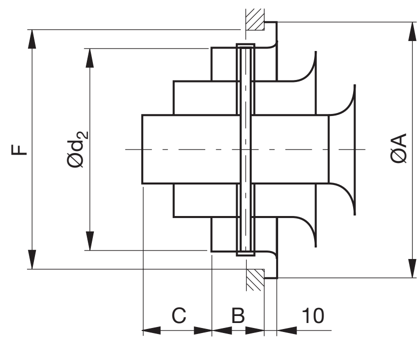
Diffused supply air – for installation in a circular duct or fitting. Supplied adapted to this form of installation as standard.

Installation 1



Concentrated supply air – for installation in a circular duct or fitting. The insert is turned 180 degrees.

Installation 2



Diffused supply air – for installation in a wall or duct side. Remove the external pipe.

Size	ØA mm	B mm	C mm	Ød_1 mm	E mm	F mm	Ød_2 mm	Weight kg
200	203	40	55	198	109	170	158	0,8
250	253	50	75	248	139	210	198	1,3
315	318	60	95	313	169	260	248	2,0
400	403	70	115	398	199	321	313	2,8

Free area for GTI nozzle – see pages *Nozzle calculations*.

Nozzle diffuser GTI

Technical data

Capacity

Volume flow q_v [l/s] and [m^3/h], total pressure Δp_t[Pa], throw $l_{0.3}$ and sound level L_{WA} [dB(A)] can be seen in the diagrams.

Throw $l_{0.3}$

Throw $l_{0.3}$ can be seen in the diagrams for isothermal air at a terminal velocity of 0.3 m/s

Resulting sound effect level

The sound effect level from the nozzles must be added logarithmically to the sound effect level from the flow noise in the duct. See sample calculation, pages *Nozzle calculations*.

Frequency-related sound effect level

The sound effect level in the frequency band is defined as $L_{wok} = L_{WA} + K_{ok}$. K_{ok} values can be seen in the table below.

Table 1 - diffused supply air

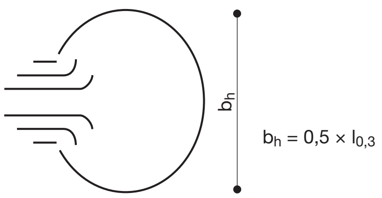
	Centre frequency Hz							
Size	63	125	250	500	1K	2K	4K	8K
200	15	0	-5	-6	-2	-10	-22	-32
250	13	-3	-6	-6	-1	-14	-14	-33
315	16	-1	-6	-2	-3	-15	-26	-35
400	14	-1	-3	0	-5	-16	-27	-32

Table 2 - concentrated supply air

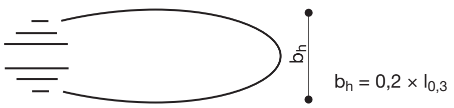
	Centre frequency Hz							
Size	63	125	250	500	1K	2K	4K	8K
200	14	0	-3	-4	-2	-13	-27	-37
250	16	-3	-6	-4	-2	-16	-25	-28
315	18	-1	-5	-2	-3	-16	-29	-40
400	15	-4	-6	-4	-2	-21	-34	-38

Air jet width b_h

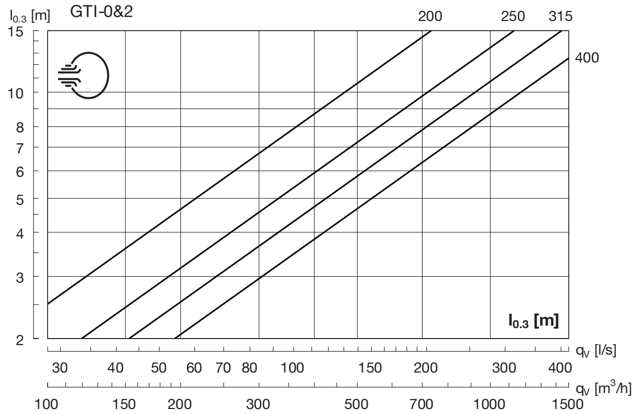
Diffuse

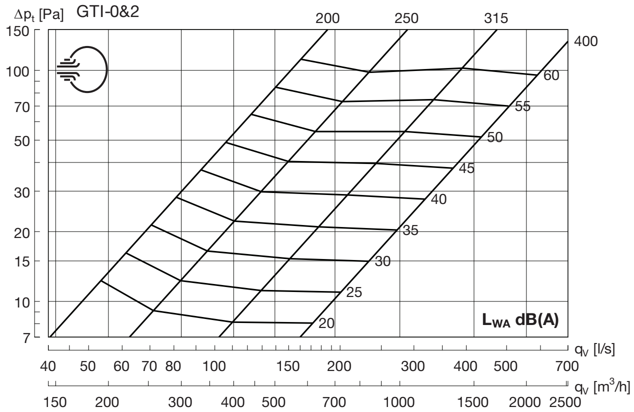


Concentrated

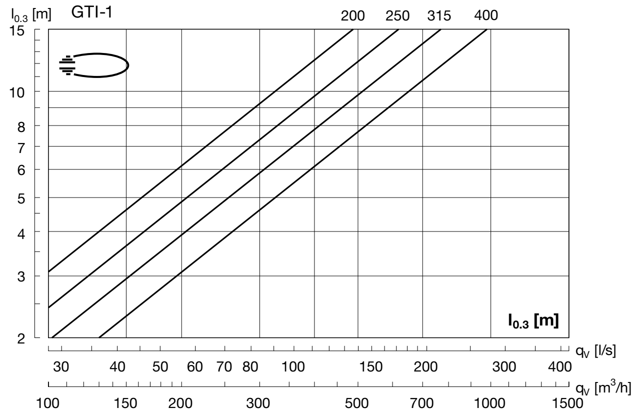


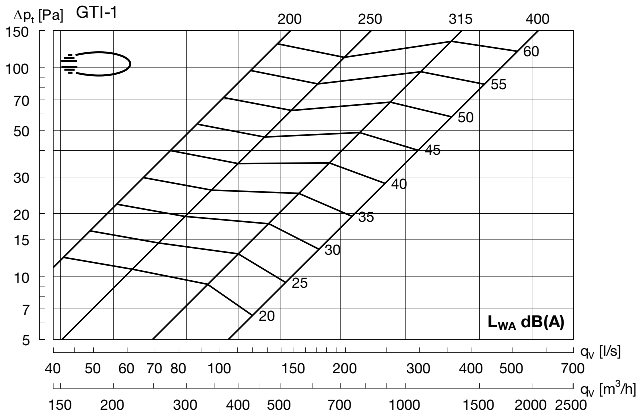
Diffuse supply





Concentrated supply





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.

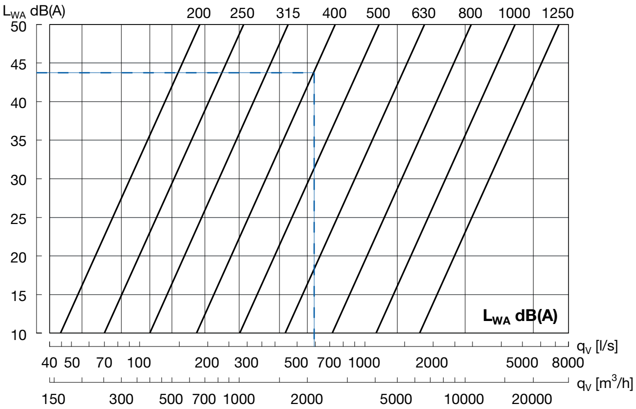
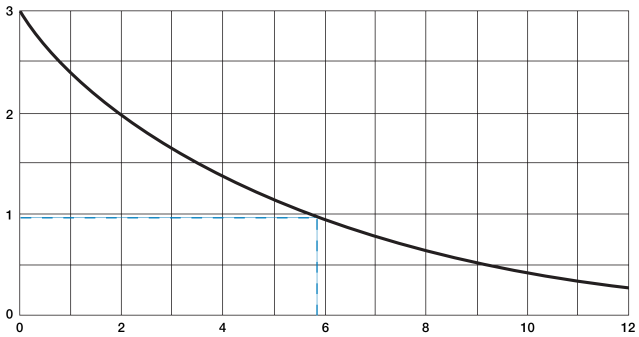
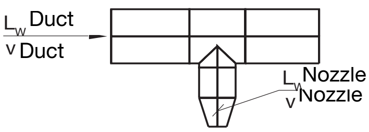


Diagram 2, addition of sound levels.

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

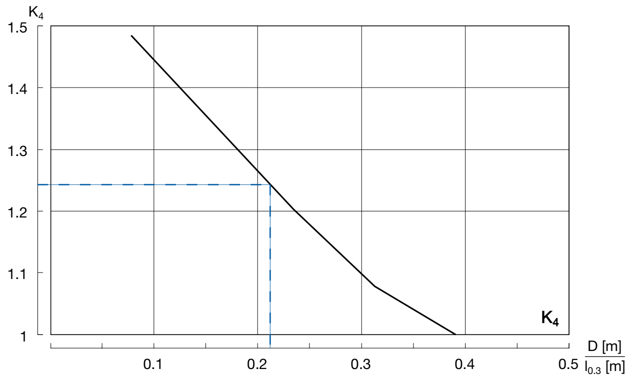
Duct size:

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_{03}. 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

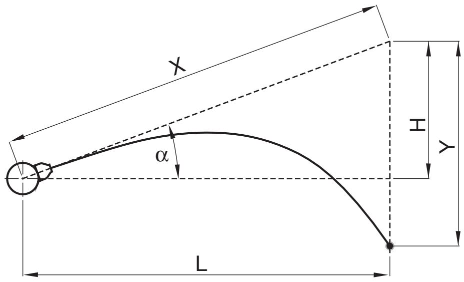
Resulting throw

K_4 x $l_{0.3}$ = 1.25 x 7 m = 8.75 m

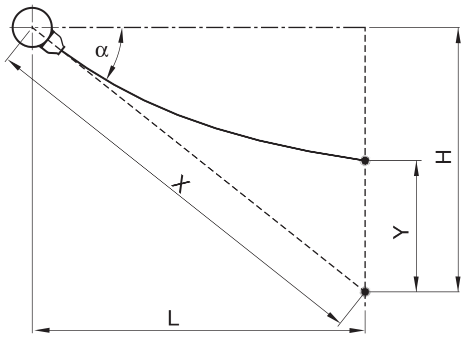
Supply air nozzle

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:	$q = 400\ m^3/h$
	$\Delta t = 6K \quad \alpha = 30°$
Final velocity	$v_x = 0{,}3\ m/s$

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

$$X = K_1 \times \frac{q}{v_x} = 0{,}020 \times \frac{400}{0{,}3} = 27\ m$$

$$Y = K_2 \times \frac{X^3}{q^2} \times \Delta t = 24 \times \frac{27^3}{400^2} \times 6 = 17{,}7\ m$$

$$H = X \times \sin\alpha = 27 \times 0{,}5 = 13{,}5\ m$$

$$L = X \times \cos\alpha = 27 \times 0{,}87 = 23{,}4\ m$$

Sample calculation: Heated air

LAD-200:	$q = 400\ m^3/h$
	$\Delta t = 6K \quad \alpha = 60°$
Final velocity	$v_x = 0{,}3\ m/s$

$$X = K_1 \times \frac{q}{v_x} = 0{,}020 \times \frac{400}{0{,}3} = 27\ m$$

$$Y = K_2 \times \frac{X^3}{q^2} \times \Delta t = 24 \times \frac{27^3}{400^2} \times 6 = 17{,}7\ m$$

$$H = X \times \sin\alpha = 27 \times 0{,}87 = 23{,}4\ m$$

$$L = X \times \cos\alpha = 27 \times 0{,}5 = 13{,}5\ m$$

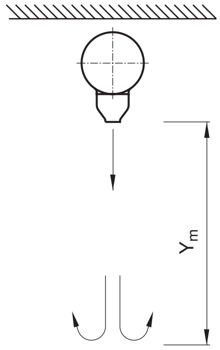
Supply air nozzle

Calculation

Calculation factors:

Size	Free area A m²	K_1 m³/h	K_1 l/s	K_2 m³/h	K_2 l/s	K_3 m³/h	K_3 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



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

Sample calculation:

LAD-160 q = 200 m³/h
Δt = 10 K

The distance to the turning point of the air jet:

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

$$Y_m = 0{,}122 \times \frac{200}{\sqrt{10}} \text{ (m)}$$

$$Y_m = 7{,}7 \text{ m}$$

Supply air nozzle DAD

Description

DAD is an adjustable supply air nozzle suitable for ventilation of large areas where long throws are required. The nozzle can be freely rotated 30 degrees in any direction in relation to the central line of the nozzle. The nozzle can be used for both heated and cooled air. The nozzle can be installed directly into a circular duct, fitting, wall or duct side. Supplied with screw holes through flange (DAD-0).

- Flexible adjustable nozzle
- Long throws
- Simple installation

Maintenance

The visible parts of the diffuser can be wiped with a damp cloth.

Materials and finish

Material:	Aluminium
Standard finish:	Powder-coated
Standard colour:	RAL 9010, gloss 30

The diffuser is available in other colours. Please contact Lindab's sales department for further information.

Ordering example

Product **DAD** **a** **bbb**

Type

with flange 0

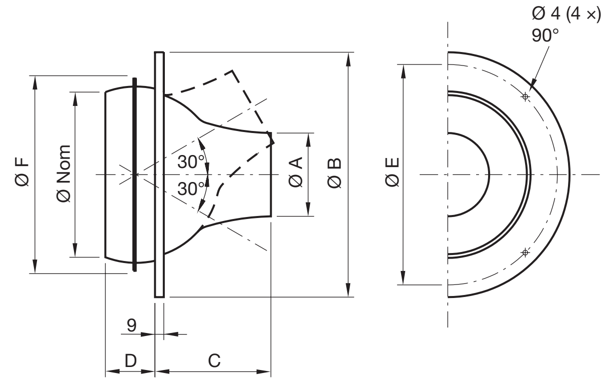
for circular ducts 1

Size

Dimensions

DAD-0

With flange for mounting on a wall or duct side.

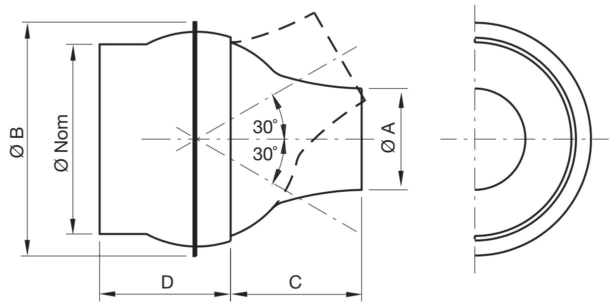


ØF = min. hole dimension

Ø nom Size	ØA [mm]	ØB [mm]	C [mm]	D [mm]	ØE [mm]	ØF [mm]	Weight [kg]
160	85	248	120	51	225	200	0.60
200	110	298	150	66	270	245	0.90
250	140	363	190	81	320	295	1.40
315	175	448	255	90	390	360	2.40

DAD-1

Installation in circular duct.



ØNom includes male connection measure

Ø nom Size	ØA [mm]	ØB [mm]	C [mm]	D [mm]	Weight [kg]
160	85	196	110	110	0.50
200	110	238	140	125	0.90
250	140	288	180	140	1.40
315	175	355	245	165	2.40

Free area for DAD nozzle – see section *Nozzle calculations*.

Supply air nozzle DAD

Technical data

Capacity
Volume flow q_v [l/s] and [m^3/h], total pressure Δp_t[Pa], throw $l_{0.3}$ and sound level L_{WA} [dB(A)] can be seen in the diagrams.

Throw $l_{0.3}$
Throw $l_{0.3}$ can be seen in the diagrams for isothermal air at a terminal velocity of 0.3 m/s

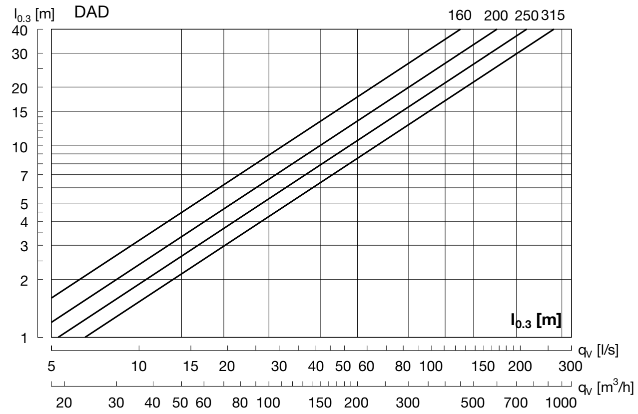
Resulting sound effect level
The sound effect level from the nozzles must be added logarithmically to the sound effect level from the flow noise in the duct. See sample
calculation, section *Nozzle calculations*.

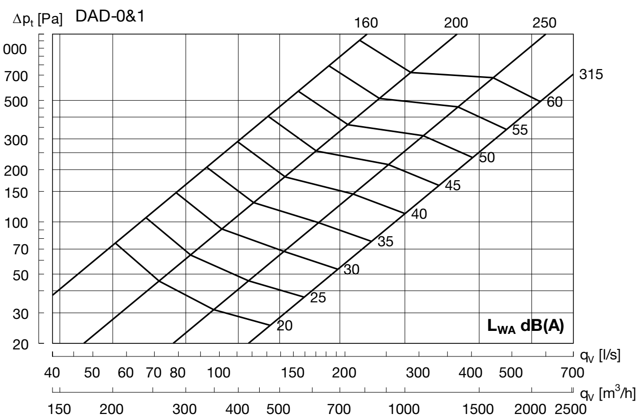
Frequency-related sound effect level
The sound effect level in the frequency band is defined as $L_{wok} = L_{WA} + K_{ok}$. K_{ok} values can be seen in the table below.

Table

	Centre frequency Hz							
Size	**63**	**125**	**250**	**500**	**1K**	**2K**	**4K**	**8K**
160	10	-1	-5	-5	-5	-8	-9	-10
200	11	1	1	-4	-4	-10	-16	-23
250	17	0	0	-4	-4	-13	-21	-29
315	16	1	-1	-2	-4	-13	-21	-32

Supply air





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.

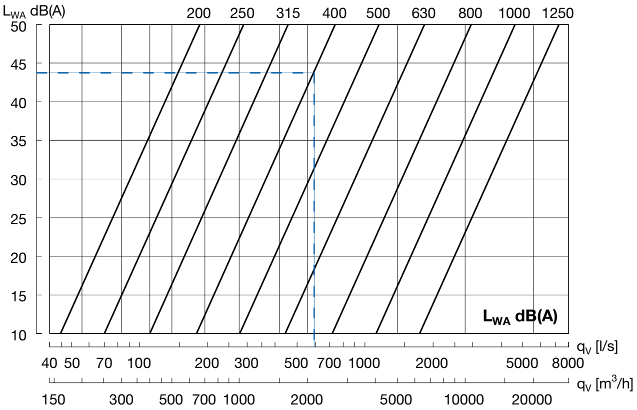
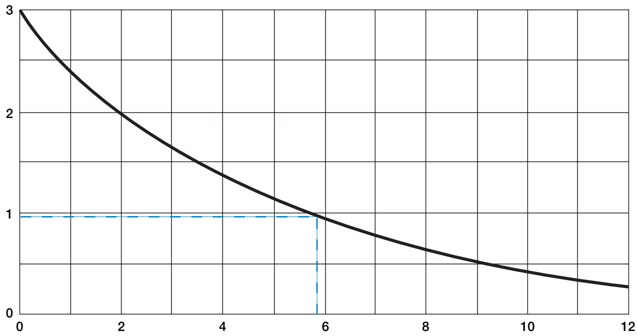
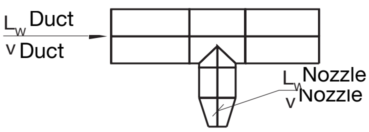


Diagram 2, addition of sound levels.
Difference to be added to the highest dB value (dB)



Difference between the dB values (dB)



Sample calculation:

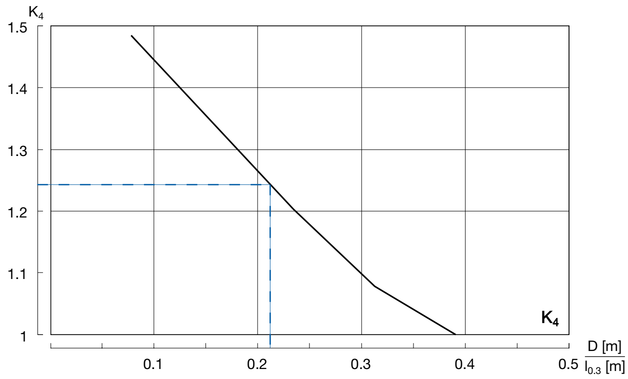
LAD-200	q = 100 l/s
ΔP_t nozzle	90 Pa

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_{03}. 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

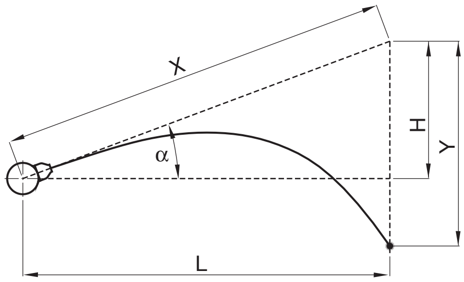
K_4 calculation factor

Can be seen in the diagram	K_4 = 1.25

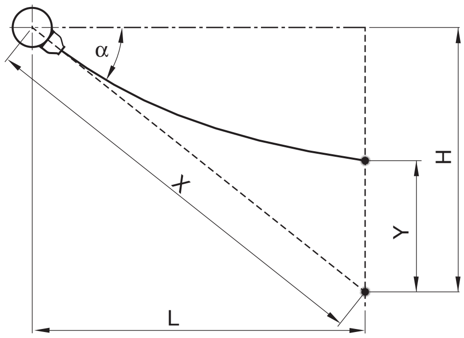
Resulting throw
$K_4 \times l_{0.3}$ = 1.25 x 7 m = 8.75 m

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: $q = 400\ m^3/h$
$\Delta t = 6K \quad \alpha = 30°$
Final velocity $v_x = 0{,}3\ m/s$

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

$$X = K_1 \times \frac{q}{v_x} = 0{,}020 \times \frac{400}{0{,}3} = 27\ m$$

$$Y = K_2 \times \frac{X^3}{q^2} \times \Delta t = 24 \times \frac{27^3}{400^2} \times 6 = 17{,}7\ m$$

$$H = X \times \sin\alpha = 27 \times 0{,}5 = 13{,}5\ m$$
$$L = X \times \cos\alpha = 27 \times 0{,}87 = 23{,}4\ m$$

Sample calculation: Heated air

LAD-200: $q = 400\ m^3/h$
$\Delta t = 6K \quad \alpha = 60°$
Final velocity $v_x = 0{,}3\ m/s$

$$X = K_1 \times \frac{q}{v_x} = 0{,}020 \times \frac{400}{0{,}3} = 27\ m$$

$$Y = K_2 \times \frac{X^3}{q^2} \times \Delta t = 24 \times \frac{27^3}{400^2} \times 6 = 17{,}7\ m$$

$$H = X \times \sin\alpha = 27 \times 0{,}87 = 23{,}4\ m$$
$$L = X \times \cos\alpha = 27 \times 0{,}5 = 13{,}5\ m$$

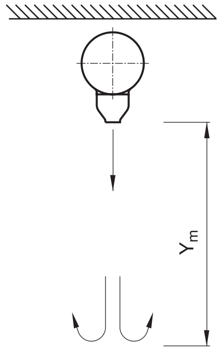
Supply air nozzle

Calculation

Calculation factors:

Size	Free area A m²	K_1 m³/h	K_1 l/s	K_2 m³/h	K_2 l/s	K_3 m³/h	K_3 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



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

Sample calculation:

LAD-160

$q = 200$ m³/h
$\Delta t = 10$ K

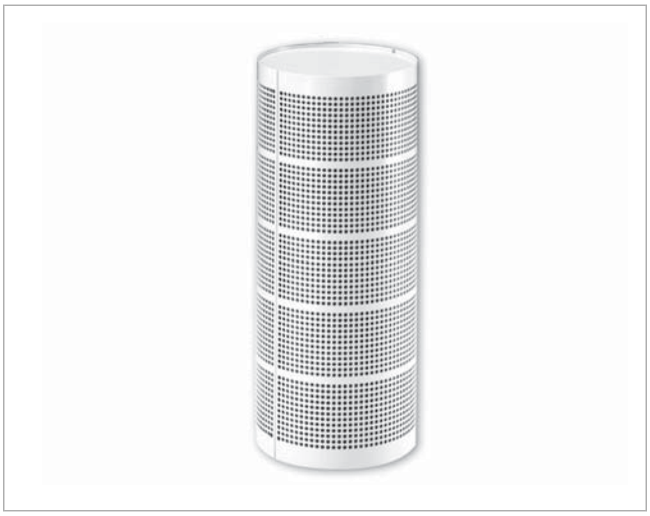
The distance to the turning point of the air jet:

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

$$Y_m = 0{,}122 \times \frac{200}{\sqrt{10}} \text{ (m)}$$

$$Y_m = 7{,}7 \text{ m}$$

Perforated diffuser - circular CCA



Description

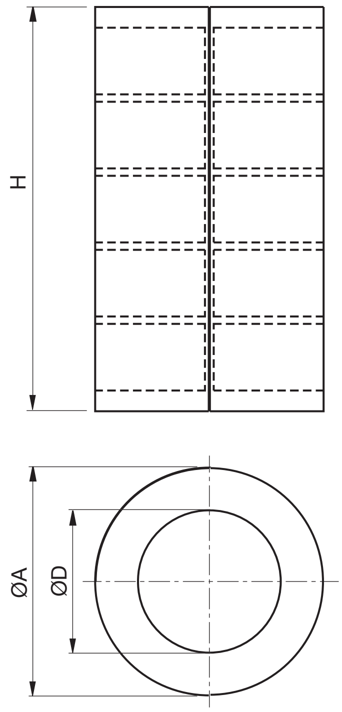
Comdif CCA is a circular perforated displacement diffuser for freestanding installation. Behind the perforated front plate, CCA is equipped with individually adjustable nozzles, making it possible to alter the geometry of the near zone. The diffuser can be turned and has a circular duct connection (MF measure), so the diffuser can be connected at the top or bottom. The diffuser is suitable for the supply of large volumes of moderately cooled air.

- The diffuser is suitable for the supply of large volumes of air.
- The geometry of the near zone can be adjusted using adjustable nozzles.
- Plinths can be supplied as accessories.

Maintenance

The front plate can be removed from the diffuser, making it possible to clean the nozzles. The visible parts of the diffuser can be wiped with a damp cloth.

Dimensions



Size	ØA mm	ØD mm	H mm	Weight kg
1207	250	125	710	5,00
1607	300	160	710	7,50
2010	360	200	970	13,0
2510	400	250	970	18,0
3115	520	315	1490	35,0
4020	630	400	2010	58,0
5020	730	500	2010	78,0
6320	830	630	2010	106

Accessories

Can be supplied with plinth.

Order code

Product	**CCA**	**aaaa**
Type	┘	
Size		┘

Order - accessories

Plinth: CCAZ - 2 - size

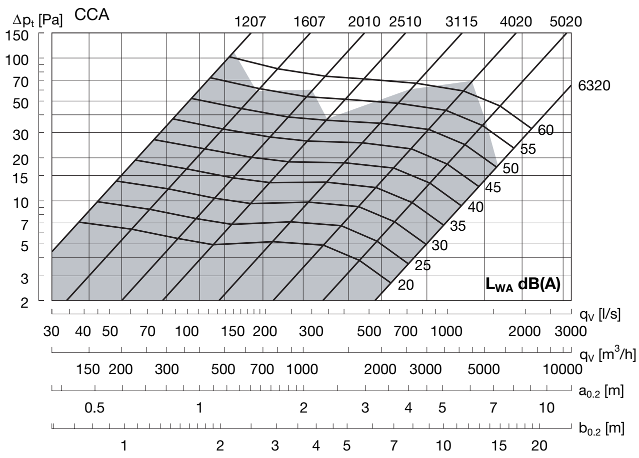
Materials and finish

Diffuser:	Galvanised steel
Nozzles:	Black plastic
Front plate:	1 mm galvanised steel
Standard finish:	Powder-coated
Standard colour:	RAL 9010 - white

The diffuser is available in other colours. Please contact Lindab's sales department for further information.

Perforated diffuser - circular CCA

Technical data



Recommended maximum volume flow

The near zone is given at an under-temperature of -3 K to a maximum terminal velocity of 0.20 m/s.

Conversion to other terminal velocities - see table correction of the near zone for -3 K and -6 K respectively.

Sound effect level

Sound effect level L_W [dB] = $L_{WA} + K_{ok}$

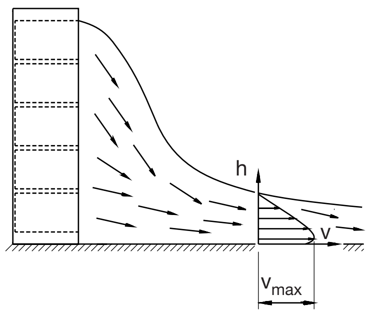
	Centre frequency Hz							
Size	**63**	**125**	**250**	**500**	**1K**	**2K**	**4K**	**8K**
1207	8	-1	1	1	-9	-17	-28	-40
1607	10	-1	1	1	-8	-17	-29	-33
2010	10	-1	3	0	-9	-17	-27	-40
2510	7	-1	3	0	-7	-18	-28	-41
3115	13	2	3	-1	-8	-17	-29	-27
4020	13	2	3	-1	-7	-16	-28	-43
5020	7	3	2	0	-6	-16	-19	-17
6320	7	3	2	0	-8	-16	-20	-17

Sound attenuation

Sound attenuation ΔL [dB] including end reflection.

	Centre frequency Hz							
Size	**63**	**125**	**250**	**500**	**1K**	**2K**	**4K**	**8K**
1207	19	14	5	3	2	1	2	1
1607	16	12	4	1	2	1	2	2
2010	12	8	4	2	3	2	2	2
2510	12	8	5	2	1	1	1	1
3115	11	8	3	2	1	1	2	2
4020	9	6	1	1	1	1	1	1
5020	6	4	1	1	1	1	1	1
6320	5	3	1	1	0	0	0	1

Nearzone



Oval diffusion

Circular diffusion (factory setting)

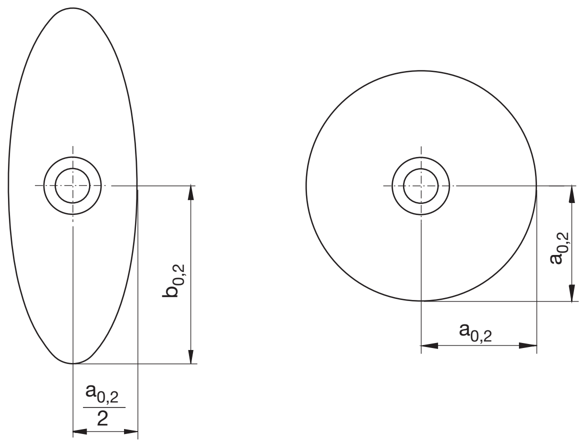
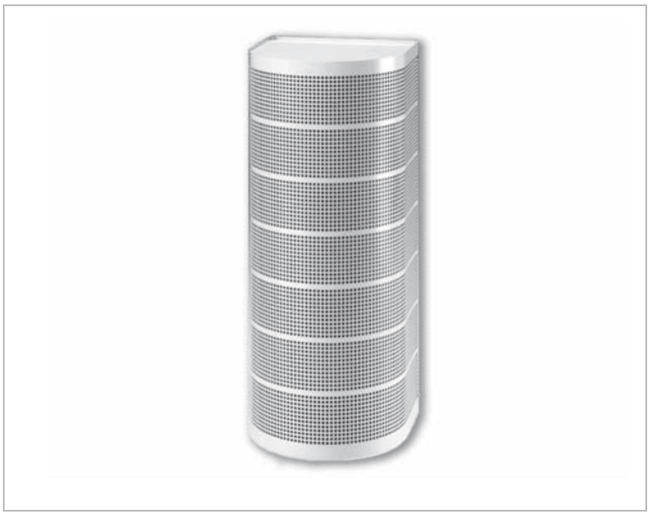


Table 1
Correction of the near zone ($a_{0.2}$, $b_{0.2}$)

Under-temperature T_i-T_r	**Maximum velocity m/s**	**Mean velocity m/s**	**Correction factor**
-3K	0.20	0.10	1.00
	0.25	0.12	0.80
	0.30	0.15	0.70
	0.35	0.17	0.60
	0.40	0.20	0.50
-6K	0.20	0.10	1.20
	0.25	0.12	1.00
	0.30	0.15	0.80
	0.35	0.17	0.70
	0.40	0.20	0.60

Perforated diffuser - semicircular CHA



Description

Comdif CHA is a semicircular perforated displacement diffuser for installation against a wall or column. Behind the perforated front plate, CHA is equipped with individually adjustable nozzles, making it possible to alter the geometry of the near zone. The diffuser can be turned and has a circular duct connection (MF measure), so the diffuser can be connected at the top or bottom. The diffuser is suitable for the supply of large volumes of moderately cooled air.

- The diffuser is suitable for the supply of large volumes of air.
- The geometry of the near zone can be adjusted using adjustable nozzles
- Duct covers, plinths and wall brackets can be supplied as accessories

Maintenance

The front plate can be removed from the diffuser, making it possible to clean the nozzles. The visible parts of the diffuser can be wiped with a damp cloth.

Order code

Product **CHA** **aaaa**

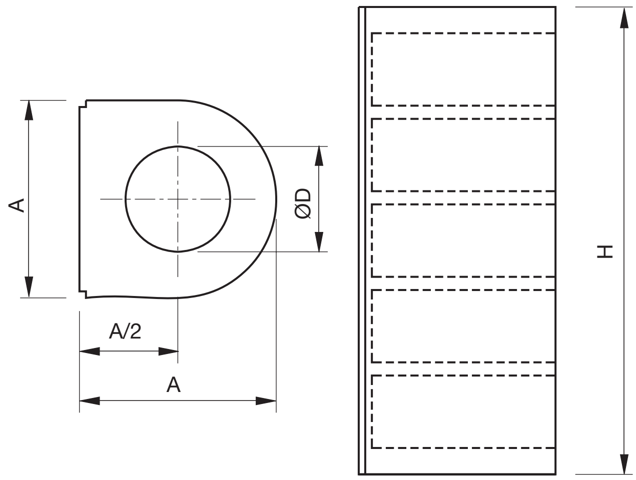
Type

Size

Order - accessories

Cover:	CHAZ - 0 - size
Plinth:	CHAZ - 2 - size
Wall bracket:	CHAZ - 3 - size

Dimensions



Size	A mm	ØD mm	H mm	Weight kg
1207	250	125	710	6,50
1607	300	160	710	7,50
2010	330	200	970	13,0
2510	400	250	970	18,0
3115	520	315	1490	35,0
4020	630	400	2010	58,0
5020	730	500	2010	78,0
6320	830	630	2010	106

Accessories

Can be supplied with duct cover, plinth and bracket for wall mounting.

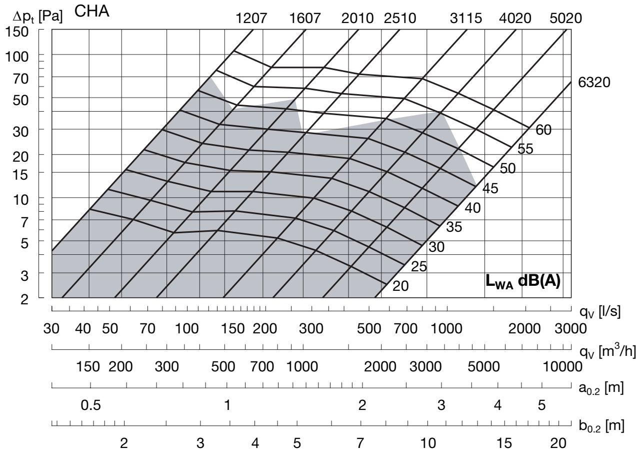
Materials and finish

Diffuser:	Galvanised steel
Nozzles:	Black plastic
Front plate:	1 mm galvanised steel
Standard finish:	Powder-coated
Standard colour:	RAL 9010 - white, gloss 30

The diffuser is available in other colours. Please contact Lindab's sales department for further information.

Perforated diffuser - semicircular CHA

Technical data



Recommended maximum volume flow

The near zone is given at an under-temperature of -3 K to a maximum terminal velocity of 0.20 m/s.

Conversion to other terminal velocities - see table 1, correction of the near zone for -3 K and -6 K respectively.

Sound effect level

Sound effect level L_W [dB] = $L_{WA} + K_{ok}$

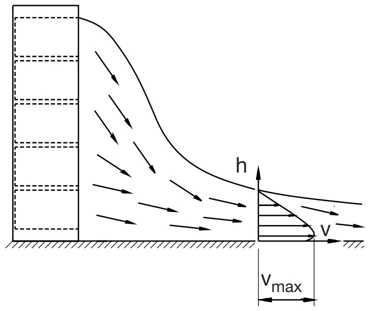
	Centre frequency Hz							
Size	**63**	**125**	**250**	**500**	**1K**	**2K**	**4K**	**8K**
1207	11	-4	1	1	-9	-16	-28	-34
1607	9	-2	2	0	-8	-16	-28	-34
2010	10	-2	3	0	-7	-16	-28	-39
2510	11	0	4	-2	-7	-15	-27	-37
3115	13	1	3	-1	-7	-17	-29	-42
4020	7	3	2	-1	-5	-14	-19	-14
5020	7	3	2	0	-6	-16	-19	-17
6320	7	3	2	0	-6	-16	-29	-17

Sound attenuation

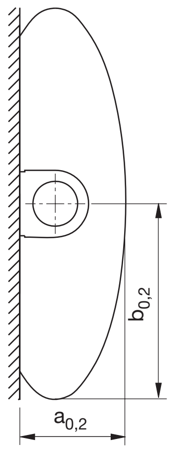
Sound attenuation ΔL [dB] including end reflection.

	Centre frequency Hz							
Size	**63**	**125**	**250**	**500**	**1K**	**2K**	**4K**	**8K**
1207	19	14	5	3	2	1	2	1
1607	16	12	4	1	2	1	2	2
2010	12	8	4	2	3	2	2	2
2510	12	8	5	2	1	1	1	1
3115	11	8	3	2	1	1	2	2
4020	9	6	1	1	1	1	1	1
5020	7	5	0	1	1	1	1	2
6320	5	3	1	1	0	0	0	0

Nearzone



Large diffusion (factory setting)



Small diffusion

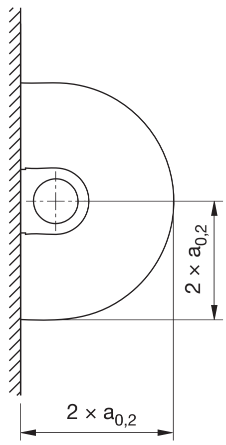
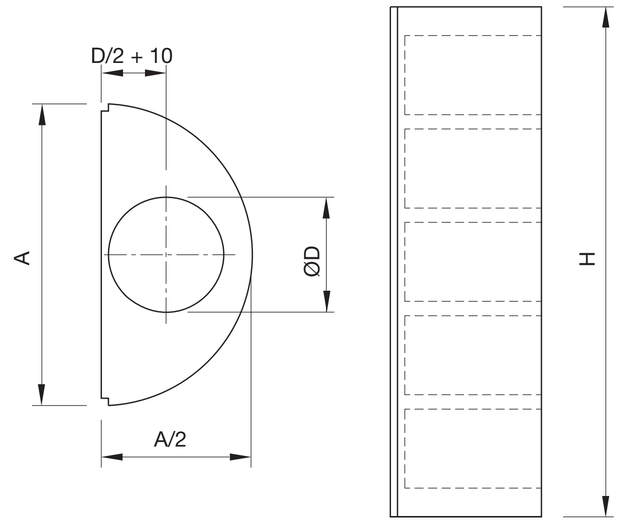


Table 1
Correction of the near zone ($a_{0.2}$, $b_{0.2}$)

Under-temperature T_i-T_r	Maximum velocity m/s	Mean velocity m/s	Correction factor
	0.20	0.10	1.00
	0.25	0.12	0.80
-3K	0.30	0.15	0.70
	0.35	0.17	0.60
	0.40	0.20	0.50
	0.20	0.10	1.20
	0.25	0.12	1.00
-6K	0.30	0.15	0.80
	0.35	0.17	0.70
	0.40	0.20	0.60

Perforated diffuser - semicircular CBA

Dimensions



Size	A mm	ØD mm	H mm	Weight kg
1207	350	125	710	6,50
1607	420	160	710	7,50
2010	500	200	970	13,0
2510	600	250	970	18,0
3115	730	315	1490	35,0
4020	900	400	2010	58,0
5020	1100	500	2010	78,0

Description

Comdif CBA is a semicircular perforated displacement diffuser for installation against/on a wall or column.
Behind the perforated front plate, CBA is equipped with individually adjustable nozzles, making it possible to alter the geometry of the near zone. The diffuser can be turned and has a circular duct connection (MF measure), so the diffuser can be connected at the top or bottom. The diffuser is suitable for the supply of large volumes of moderately cooled air.

- The diffuser is suitable for the supply of large volumes of air.
- The geometry of the near zone can be adjusted using adjustable nozzles.
- Duct covers, plinths and wall brackets can be supplied as accessories

Accessories

Can be supplied with duct cover, plinth and bracket for wall mounting.

Maintenance

The front plate can be removed from the diffuser, making it possible to clean the nozzles. The visible parts of the diffuser can be wiped with a damp cloth.

Order code

Product	CBA	aaaa
Type	✓	
Size		✓

Order - accessories

Cover:	CBAZ - 0 - size
Plinth:	CBAZ - 2 - size
Wall bracket:	CBAZ - 3 - size

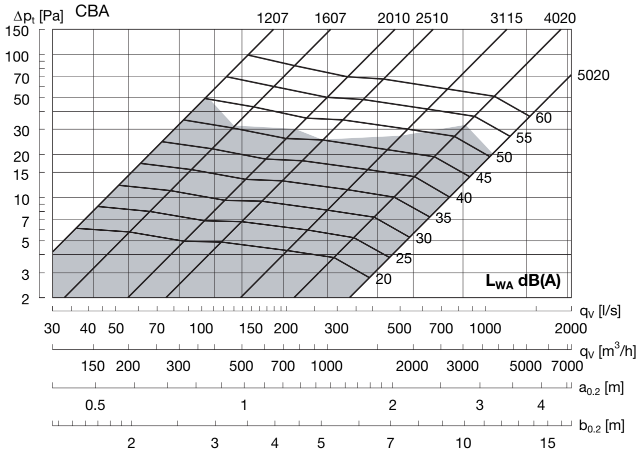
Materials and finish

Diffuser:	Galvanised steel
Nozzles:	Black plastic
Front plate:	1 mm galvanised steel
Standard finish:	Powder-coated
Standard colour:	RAL 9010 - white, gloss 30

The diffuser is available in other colours. Please contact Lindab's sales department for further information.

Perforated diffuser - semicircular CBA

Technical data



Recommended maximum volume flow

The near zone is given at an under-temperature of -3 K to a maximum terminal velocity of 0.20 m/s.

Conversion to other terminal velocities - see table 1, correction of the near zone for -3 K and -6 K respectively.

Sound effect level

Sound effect level L_W [dB] = $L_{WA} + K_{ok}$

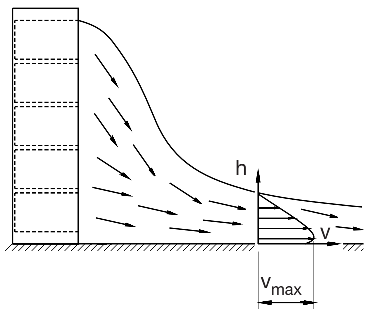
	Centre frequency Hz							
Size	**63**	**125**	**250**	**500**	**1K**	**2K**	**4K**	**8K**
1207	8	-3	0	1	-8	-15	-27	-38
1607	10	-3	3	0	-8	-18	-30	-33
2010	15	-2	3	0	-9	-16	-30	-37
2510	10	-1	4	-1	-9	-16	-29	-41
3115	11	1	4	-1	-8	-17	-30	-42
4020	13	3	4	-1	-9	-17	-30	-43
5020	7	2	2	0	-6	-16	-19	-17

Sound attenuation

Sound attenuation ΔL [dB] including end reflection.

	Centre frequency Hz							
Size	**63**	**125**	**250**	**500**	**1K**	**2K**	**4K**	**8K**
1207	19	14	5	3	2	1	2	1
1607	16	12	4	1	2	1	2	2
2010	12	8	4	2	3	2	2	2
2510	12	8	5	2	1	1	1	1
3115	11	8	3	2	1	1	2	2
4020	9	6	1	1	1	1	1	1
5020	7	5	0	1	1	1	1	2

Nearzone



Large diffusion (factory setting)

Small diffusion

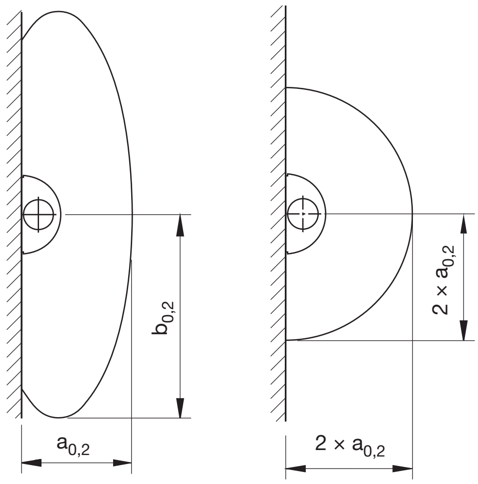


Table 1
Correction of the near zone ($a_{0.2}$, $b_{0.2}$)

Under-temperature T_i-T_r	Maximum velocity m/s	Mean velocity m/s	Correction factor
-3K	0.20	0.10	1.00
	0.25	0.12	0.80
	0.30	0.15	0.70
	0.35	0.17	0.60
	0.40	0.20	0.50
-6K	0.20	0.10	1.20
	0.25	0.12	1.00
	0.30	0.15	0.80
	0.35	0.17	0.70
	0.40	0.20	0.60

Perforated diffuser - corner CQA

1
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16
17
18

Description

Comdif CQA is a semicircular perforated displacement diffuser for corner installation. Behind the perforated front plate, CQA is equipped with individually adjustable nozzles, making it possible to alter the geometry of the near zone. The diffuser can be turned and has a circular duct connection (MF measure), so the diffuser can be connected at the top or bottom. The diffuser is suitable for the supply of large volumes of moderately cooled air.

- The diffuser is suitable for the supply of large volumes of air.
- The geometry of the near zone can be adjusted using adjustable nozzles
- Duct covers, plinths and wall brackets can be supplied as accessories

Maintenance

The front plate can be removed from the diffuser, making it possible to clean the nozzles. The visible parts of the diffuser can be wiped with a damp cloth.

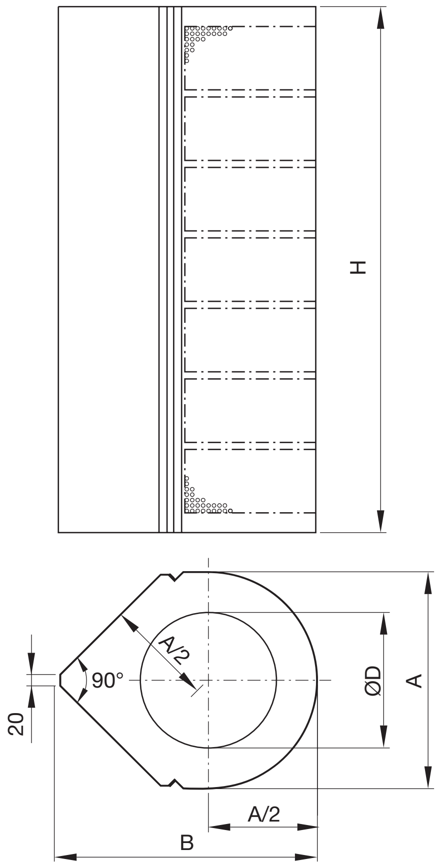
Order code

Product	CQA	aaaa
Type	CQA	
Size		aaaa

Order - accessories

Cover: CQAZ - 0 - size
Plinth: CQAZ - 2 - size
Wall bracket: CQAZ - 3 - size

Dimensions



Size	A mm	B mm	ØD mm	H mm	Weight kg
1207	250	302	125	710	8,00
1607	300	362	160	710	9,00
2010	330	398	200	970	14,0
2510	400	483	250	970	20,0
3115	520	628	315	1490	40,0
4020	630	760	400	2010	64,0

Accessories

Can be supplied with duct cover, plinth and bracket for wall mounting.

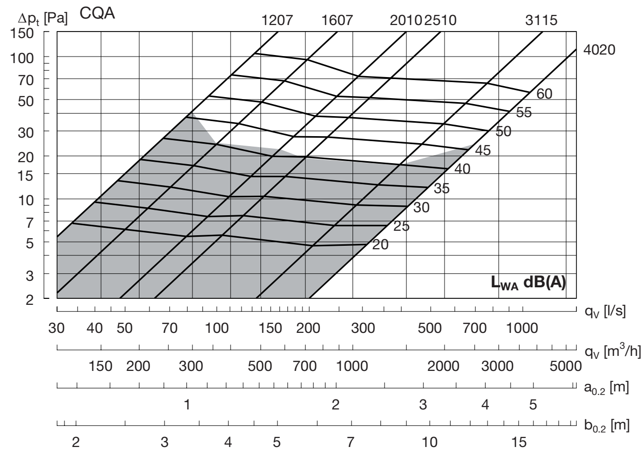
Materials and finish

Diffuser:	Galvanised steel
Nozzles:	Black plastic
Front plate:	1 mm galvanised steel
Standard finish:	Powder-coated
Standard colour:	RAL 9010 - white, gloss 30

The diffuser is available in other colours. Please contact Lindab's sales department for further information.

Perforated diffuser - corner CQA

Technical data



Recommended maximum volume flow.

The near zone is given at an under-temperature of -3 K to a maximum terminal velocity of 0.20 m/s.

Conversion to other terminal velocities - see table 1, correction of the near zone for -3 K and -6 K respectively.

Sound effect level

Sound effect level L_W [dB] = L_{WA} + K_{ok}

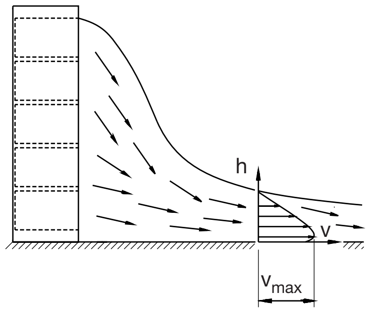
	Centre frequency Hz							
Size	**63**	**125**	**250**	**500**	**1K**	**2K**	**4K**	**8K**
1207	8	-3	3	0	-7	-15	-27	-35
1607	11	-1	5	-2	-8	-16	-28	-34
2010	11	0	5	-2	-7	-16	-28	-40
2510	11	2	5	-2	-7	-15	-29	-39
3115	11	3	5	-2	-8	-17	-29	-38
4020	12	4	2	0	-8	-16	-30	-41

Sound attenuation

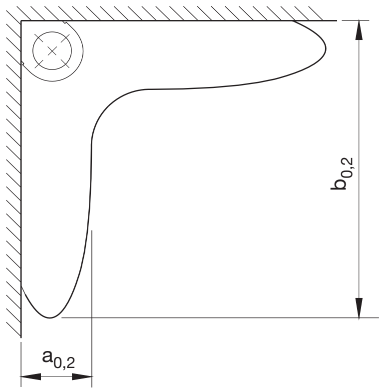
Sound attenuation ΔL [dB] including end reflection.

	Centre frequency Hz							
Size	**63**	**125**	**250**	**500**	**1K**	**2K**	**4K**	**8K**
1207	18	13	5	3	3	2	2	2
1607	15	11	3	1	2	2	2	2
2010	11	7	3	8	5	5	7	7
2510	10	6	5	7	5	4	4	5
3115	9	6	5	4	4	5	5	7
4020	8	5	2	3	2	3	3	3

Nearzone



Large diffusion (factory setting)



Small diffusion

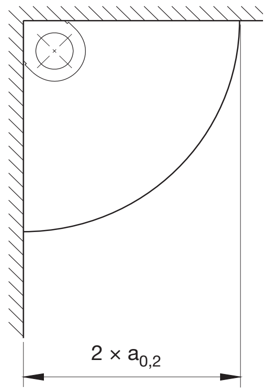


Table 1
Correction of the near zone ($a_{0.2}$, $b_{0.2}$)

Under-temperature T_i-T_r	Maximum velocity m/s	Mean velocity m/s	Correction factor
-3K	0.20	0.10	1.00
	0.25	0.12	0.80
	0.30	0.15	0.70
	0.35	0.17	0.60
	0.40	0.20	0.50
-6K	0.20	0.10	1.20
	0.25	0.12	1.00
	0.30	0.15	0.80
	0.35	0.17	0.70
	0.40	0.20	0.60

Perforated diffuser - rectangular CRA

Description

Comdif CRA is a rectangular perforated displacement diffuser for installation against a wall or column. CRA has a rectangular connection and therefore has a limited depth, making it ideal for installation in premises where a discrete appearance is required. Behind the perforated front plate, CRA is equipped with individually adjustable nozzles, making it possible to alter the geometry of the near zone. The diffuser can be turned and has a rectangular duct connection, so the diffuser can be connected at the top or bottom. The connection duct CRAZ with a circular connection is available as an accessory. The diffuser is suitable for the supply of large volumes of moderately cooled air.

- The diffuser is suitable for the supply of large volumes of air.
- The geometry of the near zone can be adjusted using adjustable nozzles
- Duct connections and plinths can be supplied as accessories

Maintenance

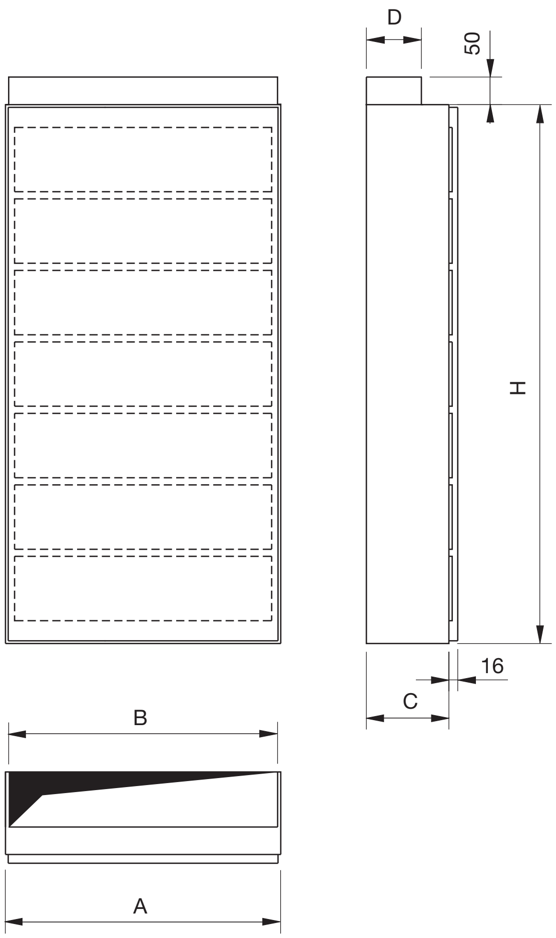
The front plate can be removed from the diffuser, making it possible to clean the nozzles. The visible parts of the diffuser can be wiped with a damp cloth.

Order code

Product	**CRA**	**aaaa**
Type		
Size		

Order - accessories
Connection duct: CRAZ - 1 - size
Plinth: CRAZ - 2 - size

Dimensions



Size	A mm	B mm	C mm	D mm	H mm	Weight kg
3010	300	278	150	98	980	10,0
5010	500	478	150	98	980	17,0
8010	800	778	150	98	980	27,0
8020	800	778	250	198	2020	32,0

Accessories

Can be supplied with duct connection and plinth.

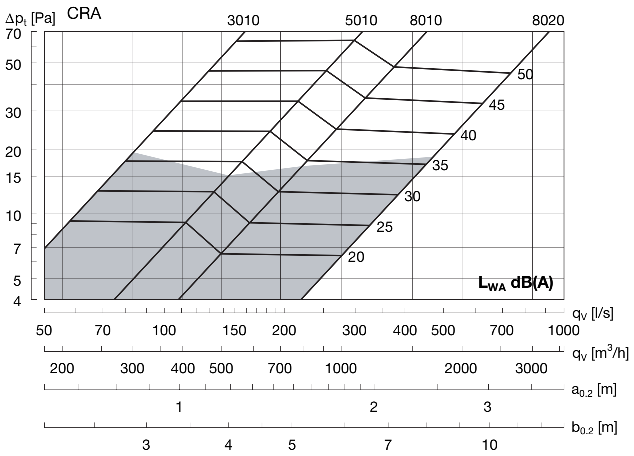
Materials and finish

Diffuser:	Galvanised steel
Nozzles:	Black plastic
Front plate:	1,5 mm galvanised steel
Standard finish:	Powder-coated
Standard colour:	RAL 9010 - white, gloss 30

The diffuser is available in other colours. Please contact Lindab's sales department for further information.

Perforated diffuser - rectangular CRA

Technical data



Recommended maximum volume flow

The near zone is given at an under-temperature of -3 K to a maximum terminal velocity of 0.20 m/s.

Conversion to other terminal velocities - see table 1, correction of the near zone for -3 K and -6 K respectively.

Sound effect level

Sound effect level L_W [dB] = $L_{WA} + K_{ok}$

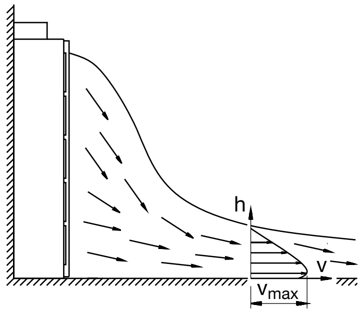
	Centre frequency Hz							
Size	**63**	**125**	**250**	**500**	**1K**	**2K**	**4K**	**8K**
3010	9	-1	5	-1	-11	-17	-30	-41
5010	7	1	4	0	-11	-19	-32	-42
8010	15	0	4	0	-12	-20	-31	-43
8020	10	4	6	-2	-11	-21	-33	-39

Sound attenuation

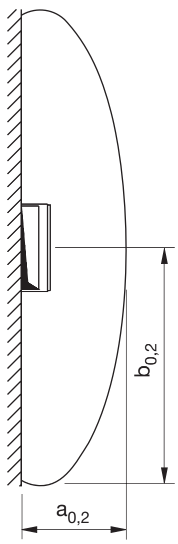
Sound attenuation ΔL [dB] including end reflection.

	Centre frequency Hz							
Size	**63**	**125**	**250**	**500**	**1K**	**2K**	**4K**	**8K**
3010	11	7	6	4	2	2	1	2
5010	10	6	6	4	2	2	1	2
8010	10	6	4	3	2	1	1	1
8020	7	4	3	2	1	1	1	1

Nearzone



Large diffusion (factory setting)



Small diffusion

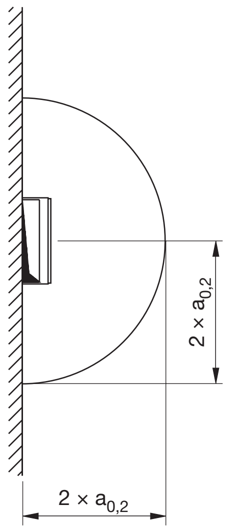


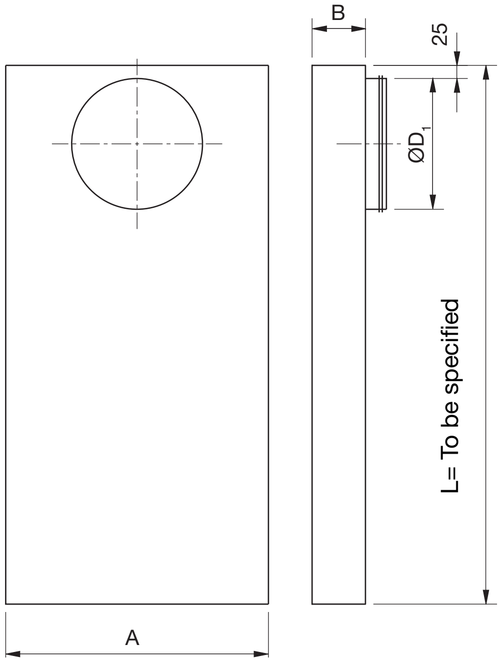
Table 1
Correction of the near zone ($a_{0.2}$, $b_{0.2}$)

Under-temperature T_i-T_r	Maximum velocity m/s	Mean velocity m/s	Correction factor
	0.20	0.10	1.00
	0.25	0.12	0.80
-3K	0.30	0.15	0.70
	0.35	0.17	0.60
	0.40	0.20	0.50
	0.20	0.10	1.20
	0.25	0.12	1.00
-6K	0.30	0.15	0.80
	0.35	0.17	0.70
	0.40	0.20	0.60

Perforated diffuser - rectangular CRA

Accessories

Connection duct CRAZ-1



Size	A mm	B mm	$ØD_1$ mm	Weight kg/m
3010	280	100	200	5,0
5010	480	100	250	7,0
8010	780	100	315	9,0
8020	780	200	400	11,0

Order code

Connection duct **CRAZ-1 aaaa bbbb c**

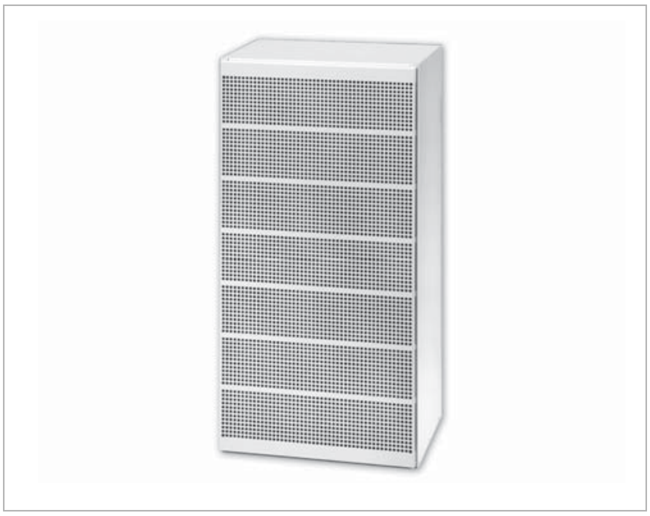
Type (CRAZ-1)

Size (aaaa)

Length (bbbb) — According to dimensions in mm, L=max. 2,000 mm

Connection (c) — Front 0; Back (Standard) 1

Perforated diffuser - rectangular CEA



Description

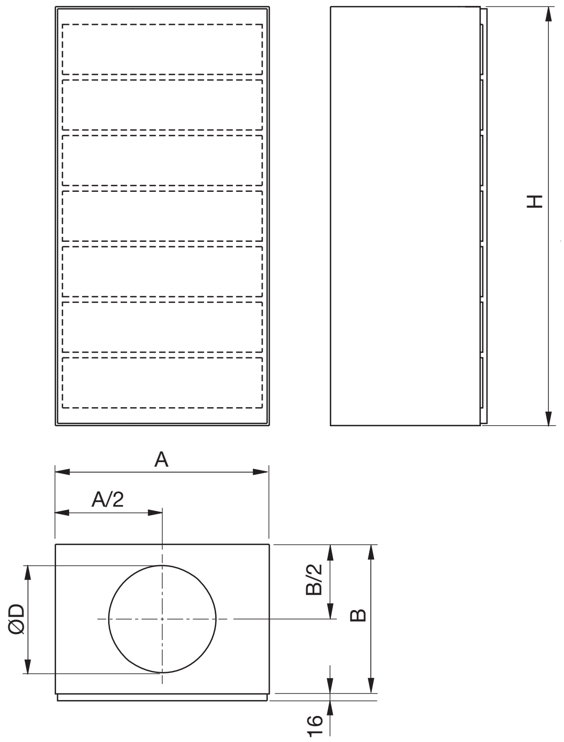
Comdif CEA is a rectangular perforated displacement diffuser for installation against a wall or column. Behind the perforated front plate, CEA is equipped with individually adjustable nozzles, making it possible to alter the geometry of the near zone. The diffuser can be turned and has a circular duct connection (MF measure), so the diffuser can be connected at the top or bottom. The diffuser is suitable for the supply of large volumes of moderately cooled air.

- The diffuser is suitable for the supply of large volumes of air.
- The geometry of the near zone can be adjusted using adjustable nozzles.
- Plinths be supplied as accessories.

Maintenance

The front plate can be removed from the diffuser, making it possible to clean the nozzles. The visible parts of the diffuser can be wiped with a damp cloth.

Dimensions



Size	A mm	B mm	ØD mm	H mm	Weight kg
200	300	300	200	980	12,0
250	500	350	250	980	24,0
315	800	500	315	1500	80,0
400	800	600	400	1500	96,0

Accessories

Can be supplied with plinth.

Order code

Product	**CEA**	**aaaa**
Type	↑	
Size		↑

Order - accessories

Plinth: CEAZ - 2 - size

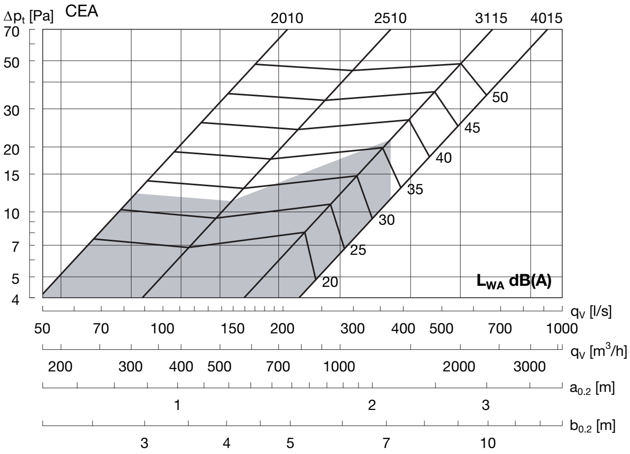
Materials and finish

Diffuser:	Galvanised steel
Nozzles:	Black plastic
Front plate:	1,5 mm galvanised steel
Standard finish:	Powder-coated
Standard colour:	RAL 9010 - white, gloss 30

The diffuser is available in other colours. Please contact Lindab's sales department for further information.

Perforated diffuser - rectangular CEA

Technical data



Recommended maximum volume flow.

The near zone is given at an under-temperature of -3 K to a maximum terminal velocity of 0.20 m/s.

Conversion to other terminal velocities - see table 1, correction of the near zone for -3 K and -6 K respectively.

Sound effect level

Sound effect level L_W [dB] = $L_{WA} + K_{ok}$

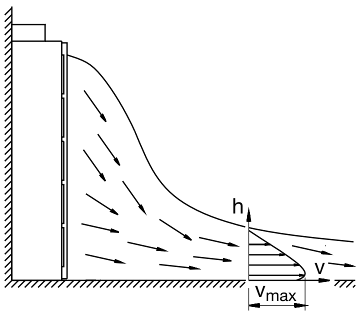
	Centre frequency Hz							
Size	**63**	**125**	**250**	**500**	**1K**	**2K**	**4K**	**8K**
2010	11	4	4	-1	-8	-14	-25	-37
2510	8	4	2	0	-6	-16	-27	-40
3115	14	6	3	-1	-8	-17	-29	-25
4015	11	3	2	1	-10	-18	-30	-37

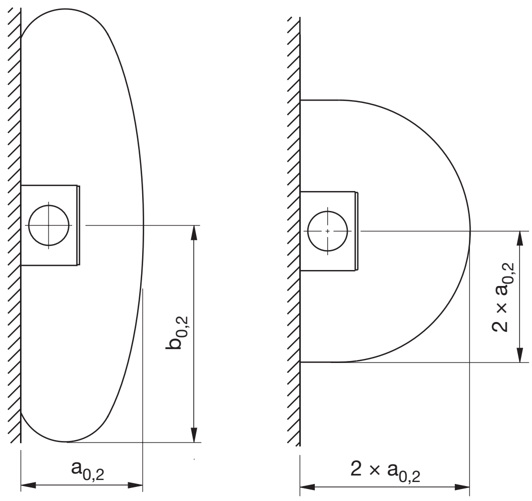
Sound attenuation

Sound attenuation ΔL [dB] including end reflection.

	Centre frequency Hz							
Size	**63**	**125**	**250**	**500**	**1K**	**2K**	**4K**	**8K**
2010	10	6	1	4	5	3	4	4
2510	10	6	6	4	2	2	4	3
3115	9	6	5	3	3	4	4	5
4015	8	5	3	3	2	3	4	4

Nearzone

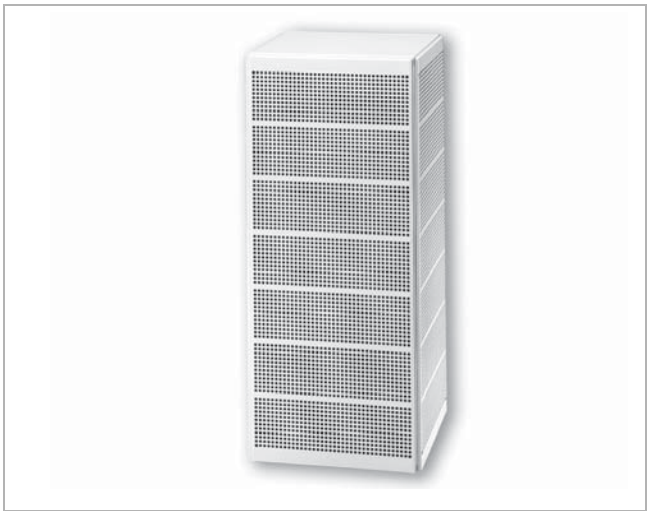




Correction of the near zone ($a_{0.2}$, $b_{0.2}$)

Under-temperature T_i-T_r	Maximum velocity m/s	Mean velocity m/s	Correction factor
-3K	0.20	0.10	1.00
	0.25	0.12	0.80
	0.30	0.15	0.70
	0.35	0.17	0.60
	0.40	0.20	0.50
-6K	0.20	0.10	1.20
	0.25	0.12	1.00
	0.30	0.15	0.80
	0.35	0.17	0.70
	0.40	0.20	0.60

Perforated diffuser - square CKA



Description

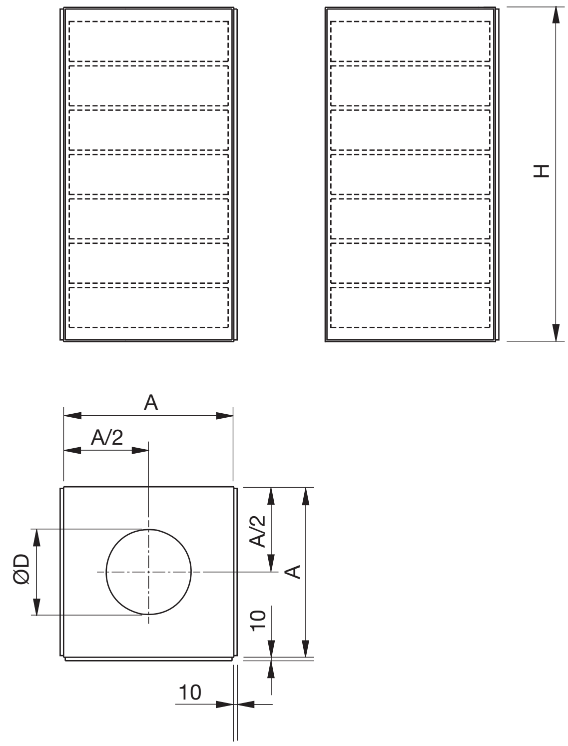
Comdif CKA is a square perforated displacement diffuser for installation against a wall or column. Behind the perforated front plate, CKA is equipped with individually adjustable nozzles, making it possible to alter the geometry of the near zone. The diffuser can be turned and has a circular duct connection (MF measure), so the diffuser can be connected at the top or bottom. The diffuser is suitable for the supply of large volumes of moderately cooled air.

- The diffuser is suitable for the supply of large volumes of air
- The geometry of the near zone can be adjusted using adjustable nozzles
- Plinths can be supplied as accessories

Maintenance

The front plate can be removed from the diffuser, making it possible to clean the nozzles. The visible parts of the diffuser can be wiped with a damp cloth.

Dimensions



Size	A mm	ØD mm	H mm	Weight kg
200	300	200	980	11,0
250	400	250	980	20,0
315	500	315	980	30,0
400	500	400	1500	45,0
500	800	500	2020	150
630	800	630	2020	150

Accessories

Can be supplied with plinth.

Order code

Product	**CKA**	**aaaa**
Type	┘	
Size		┘

Order - accessories

Plinth: CKAZ - 2 - size

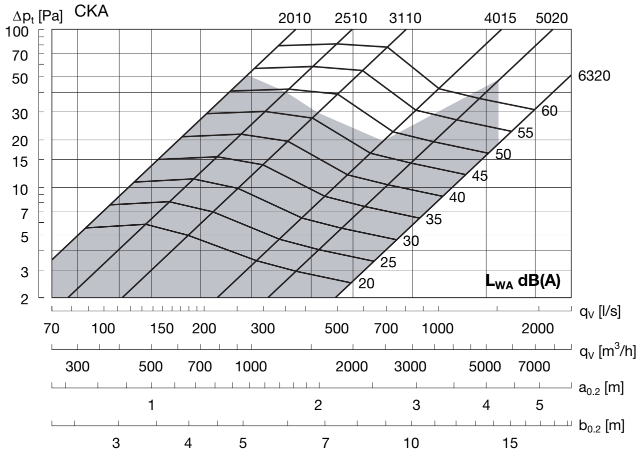
Materials and finish

Diffuser:	Galvanised steel
Nozzles:	Black plastic
Front plate:	1,5 mm galvanised steel
Standard finish:	Powder-coated
Standard colour:	RAL 9010 - white, gloss 30

The diffuser is available in other colours. Please contact Lindab's sales department for further information.

Perforated diffuser - square CKA

Technical data



Recommended maximum volume flow.

The near zone is given at an under-temperature of -3 K to a maximum terminal velocity of 0.20 m/s.

Conversion to other terminal velocities - see table correction of the near zone for -3 K and -6 K respectively.

Sound effect level

Sound effect level L_W [dB] = $L_{WA} + K_{ok}$

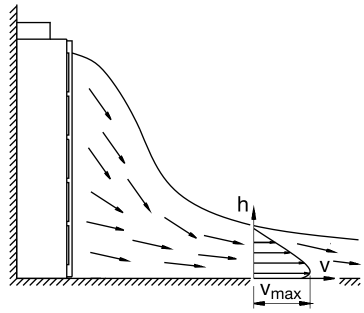
	Centre frequency Hz							
Size	**63**	**125**	**250**	**500**	**1K**	**2K**	**4K**	**8K**
2010	10	0	4	0	-8	-18	-29	-43
2510	11	1	4	-1	-8	-19	-30	-42
3110	14	3	4	-1	-10	-18	-30	-32
4015	10	1	2	0	-8	-17	-27	-42
5020	7	3	2	0	-6	-16	-19	-17
6320	7	3	2	0	-6	-16	-19	-17

Sound attenuation

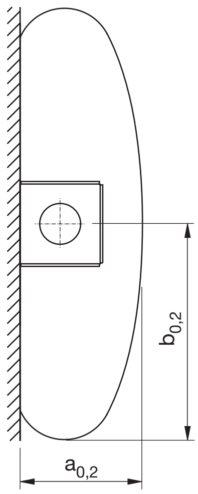
Sound attenuation ΔL [dB] including end reflection.

	Centre frequency Hz							
Size	**63**	**125**	**250**	**500**	**1K**	**2K**	**4K**	**8K**
2010	12	8	4	2	1	1	1	1
2510	10	6	6	4	2	2	4	3
3110	10	7	3	1	2	1	2	1
4015	9	6	1	1	1	1	1	1
5020	6	4	1	1	1	1	1	1
6320	5	3	1	0	0	0	0	0

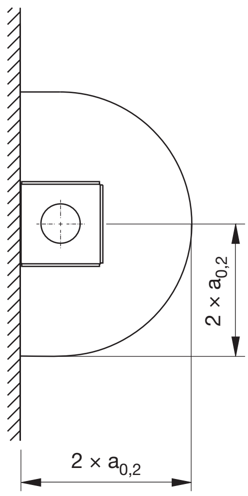
Nearzone



Large diffusion (factory setting)



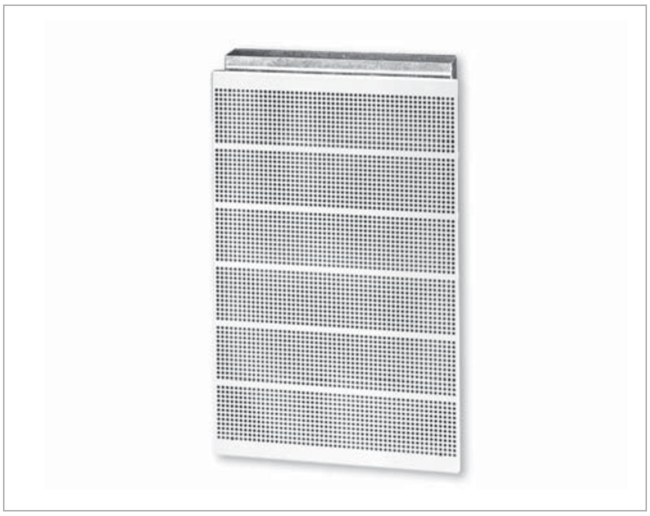
Small diffusion



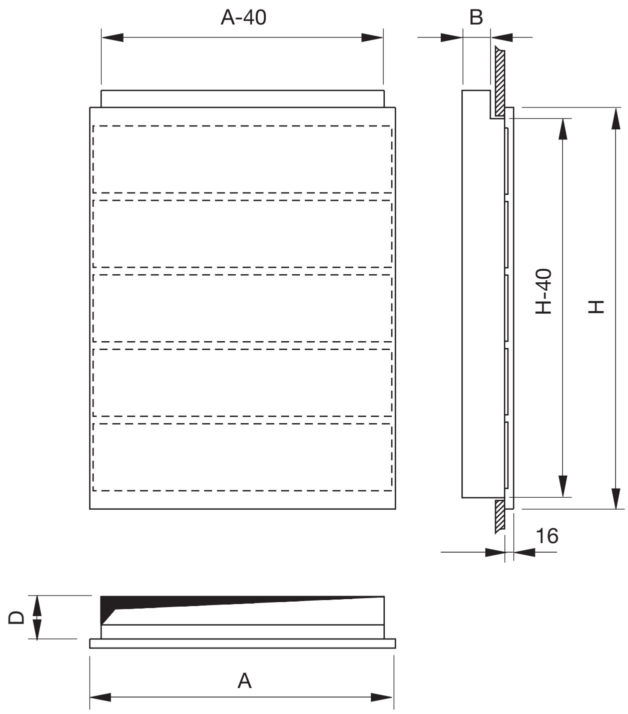
Correction of the near zone ($a_{0.2}$, $b_{0.2}$)

Under-temperature T_i-T_r	**Maximum velocity m/s**	**Mean velocity m/s**	**Correction factor**
-3K	0.20	0.10	1.00
	0.25	0.12	0.80
	0.30	0.15	0.70
	0.35	0.17	0.60
	0.40	0.20	0.50
-6K	0.20	0.10	1.20
	0.25	0.12	1.00
	0.30	0.15	0.80
	0.35	0.17	0.70
	0.40	0.20	0.60

Perforated diffuser - installation CVA



Dimensions



Size	A mm	B mm	D mm	H mm	m kg
3005	540	50	75	320	4,40
5005	540	50	75	450	5,80
6005	540	50	75	580	8,70
6008	540	80	105	580	9,00
8008	540	80	105	840	12,0

Cutting dimension: A - 30 x H - 30

Description

Comdif CVA is a rectangular perforated displacement diffuser for installation in walls or similar structures. CVA has a rectangular connection. Behind the perforated front plate, CVA is equipped with individually adjustable nozzles, making it possible to alter the geometry of the near zone. The diffuser can be turned and has a rectangular duct connection, so the diffuser can be connected at the top or bottom. A wall duct with circular connection is supplied as an accessory. The diffuser is suitable for the supply of large volumes of moderately cooled air.

- The diffuser is suitable for installation in walls.
- The geometry of the near zone can be adjusted using adjustable nozzles.
- A wall duct can be supplied as an accessory.

Maintenance

The front plate can be removed from the diffuser, making it possible to clean the nozzles. The visible parts of the diffuser can be wiped with a damp cloth.

Accessories

Can be supplied with wall duct.

Order code

Product	**CVA**	**aaaa**
Type	┘	
Size		┘

Order - accessories

Wall duct: CVAZ -1 - size

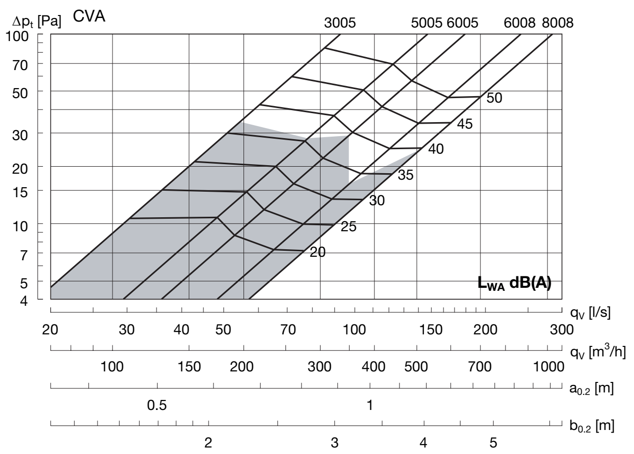
Materials and finish

Diffuser:	Galvanised steel
Nozzles:	Black plastic
Front plate:	1,5 mm galvanised steel
Standard finish:	Powder-coated
Standard colour:	RAL 9010 - white, gloss 30

The diffuser is available in other colours. Please contact Lindab's sales department for further information.

Perforated diffuser - installation CVA

Technical data



Recommended maximum volume flow

The near zone is given at an under-temperature of -3 K to a maximum terminal velocity of 0.20 m/s.

Conversion to other terminal velocities - see table 1, correction of the near zone for -3 K and -6 K respectively.

Sound effect level

Sound effect level L_W [dB] = $L_{WA} + K_{ok}$

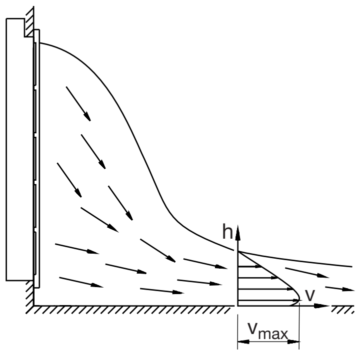
	Centre frequency Hz							
Size	**63**	**125**	**250**	**500**	**1K**	**2K**	**4K**	**8K**
3005	7	-2	-2	1	-8	-17	-27	-38
5005	7	-3	-1	1	-7	-17	-29	-36
6005	11	-4	-1	1	-7	-17	-29	-37
6008	12	-4	2	1	-9	-20	-31	-31
8008	10	-4	2	1	-9	-19	-30	-43

Sound attenuation

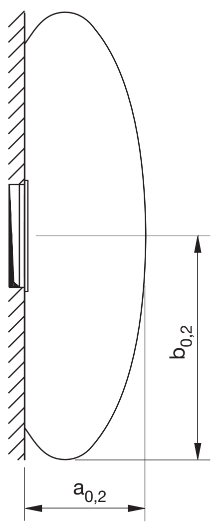
Sound attenuation ΔL [dB] including end reflection.

	Centre frequency Hz							
Size	**63**	**125**	**250**	**500**	**1K**	**2K**	**4K**	**8K**
3005	18	13	9	4	1	0	0	1
5005	15	11	8	2	2	1	0	0
6005	15	10	4	2	0	0	0	1
6008	12	8	3	2	0	0	0	0
8008	12	8	3	1	0	0	0	0

Nearzone



Large diffusion (factory setting)



Small diffusion

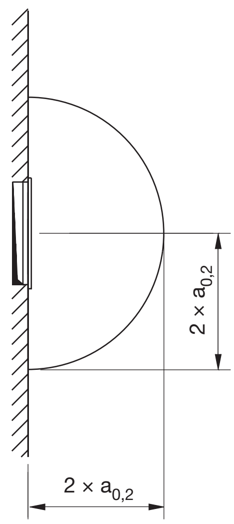


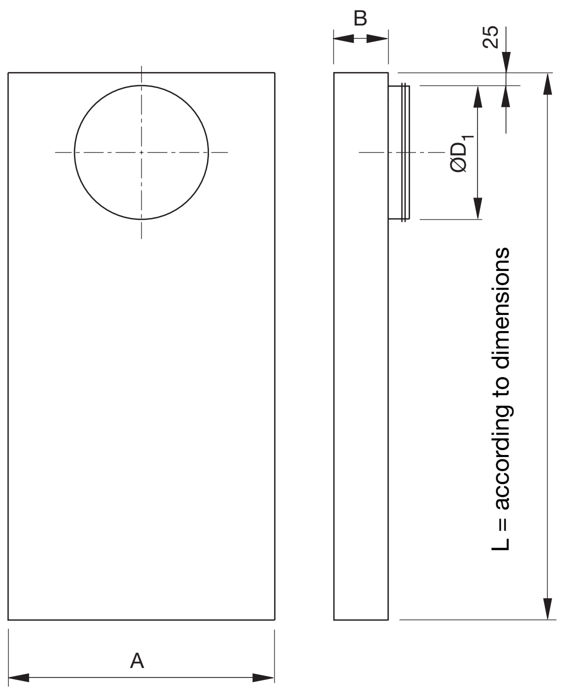
Table 1
Correction of the near zone ($a_{0.2}$, $b_{0.2}$)

Under-temperature T_i-T_r	Maximum velocity m/s	Mean velocity m/s	Correction factor
-3K	0.20	0.10	1.00
	0.25	0.12	0.80
	0.30	0.15	0.70
	0.35	0.17	0.60
	0.40	0.20	0.50
-6K	0.20	0.10	1.20
	0.25	0.12	1.00
	0.30	0.15	0.80
	0.35	0.17	0.70
	0.40	0.20	0.60

Perforated diffuser - installation CVA

Accessories

Wall duct CVAZ-1



Size	A mm	B mm	$ØD_1$ mm	Weight kg/m
3005	502	52	125	6,0
5005	502	52	160	6,0
6005	502	52	200	6,0
6008	502	82	250	6,5
8008	502	82	315	6,5

Order code

Wall duct **CVAZ-1** **aaaa** **bbbb**

Type

Size

Length According to dimensions in mm L=max. 2,000 mm

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

Theatre diffuser CRP

Description

CRP is a rectangular displacement diffuser for installation under seats in theatres, auditoriums, etc. It is suitable for installation in a pressure chamber and has a fixed resistance that ensures even distribution of the air. The diffuser can be adapted to the correct air volume and pressure, specified according to the actual conditions.

- It has built-in resistance that ensures even distribution over the diffusers
- The diffuser can be supplied with a specified pressure setting
- The diffuser is available in other dimensions

Maintenance

The front plate of the diffuser can be removed to enable cleaning of the internal components. The visible parts of the diffuser can be wiped with a damp cloth.

Materials and finish

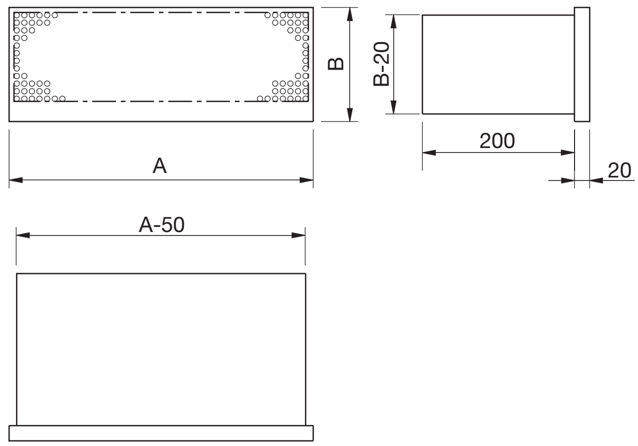
Diffuser:	Galvanised steel
Front plate:	1 mm galvanised steel
Standard finish:	Powder-coated
Standard colour:	RAL 7040 - grey, gloss 30
	RAL 9010 - white, gloss 30

The diffuser is available in other colours. Please contact Lindab's sales department for further information.

Order code

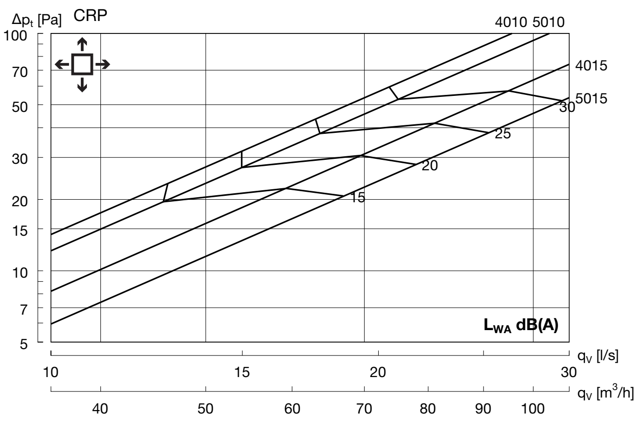
Product		CRP	a	bbbb
Type				
Colour	RAL 7040 - grey	0		
	RAL 9010 - white	1		
	Special colour	2		
Size				

Dimensions



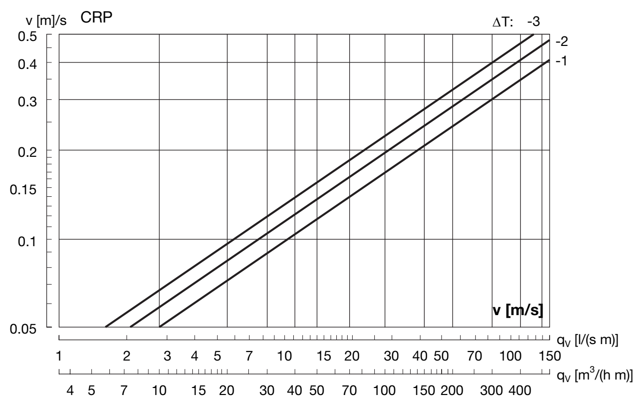
Size	A mm	B mm	Weight kg
4010	400	100	1,60
4015	400	150	2,20
5010	500	100	2,00
5015	500	150	2,70

Pressure, sound level



Size	63	125	250	500	1K	2K	4K	8K
4010	5	-6	-5	-2	-4	-9	-17	-26
4015	0	-4	-1	0	-6	-10	-18	-27
5010	7	-4	-3	0	-6	-12	-18	-29
5015	5	-3	-1	0	-6	-11	-19	-30

Near zone



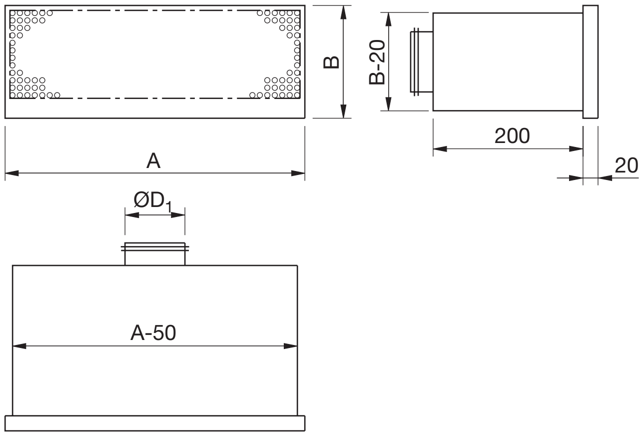
The speed is measured 0.5 m from the diffuser.

We reserve the right to make changes without prior notice

Lindab

Theatre diffuser CRU

Dimensions



Size	A mm	B mm	ØD₁ mm	Weight kg
4010	400	100	80	1,40
4015	400	150	100	2,00
5010	500	100	80	1,70
5015	500	150	125	2,50

Description

CRU is a rectangular displacement diffuser for installation under seats in theatres, auditoriums, etc. The diffuser is supplied with a circular connection. The diffuser can be supplied with a fixed resistance adapted to the correct air volume and pressure, specified according to the actual conditions.

- Circular connection with Lindab Safe.
- The diffuser can be supplied with a fixed resistance at a specified pressure setting
- The diffuser is available in other dimensions.

Maintenance

The front plate can be removed from the diffuser for cleaning of the internal components. The visible parts of the diffuser can be wiped with a damp cloth.

Materials and finish

Diffuser:	Galvanised steel
Front plate:	1 mm galvanised steel
Standard finish:	Powder-coated
Standard colour:	RAL 7040 - grey, gloss 30
	RAL 9010 - white, gloss 30

The diffuser is available in other colours. Please contact Lindab's sales department for further information.

Order code

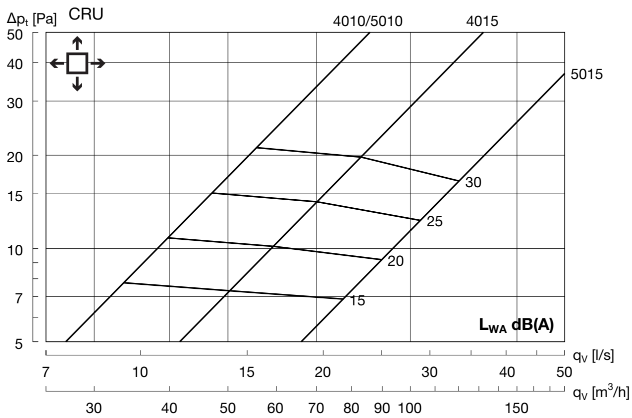
Product **CRU** **aaaa** **bbbb**

Type

Colour	RAL 7040 - grey	0
	RAL 9010 - white	1
	Special colour	2

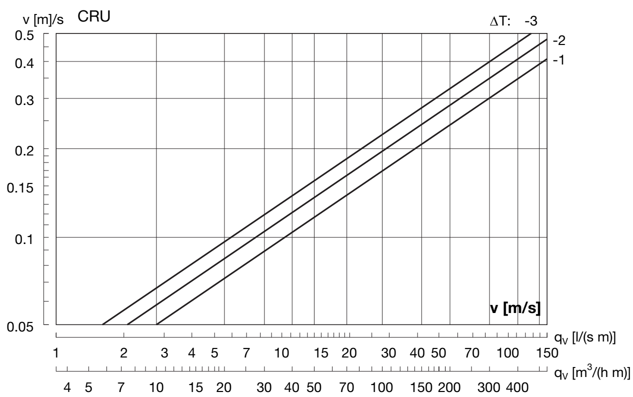
Size

Pressure, sound level



Size	63	125	250	500	1K	2K	4K	8K
4010	5	-4	-2	2	-9	-18	-30	-42
4015	9	-2	-2	2	-10	-17	-30	-37
5010	5	-4	-2	2	-9	-18	-30	-42
5015	7	-6	-2	2	-11	-21	-33	-28

Near zone



The speed is measured 0.5 m from the diffuser.

Theatre diffuser CCP

Description

CCP is a circular displacement diffuser for installation under seats in theatres, auditoriums, etc. This diffuser is suitable for installation in a pressure chamber. It has a fixed resistance that ensures even distribution of the air. The diffuser can be adapted to the correct air volume and pressure, specified according to the actual conditions.

- It has built-in resistance that ensures even distribution over the diffuser
- The diffuser can be supplied with a specified pressure setting
- The diffuser is available in other dimensions

Maintenance

The front plate of the diffuser can be removed to enable cleaning of the internal components.The visible parts of the diffuser can be wiped with a damp cloth.

Materials and finish

Diffuser:	Galvanised steel
Front plate:	1 mm galvanised steel
Standard finish:	Powder-coated
Standard colour:	RAL 7040 - grey, gloss 30
	RAL 9010 - white, gloss 30

The diffuser is available in other colours. Please contact Lindab's sales department for further information.

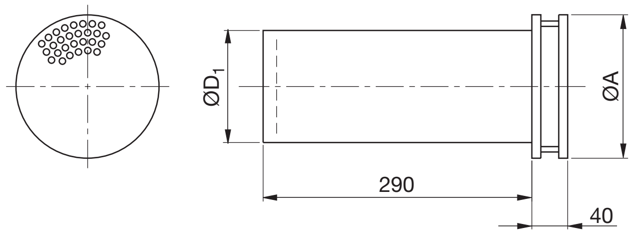
Order code

Product	CCP	a	bbb
Type			

Colour		
	RAL 7040 - grey	0
	RAL 9010 - white	1
	Special colour	2

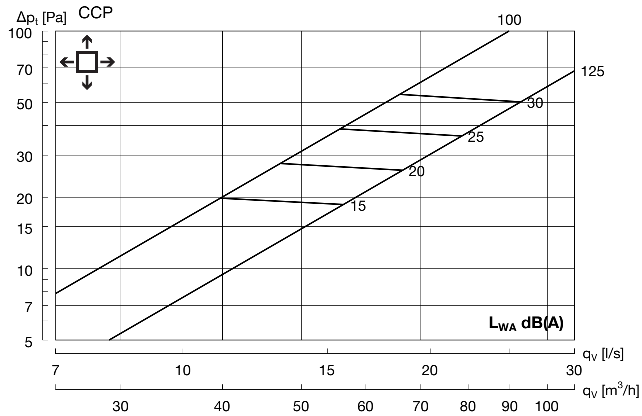
Size

Dimensions



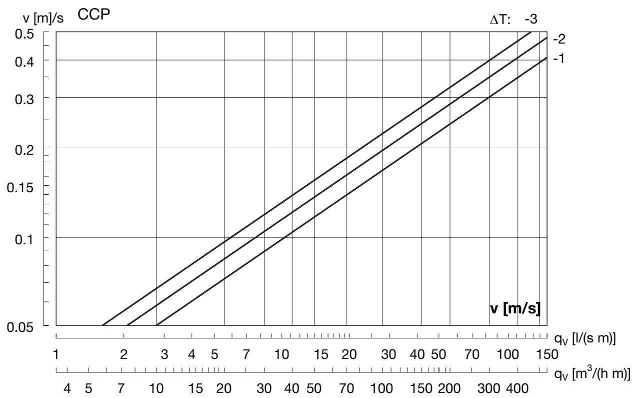
Size	ØA mm	$ØD_1$ mm	Weight kg
100	140	100	0,70
125	160	125	0,90

Pressure, sound level



Size	63	125	250	500	1K	2K	4K	8K
100	10	-7	-6	-1	-5	-8	-13	-24
125	3	-7	-5	0	-5	-10	-15	-27

Near zone

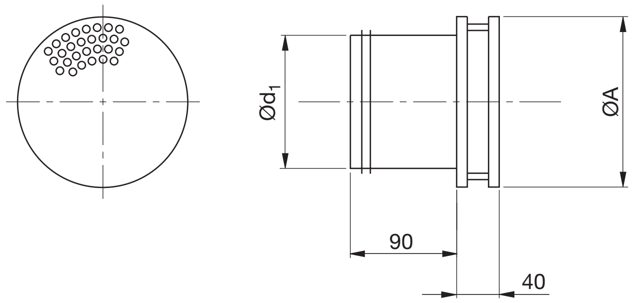


The speed is measured 0.5 m from the diffuser.

Theatre diffuser

CCU

Dimensions



Size	ØA mm	ØD1 mm	Weight kg
100	140	100	0,40
125	160	125	0,50

Description

CCU is a circular displacement diffuser for installation under seats in theatres, auditoriums, etc. The diffuser is supplied with a circular connection. The diffuser can be supplied with a fixed resistance, adapted to the correct air volume and pressure, specified according to the actual conditions.

- Circular connection with Lindab Safe.
- The diffuser can be supplied with a fixed resistance at a specified pressure setting.
- The diffuser is available in other dimensions.

Maintenance

The front plate of the diffuser can be removed to enable cleaning of the internal components. The visible parts of the diffuser can be wiped with a damp cloth.

Materials and finish

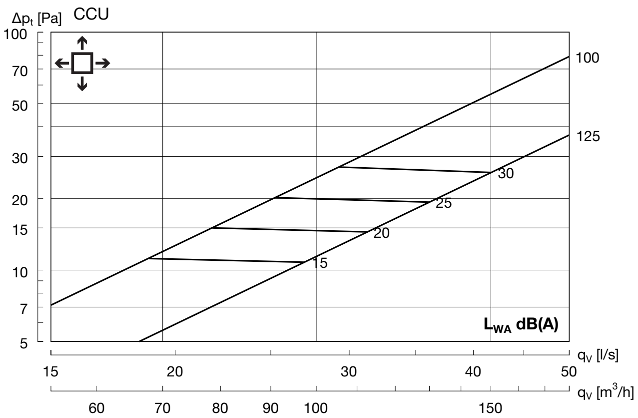
Diffuser:	Galvanised steel
Front plate:	1 mm galvanised steel
Standard finish:	Powder-coated
Standard colour:	RAL 7040 - grey, gloss 30
	RAL 9010 - white, gloss 30

The diffuser is available in other colours. Please contact Lindab's sales department for further information.

Order code

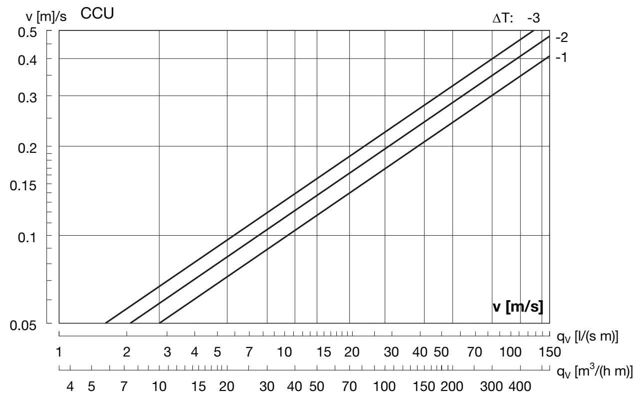
Product		CCU	a	bbb
Type				
Colour	RAL 7040 - grey	0		
	RAL 9010 - white	1		
	Special colour	2		
Size				

Pressure, sound level



Size	63	125	250	500	1K	2K	4K	8K
100	10	1	-2	-3	-3	-11	-19	-29
125	9	-1	-2	-3	-3	-12	-20	-19

Near zone



The speed is measured 0.5 m from the diffuser.

Variable flow systems VAV theory

LKPV, IBM, Aarhus.

Optimized usage

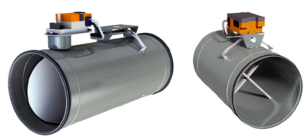
Ventilation makes up considerable part of energy costs in the daily usage of the building. At the same time authorities have several requirements concerning how much energy is to be spent on ventilation. In pretty much all types of systems, it consequently makes good sense to use some sort of VAV, making it possible to reduce the air volume depending on the need in each individual room. The reduction of air volume in connection with transport of the air, in addition to the energy needed to cool/heat the outer air, will reduce costs.

Besides saving money on the energy, it also makes it possible to maintain a desired temperature in the individual room at varying loads. Through documented research and testing, it has turned out that there is a specific connection between the operative temperature in the room and the people's productivity. If the temperature in the room is not right, the productivity will fall, which in many instances will mean an economical loss to the individual users of the construction.

With these parameters taken into consideration, there is no doubt that VAV, despite the more expensive one-off investment, will pay for itself in the long run.

Complete programme

Lindab's series of VAV products include several types of supply air diffusers with motorized dampers, in order to reduce the air volume from 100% to 0%. At the same time a constant air throw is ensured, in order to maintain the Coanda effect and avoid the risk of the air dropping in the occupied zone. Likewise, air flow regulators are available to regulate zones, in addition to motorized dampers for pressure regulation in the distribution ducts. Furthermore room regulator REGULA Combi and pressure regulator PR are available as well.



VRU / FRU

Variable flow systems VAV theory

General information on VAV

VAV is short for "Variable Air Volume". VAV is a demand-controlled ventilation, to be used when the loads in a building vary. In rooms with changing numbers of people, a more satisfactory air quality can be ensured by regulating the air flow in relation to CO_2 concentration, which is a good indicator of air quality. It is however often the heat load, such as people, computers and sun, that is dimensioning the ventilation need in a room. These heat loads will almost always vary throughout the day and the night. By maintaining a constant supply air temperature, lower than the room temperature and instead regulate the air flow in ratio to the desired room temperature, the demand-controlled ventilation will cancel out the heat load.

The variations in airflow are brought about by a duct-damper or by motorized supply air diffusers with a damper function.
VAV-units can be produced for both with displacement ventilation and mixed ventilation.

Description of regulation types

In VAV-units, it is a pre-requisite that the fans can be speed-controlled.
Furthermore the VAV-unit must be divided into zones, typically one zone for each distribution air duct. These zones can be identified from two different principles. The airflow regulation or pressure regulation.

Airflow regulation

With airflow regulation, it is the airflow / air volume in the distribution air duct which is measured and regulated. The airflow is set to be able to vary between a pre-programmed minimum and maximum airflow. An electronic signal from a sensor (temperature, CO_2, movement) or BMS regulates the airflow within the set minimum and maximum airflow limits.

In airflow regulation, the right airflow will be achieved even when the pressure conditions in the air duct are changing, since the airflow regulator is independent of the pressure (and only requires a minimum pre-pressure).

This type of regulation is usually used for zone-regulation in connection with diffusers without dampers in mixed- or displacement systems. If mixed ventilation units without dampers are used, and the temperature difference is high. (ΔT = -8 to 10 K) between supply air and room air, the attention should turn to the risk of cold-drops from the supply air diffusers.

Since the airflow should be measured, there is a minimum limit on the airflow regulator. The minimum airflow must not be set lower than the measurement limit for the velocity of approx. 0.7 m/s. Airflow regulation can be used in the distribution air duct both for supply air and exhaust, either with a parallel signal from a sensor or BMS or with a Master/Slave function. If for example an over- or under pressure in a room is desired, with respect to the surroundings, a Master/Slave function is advisable.

Pressure regulation

Normally it is the distribution air duct on the supply air side which is regulated for pressure. A pressure regulation entails that a constant static pressure is maintained in the air duct. The static pressure is measured by a probe mounted inside the air duct. The probe is connected by a pipe to an electronic unit (pressure regulator) which registers the static pressure in the air duct with a membrane sensor unit.

For units with motorized supply air diffusers there should be a pressure regulation in the distribution air duct, since the diffusers are set and calibrated for a certain airflow variation at a given pressure. Furthermore the pressure regulation ensures that the correct pressure loss over the diffusers is reached, and consequently unwanted diffuser noise is avoided at a minimum airflow.

If instead, un-motorized diffusers are used, and airflow variations are made from motorized dampers in the air duct, a pressure regulation in the distribution air duct will ensure stable pressure conditions in the zone, and therefore good conditions for controlling these air duct dampers.

No matter the unit type however, the pressure loss in the zones distribution air duct has to be taken into consideration, in order to obtain a similar if not identical pressure at all branches to the connection ducts. As a general rule, the pressure loss in the distribution air duct from the first branch to the last branch should not exceed approx. 40 % of the static pressure.

In principle it is possible to obtain an airflow variation from 0-100% using air pressure regulation. The variation is solely dependent on which dampers or VAV-units are being used.

Pressure regulation of a distribution air duct using the supply air diffuser can be combined with an airflow regulation of the exhaust air. Using the Master/Slave principle and measuring the airflow /air volume, in the supply air, the signal for the measured airflow can be used as a signal to the airflow regulator on the exhaust air. That way it is definite that the same volume of air will be removed from a VAV-zone as the volume supplied.

A more simple, but less precise method to secure the same volume of air in and out of the VAV-zone, is to use a mechanical slave-control of the exhaust-damper, which takes the same position as the supply air-damper. Regulation of the exhaust-damper happens by a simple electronic adjustment, when the turning angle has been determined.

Variable flow systems VAV theory

Choice of regulation type

In smaller zones, with a clear pressure conditions (not too long supply air ducts) both in supply air and exhaust air, a VAV-system with a pressure regulation of the distribution air ducts is preferable. If motorized VAV-diffusers are required, a pressure regulation of the zone is necessary.

For units with widely varying pressure conditions, we instead recommend an airflow regulation of each zone.

In zones with longer distribution air ducts, eg. big office spaces, where not much variety happens in the thermal loads, airflow regulation will be preferable.

Airflow regulation

+ full control over airflow
+ measuring of actual airflow
+ signal to BMS about airflow
+ no airflow variations at pressure variations in the air duct system
- minimum airflow limited to 0,7 m/s
- demands special equipment to change settings (compact model)

Pressure regulation

+ very low minimum airflow
+ can be set without the help of tools
+ levels pressure variations from the system in the VAV-zone
+ ensures a low noise level for diffuser and dampers
+ possibility of combination with CAV
- no airflow control
- small pressure loss in distribution air duct is important

Choice of diffuser

Mixed ventilation

1) Motorized supply air diffusers

Advantages:
Built-in damper function, and no extra dampers necessary. Constant air throw despite varying airflow, resulting in good mix even at minimum airflow. Also suitable for supply air at cooling temperature.

Limitations:
Owing to sound generation in the diffuser, the duct pressure must be maintained at a constant (relatively low) level.

2) Non-motorized supply air diffusers

Advantages:
Simple diffusers without moveable parts.
Low sound level particularly at reduced air flow.

Existing systems can be changed to VAV without change of diffuser.
No electrical installations needed for diffusers.
More diffusers can be controlled by one motor damper.
Shut-off is possible with duct damper or airflow regulator.

Limitations:
Minimum airflow should not be chosen less than 50% for perforated or unperforated diffusers, and 40% for swirl diffusers, if cooling supply air is used at a temperature difference of (ΔT = -8 to -10 K) between supply air and room air.

Displacement ventilation

All displacement units are suitable for VAV-systems. The units should be dimensioned for the maximum airflow, where the biggest near-zones and the highest sound levels arise. When the airflow is reduced, so is the near-zone and the sound level. Consequently there is no lower limit to the size of minimum airflow, which is why an airflow variation from 0-100% is possible.

Possible consequences should be evaluated in each case.

Variable flow systems VAV theory

Component qualities

SUPPLY AIR		Airflow control	Pressure control	
		VRU	VAV-unit	Damper
Measurement of airflow - airflow signal to CTS		yes	no	no
Linear functions		yes	no	no
Reliability of airflow		yes	dependent on pressure variation	dependent on pressure variation
Limitation of airflow	max:	yes (standard up to 7 m/s)	pressure dependent	pressure dependent
	min:	yes (standard of 0,7 m/s)	approx. 20% of max. (standard)	damper angle
Shut-off possible		yes	no	yes
Constant airthrow (only mixed ven-tilation)		no	yes	no
Balancing		not necessary (diffusers are controlled)	by setting of static pressure or damper-position	by setting of static pressure or damper-position

EXHAUST AIR	Airflow control	Mechanical slave control
	VRU	Dampers
Requirements for supply air	VRU/FRU	motor for slave control
Measurement airflow (exhaust) - air flow signal to CTS	yes	no
Reliability of airflow	yes	highly pressure dependent, therefore inaccurate
Control of over pressure, under pressure or pressure balance in room	yes	no
Balancing	not necessary (diffuser controls)	by setting of static pressure or damper-position

Volume flow regulator - circular VRU

Description

VRU is a circular volume flow regulator for VAV regulation in duct systems and consists of a measuring unit and a damper. VRU is used for volume flow regulation in circular ducts controlled from e.g. a room controller or BMS. VRU is as standard supplied with MF actuator without communication, but can on request be delivered for Belimo MP, LON, KNX or ModBus communication. Further documentation on the actuator can be requested from Lindab.

VRU is equipped with LindabSafe for connection to the duct and is prepared for insulation up to 50 mm.

VRU can be installed in any position without adjustment required. To avoid contamination of the measuring cross, VRU should only be used for clean air.

- Requires minimal initial pressure (Less than 20 Pa at V_{nom})
- Simple adjustment of settings with ZTH or PC tool
- Damper tightness class 4 according to EN 1751
- Tightness class C according to EN 1751
- Standard delivered with 2-10 V control signal
- Standard delivered with 2-10 V damper position feedback signal *
- Can be supplied with attenuation shield on request
- Can be supplied with actuator for several BUS systems
- Standard MF actuator is used in Pascal systems

Order code

Product **VRU** **bbb** **cccc**

Type

VRU

Dimension

Ød 100 - 630

Motor type

MF, MP, LON, MOD, KNX, SPR,
MF-D, MP-D, LON-D, MOD-D, KNX-D

Example: VRU - 250 - MF

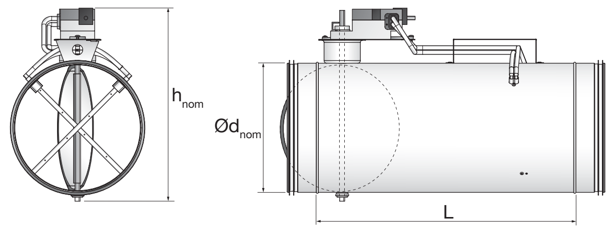
Factory settings

	Standard	On request
Min. air flow	0	Other min. flow
Max. air flow	V_{nom} (7m/s)	Other max. flow
Control signal	2-10 V	0-10 V
Feedback signal	Damper position *	Air flow

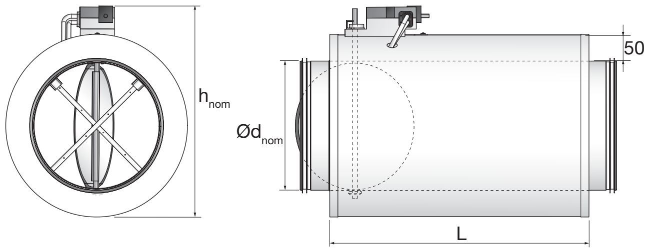
* Valid for MF and MP. SPR only available with air flow feedback signal.

Dimensions

VRU (MF, MP, LON, MOD, KNX)



VRU (MF-D, MP-D, LON-D, MOD-D, KNX-D)



Ød nom mm	L mm	h_{nom} MF / MP / LON / MOD / KNX	MF-D / MP-D / LON-D / MOD-D / KNX-D	SPR
100	400	225	262	241
125	400	250	287	266
160	400	285	322	301
200	400	325	358	341
250	500	375	407	391
315	500	440	471	455
400	510	526	557	560
500	610	626	657	660
630	660	756	787	790

Motor type table

	Motor	
Type	**Ød 100 - 315**	**Ød 400 - 630**
MF (Standard)	LMV-D3-MF-F	NMV-D3-MF-F
MP	LMV-D3-MP-F	NMV-D3-MP-F
LON	LMV-D3-LON-F	NMV-D3-LON-F
MOD	LMV-D3-MOD-F	NMV-D3-MOD-F
KNX	LMV-D3-KNX-F	NMV-D3-KNX-F
SPR	VRD3+LF24-MFT	VRD3-NF24A-V-F
MF-D *	LMV-D3-MF-F	NMV-D3-MF-F
MP-D *	LMV-D3-MP-F	NMV-D3-MP-F
LON-D *	LMV-D3-LON-F	NMV-D3-LON-F
MOD-D *	LMV-D3-MOD-F	NMV-D3-MOD-F
KNX-D *	LMV-D3-KNX-D-F	NMV-D3-KNX-D-F

* VRU with attenuation shield.

Volume flow regulator - circular VRU

Technical data

Settings

V_{nom} indicates the measuring range for the actuator. A standard VRU is calibrated to a V_{nom} of 7 m/s according to the table below.

In special cases the VRU can be set to a higher V_{nom} , e.g. 10 m/s.

For VRU, V_{max} and V_{min} indicate the limits for the actuators working range.

There is linearity between V_{min} to V_{max} and the input signal. V_{max} can be set in the range 20-100% of V_{nom} , V_{min} in the range of 0-100% of V_{nom} ; however, there is no regulation between 0,7 m/s and closed position..

Air flow measurement

The accuracy of air flow measurement depends on the flow conditions in front of the measuring cross. It is preferable to have a long straight duct section in front of the measuring point, according to the table below.

If these recommendations are not followed, it will cause an unstable flow measurement and therefore higher inaccuracy in the regulation of the required air flow.

Components	Recommended straight duct before unit
Bend	3 x Ød
Tee-piece	2 x Ød
Damper	6 x Ød

With recommended straight duct in front of the unit, the air flow accuracy will be according to the table below.

Duct velocity	Air flow accuracy
> 3 m/s	+/- 5%
1,2 - 3 m/s	+/- 10%
0,7 - 1,2 m/s	+/- 25%

VRU nominal air flow (V_{nom}) and measuring limit

Size Ød mm	Measuring limit (0,7 m/s) * m³/h	l/s	(Standard) V_{nom} (7m/s) m³/h	l/s	V_{nom} (10m/s) m³/h	l/s
100	20	6	198	55	283	79
125	31	9	309	86	442	123
160	51	14	506	141	723	201
200	79	22	791	220	1130	314
250	124	34	1236	343	1766	491
315	196	54	1963	545	2804	779
400	317	88	3165	879	4522	1256
500	495	138	4946	1374	7065	1963
630	785	218	7851	2181	11216	3116

* VRU-SPR with regulator VRD3 has a measuring limit of 2 Pa, which corresponds to a velocity of approximately 1,2 m/s.

Volume flow regulator - circular VRU

Technical data

Pressure loss diagram and sound data for dimensioning.

The solid curves indicate the total pressure loss Δp_t over the damper as a function of the air flow q_v and the blade angle α.

The broken curves indicate the A-weighted sound power level L_{WA}, in dB to the duct.

Example:

Dimension Ød: .... 100 mm
Air flow q_v:................................ 60 l/s
Total pressure loss Δp_t :............ 200 Pa

The following can be obtained from the diagram:

Blade angle α:.......................... 32°
Sound power level L_{WA}:........... 63 dB(A)

Dimensioning

When dimensioning the dampers inherent noise from the dampers and their regulating properties (damper characteristics) must be taken into consideration.

If excessively large dampers are used, the working area (angle of rotation) at given V_{min} and V_{max} may be so limited that regulation does not function satisfactorily.

Efforts must be made to use damper dimensions that result in the largest possible working areas (angles of rotation).

Due to regulation accuracy, working areas with damper angles < 15° should be avoided.

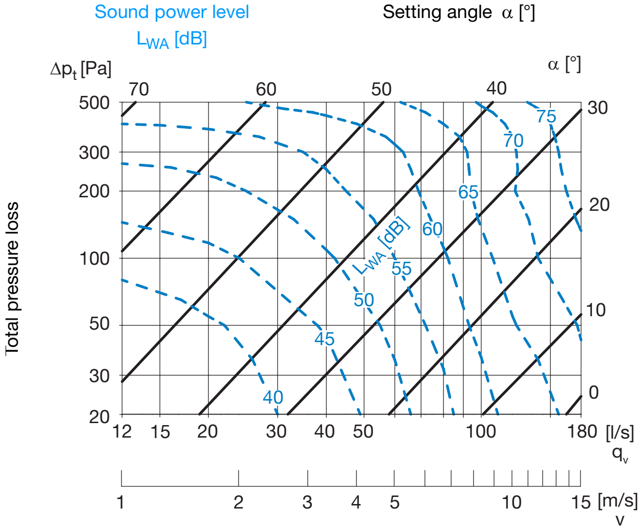
Measuring method for sound:

Sound data has been measured by the Swedish National Testing and Research Institute (SP) with reference to ISO 5135 and EN/ISO 3741.

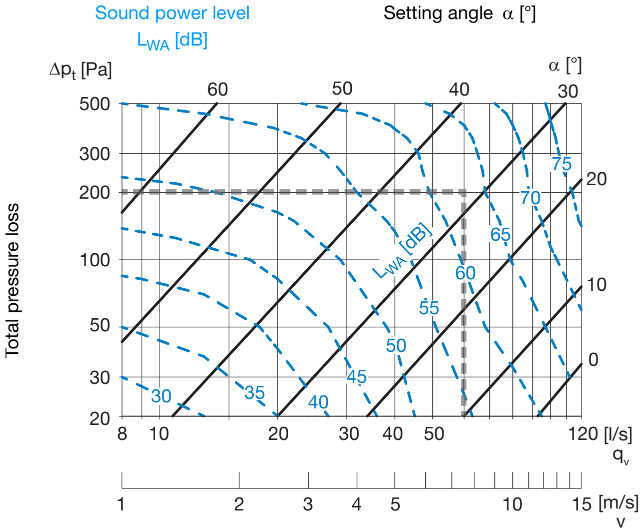
Blade angle α:

0°.. = open damper.
90° .... = closed damper.

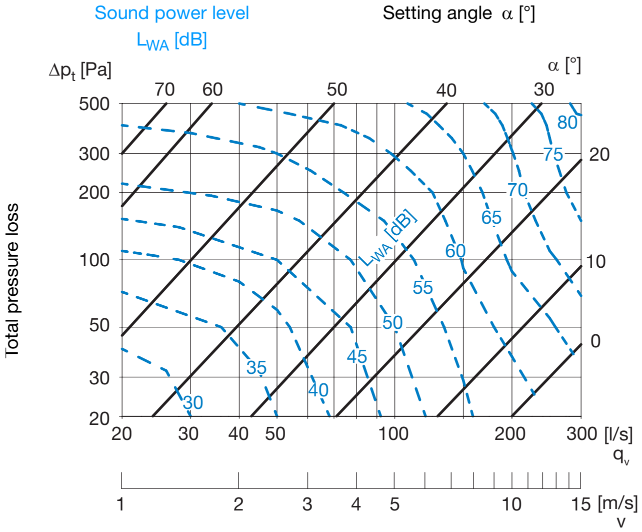
Ød 125



Ød 100



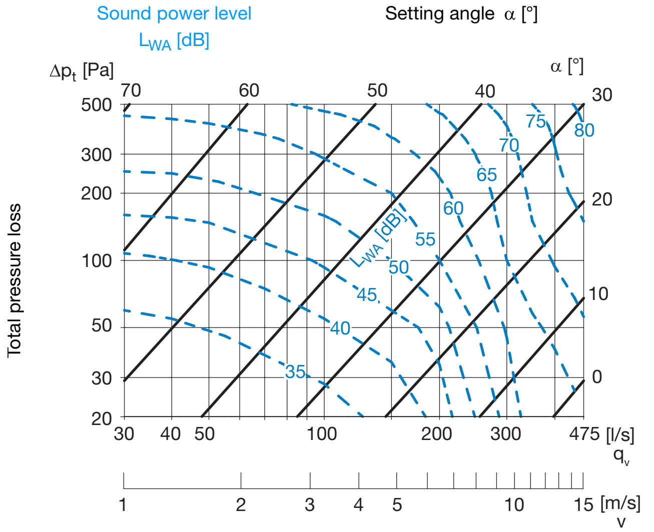
Ød 160



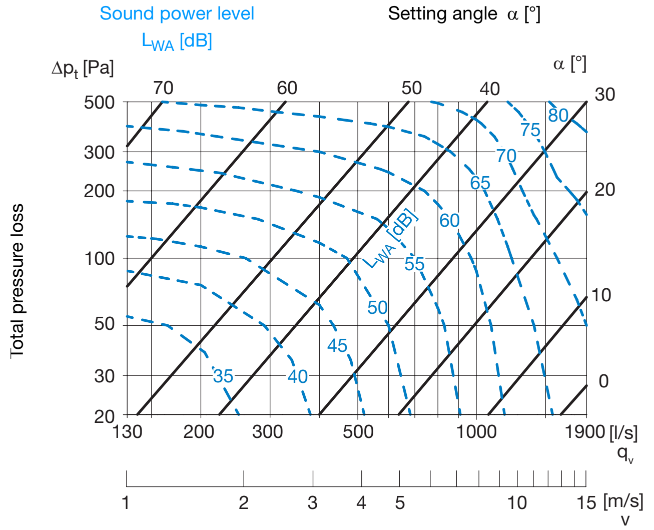
Volume flow regulator - circular VRU

Technical data

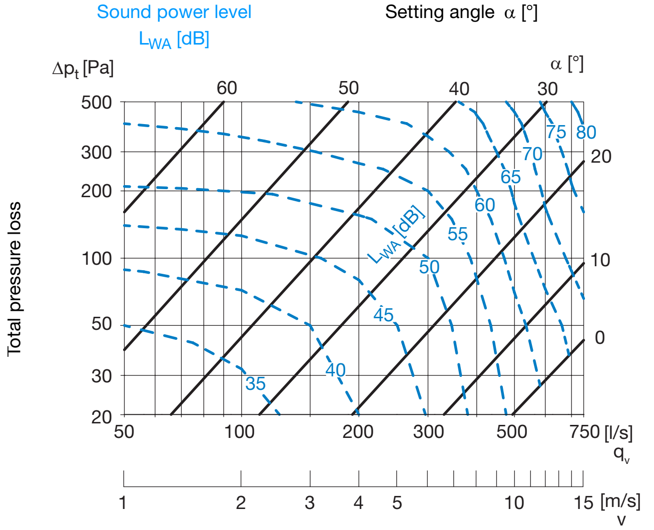
Ød 200



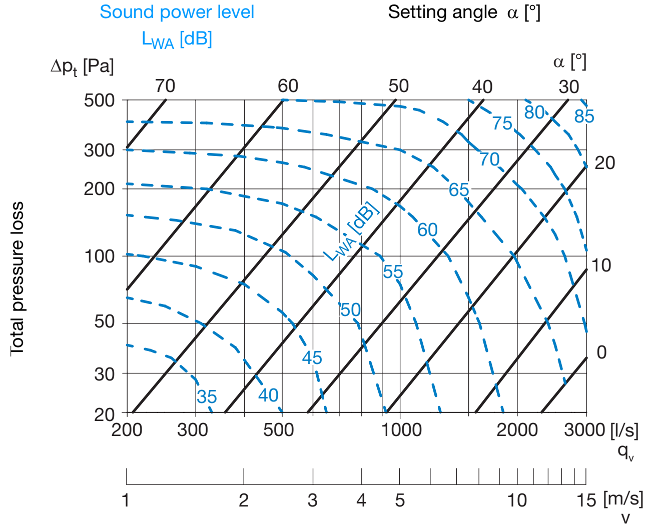
Ød 400



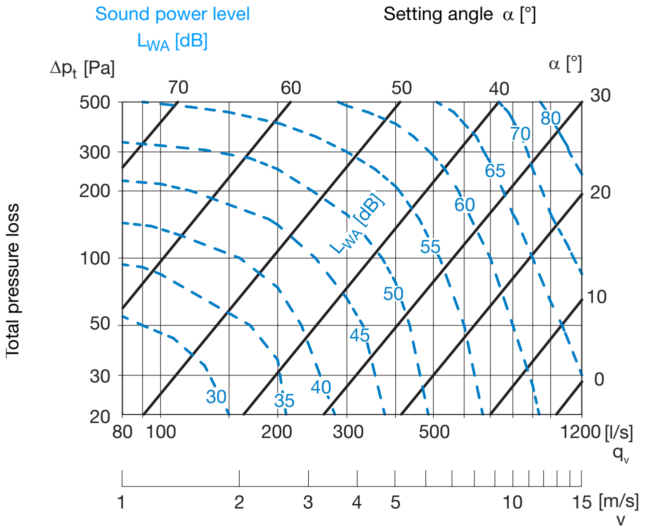
Ød 250



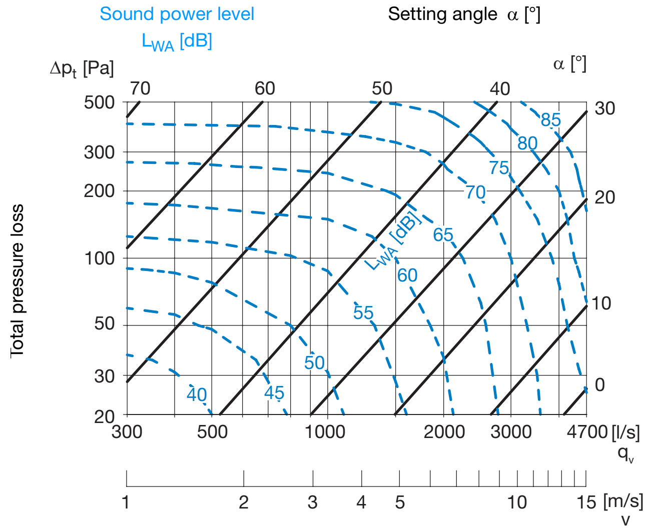
Ød 500



Ød 315



Ød 630



Volume flow regulator - circular VRU

Technical data

Sound data

Below sound power levels for ducts (flow noise) with reference to ISO 5135 as a function of air flow and pressure difference. The necessary minimum prepressure is 20 Pa for all sizes, equivalent to the total pressure loss over VRU at nominal air flow and with fully open damper.

dim Ød	Pressure loss [Pa]	Velocity app. 1 [m/s]								Velocity app. 3 [m/s]								Velocity app. 6 [m/s]							
		Centre frequency [Hz]								Centre frequency [Hz]								Centre frequency [Hz]							
		63	125	250	500	1k	2k	4k	8k	63	125	250	500	1k	2k	4k	8k	63	125	250	500	1k	2k	4k	8k
100		Flow 8 [l/s] / 29 [m^3/h]								Flow 25 [l/s] / 90 [m^3/h]								Flow 50 [l/s] / 180 [m^3/h]							
	500	60	60	59	52	50	44	44	44	67	64	64	57	54	48	48	48	72	69	69	62	59	52	52	52
	200	53	51	53	43	42	35	32	32	59	58	58	50	48	40	37	37	66	65	64	57	54	45	42	42
	100	51	46	44	38	35	28	21	20	58	55	53	46	41	34	26	24	65	64	62	54	48	40	31	29
	50	48	42	38	33	26	19	16	14	55	53	48	42	35	26	22	18	64	63	60	53	44	33	28	22
	20	43	35	30	23	17	9	7	6	50	49	42	37	28	17	15	14	62	61	57	51	41	27	25	15
125		Flow 12 [l/s] / 43 [m^3/h]								Flow 40 [l/s] / 144 [m^3/h]								Flow 75 [l/s] / 270 [m^3/h]							
	500	66	63	61	55	52	46	47	44	71	68	65	59	56	50	50	47	76	73	70	63	60	53	53	50
	200	59	53	49	44	38	34	33	32	65	62	57	51	46	41	38	38	72	71	65	59	53	47	43	43
	100	58	49	43	40	31	28	22	22	64	59	53	47	39	34	29	27	71	70	63	55	47	40	35	32
	50	57	42	41	31	29	20	17	15	63	54	50	41	36	27	25	20	70	68	60	51	43	34	32	24
	20	56	32	39	29	27	11	15	11	62	48	48	34	34	20	22	15	68	65	56	47	39	29	28	17
160		Flow 20 [l/s] / 72 [m^3/h]								Flow 60 [l/s] / 216 [m^3/h]								Flow 120 [l/s] / 432 [m^3/h]							
	500	62	63	61	56	52	51	50	49	68	67	64	59	55	53	52	51	73	71	68	62	59	55	54	53
	200	52	52	51	44	43	38	37	36	61	58	56	50	48	42	40	40	71	65	62	56	53	47	44	44
	100	47	43	39	37	32	27	27	25	59	54	50	45	40	35	33	31	70	64	60	53	48	42	39	38
	50	42	36	33	28	25	20	17	16	54	50	46	37	33	29	25	25	69	63	58	48	42	37	32	32
	20	37	30	30	26	19	16	11	10	49	46	43	35	27	24	19	18	68	61	55	44	36	32	27	23
200		Flow 30 [l/s] / 108 [m^3/h]								Flow 100 [l/s] / 360 [m^3/h]								Flow 200 [l/s] / 720 [m^3/h]							
	500	65	60	56	52	49	47	44	42	70	64	61	55	52	52	55	55	75	69	65	59	55	55	59	59
	200	55	52	51	43	40	37	38	38	62	57	55	47	44	42	42	42	71	65	61	53	50	48	47	47
	100	46	43	41	34	32	29	29	29	57	52	48	41	39	36	34	34	69	64	58	50	47	44	42	42
	50	40	38	33	30	28	27	23	22	51	45	41	36	32	32	28	28	63	56	51	44	39	39	34	34
	20	34	31	26	25	25	23	18	16	44	37	33	29	27	25	21	19	56	47	43	36	29	27	24	22
250		Flow 50 [l/s] / 180 [m^3/h]								Flow 150 [l/s] / 540 [m^3/h]								Flow 300 [l/s] / 1080 [m^3/h]							
	500	67	65	57	50	47	52	51	50	69	66	59	53	50	54	53	52	71	67	61	56	53	56	55	54
	200	55	54	49	43	42	38	42	42	59	57	52	46	44	41	44	44	63	60	55	49	46	44	46	46
	100	52	48	40	37	34	33	31	28	56	52	45	41	38	36	34	31	62	57	51	46	43	40	38	35
	50	44	41	35	32	29	24	22	20	52	48	40	38	34	30	28	24	61	56	47	45	40	38	33	28
	20	33	35	29	29	25	15	12	10	47	44	37	35	31	25	22	17	59	54	46	42	38	36	30	24
315		Flow 80 [l/s] / 288 [m^3/h]								Flow 250 [l/s] / 900 [m^3/h]								Flow 500 [l/s] / 1800 [m^3/h]							
	500	63	60	53	49	47	46	45	44	68	65	59	53	50	50	53	50	74	71	65	58	55	55	58	55
	200	50	44	42	38	38	33	37	34	60	55	50	45	43	40	43	40	70	65	58	52	49	48	49	46
	100	42	39	33	31	30	25	30	23	54	52	45	41	38	36	36	31	66	64	56	50	47	46	44	39
	50	34	34	30	26	22	21	19	15	49	49	43	38	34	32	30	24	64	63	55	49	45	42	40	32
	20	26	30	27	21	16	15	13	11	44	46	41	35	30	27	25	18	62	61	54	48	43	37	34	24
400		Flow 130 [l/s] / 468 [m^3/h]								Flow 400 [l/s] / 1440 [m^3/h]								Flow 800 [l/s] / 2880 [m^3/h]							
	500	76	71	66	59	55	58	57	56	79	73	67	62	57	60	59	58	82	75	68	65	59	62	61	60
	200	61	58	50	44	43	44	45	41	67	62	56	50	48	48	48	45	74	68	62	56	53	52	52	49
	100	50	45	40	34	36	35	35	29	61	56	49	44	42	39	39	34	72	67	58	53	49	47	46	40
	50	42	37	31	29	28	27	25	20	57	52	44	39	37	35	34	26	71	66	56	50	47	44	44	33
	20	40	34	27	25	24	23	21	11	55	50	40	35	34	32	30	20	70	65	54	47	44	40	38	28
500		Flow 200 [l/s] / 720 [m^3/h]								Flow 600 [l/s] / 2160 [m^3/h]								Flow 1200 [l/s] / 4320 [m^3/h]							
	500	82	76	69	63	62	61	60	59	84	77	70	64	63	62	61	60	85	78	71	65	64	63	62	61
	200	66	60	55	48	45	44	46	43	71	65	59	53	50	50	50	47	77	70	64	58	56	55	54	51
	100	55	50	47	38	38	36	34	31	63	58	53	47	46	44	42	37	72	66	60	55	53	51	49	43
	50	46	40	36	33	32	29	29	25	59	52	47	44	42	38	38	31	71	63	57	54	51	46	46	37
	20	41	33	29	27	26	19	18	20	56	47	42	40	38	32	30	26	70	60	54	52	49	44	40	32
630		Flow 300 [l/s] / 1080 [m^3/h]								Flow 900 [l/s] / 3240 [m^3/h]								Flow 1800 [l/s] / 6480 [m^3/h]							
	500	86	77	71	67	64	61	61	60	88	80	73	69	66	64	63	62	90	83	75	71	68	67	65	64
	200	76	70	63	60	56	53	52	48	78	72	65	62	59	55	55	49	80	74	67	64	60	57	57	50
	100	65	61	52	49	45	43	41	37	71	66	59	54	50	46	45	40	78	71	66	59	56	49	48	44
	50	54	49	45	39	34	36	30	26	66	58	53	48	43	40	39	30	77	68	62	57	51	45	47	36
	20	45	35	38	30	29	29	26	20	61	50	47	43	38	36	33	25	76	65	57	55	46	42	39	30