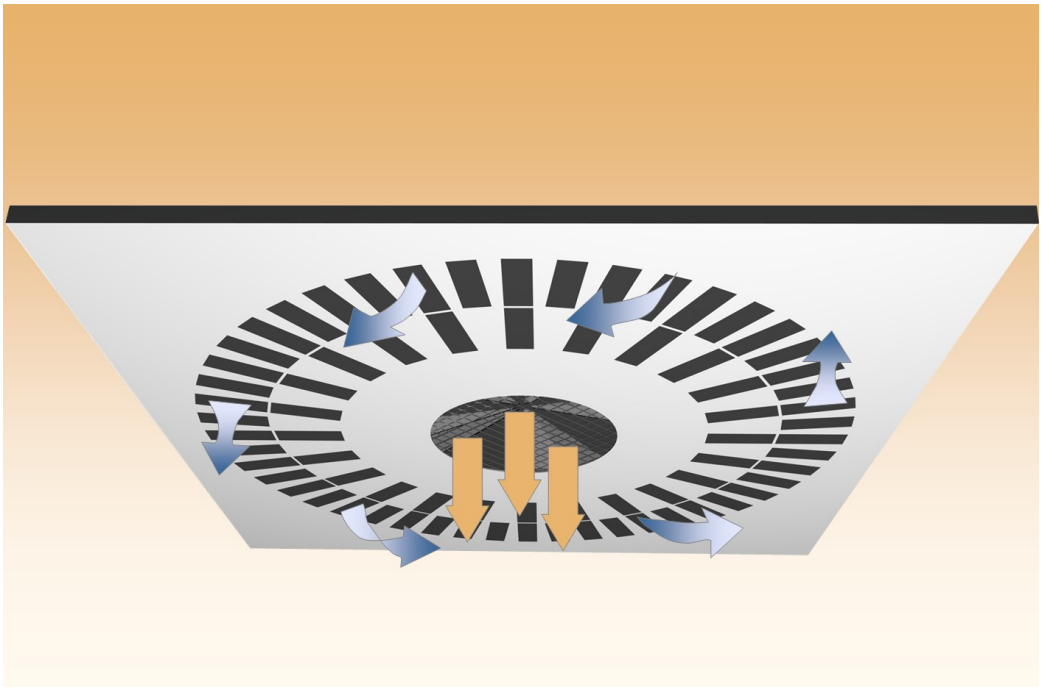
Kiefer Klimatechnik

Technical Information

Ceiling air diffuser
INDULTHERM
INDULTHERM-e



- Effective cooling and heating with a diffuser
- Thermomechanical or electrical switching
- Draught-free air distribution for cooling down to –12 K

Content

Features

Performance features

- Effective cooling and heating using a diffuser
- For high supply air temperature differences
- Low room air velocities
- Draught-free air distribution for cooling down to -12 K
- Small pressure losses
- Large penetration depths in heating mode

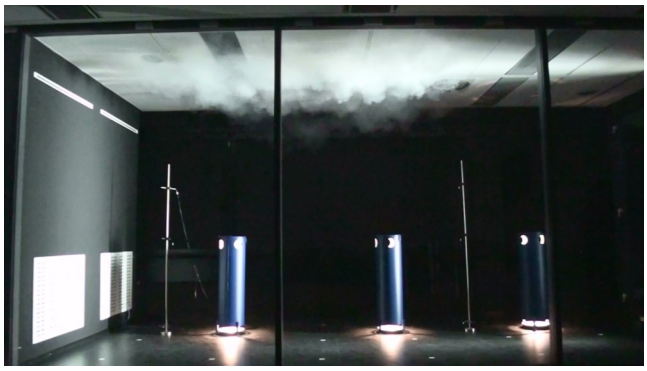
INDULTHERM

- Fully-automatic switching without any external energy

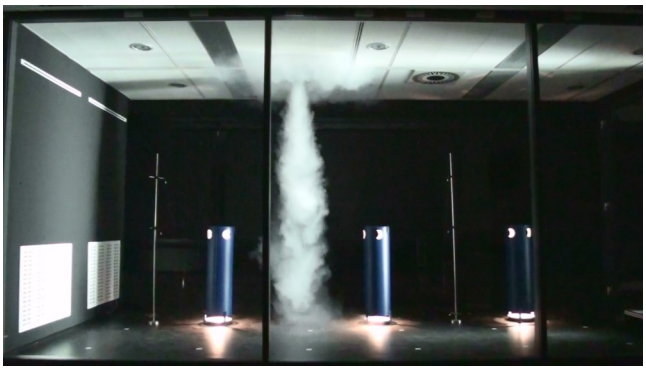
INDULTHERM-e

- Thermomechanical or electrical switching between cooling and heating mode
- Also in combination with split and multi-split systems
- Flexible selection of switching temperature

INDULTHERM is a self-regulating diffuser for cooling and heating via supply air



Air distribution in cooling mode



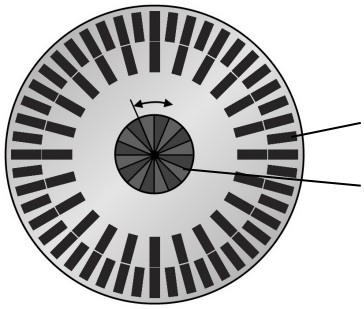
Air distribution in heating mode

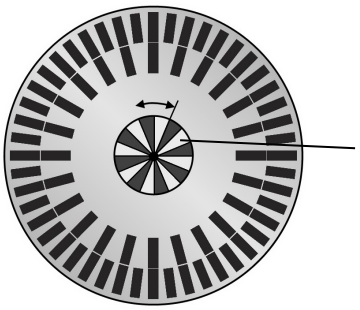
INDULTHERM in cooling mode:

- Air is distributed in the room without any draught and with a temperature difference of up to -12 K.
- INDULTHERM operates as a high-induction ceiling air diffuser.

INDULTHERM in heating mode:

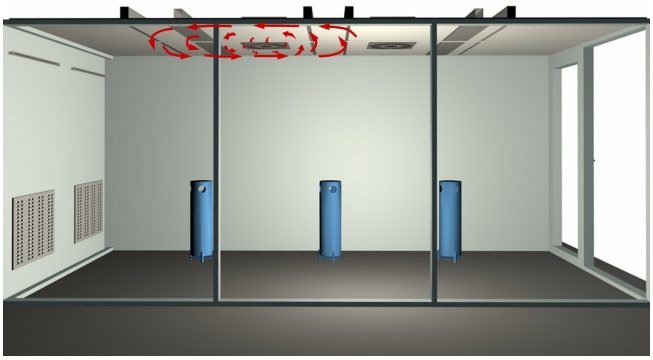
- Despite the difference in density, warm air is distributed throughout the entire room even down to floor level.
- During warm supply air, INDULTHERM automatically switches to vertical air outlet for a large penetration depth without requiring any external energy.
- At the INDULTHERM-e, this is achieved by an electric actuator.

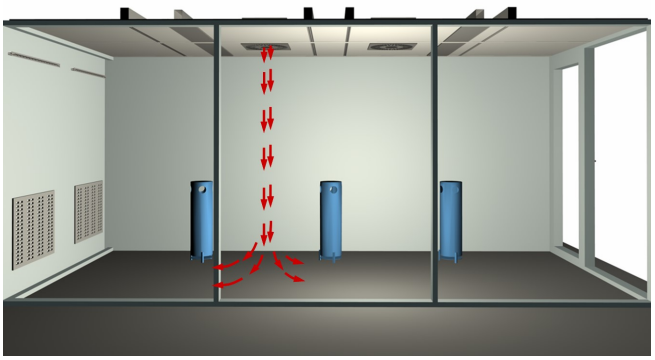




During cooling mode, cooled air is distributed in the room at an optimal mixture and without any draught at a temperature rate down to -12 K.

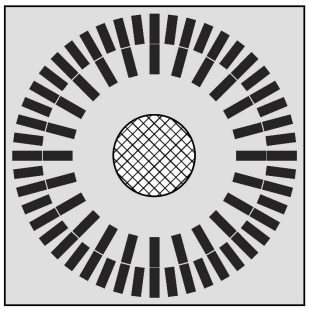
In heating mode, warm air is distributed throughout the entire room, even down to floor level, despite the difference in density.



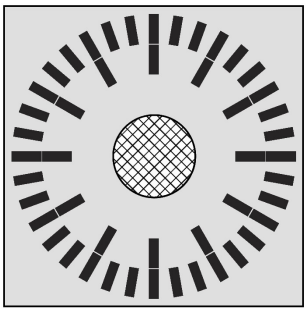


Types

Type RQ

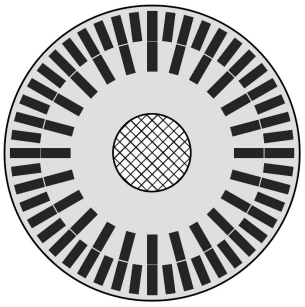


INDULTHERM RQ 600 or RQ 625
Nominal size of 600 mm or 625 mm
Hole pattern 600
Air flow 250 m³/h to 1000 m³/h

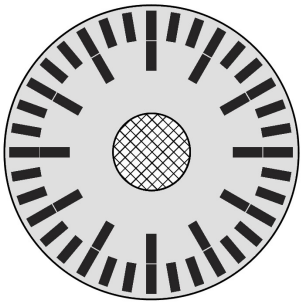


INDULTHERM RQ 600 or RQ 625
Nominal size 600 mm or 625 mm
Hole pattern 500
Air flow 180 m³/h to 650 m³/h

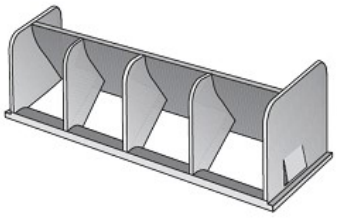
Type RR

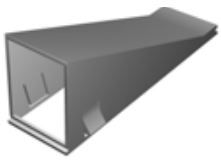


INDULTHERM RR 600 or RR 625
Nominal size of 600 mm or 625 mm
Hole pattern 600
Air flow 250 m³/h to 1000 m³/h



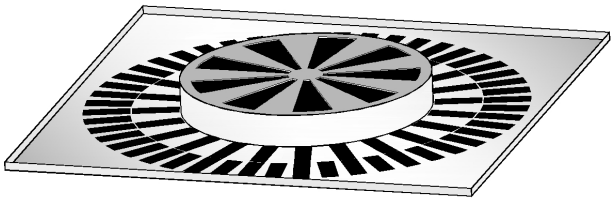
INDULTHERM RR 600 or RR 625
Nominal size 600 mm or 625 mm
Hole pattern 500
Air flow 180 m³/h to 650 m³/h





The INDULCLIP air guide elements

Proven highly inductive air guide elements permitting the individual arrangement of diffusers.



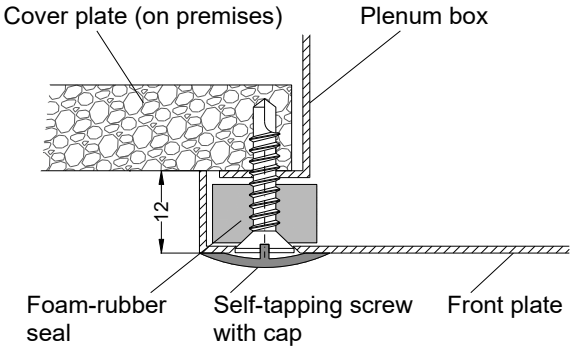
Thermal insert (with a segment disc)

Front plate

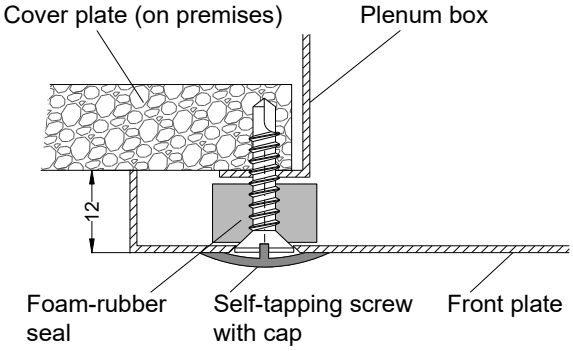
The front plate of the INDULTHERM is coated in RAL 9010. The INDULCLIP air guide elements are black or grey, similar to RAL 7035. Other colours are available on request. The central opening for heating mode is covered with a diagonally-running honeycomb cover in black or grey. Other colours are available on request.

Type RR INDULTHERM ceiling diffusers are secured at three points by countersunk dome-head screws, type RQ diffusers are secured at four points. The front plate can be easily removed from the plenum box for service purposes. The plenum box has a standard butterfly damper for making adjustments from the room. Eight holes of 9 mm in Ø are provided in the top of the plenum box for suspension at the point of installation.

Type of mounting for nominal size 600



Type of mounting for nominal size 625

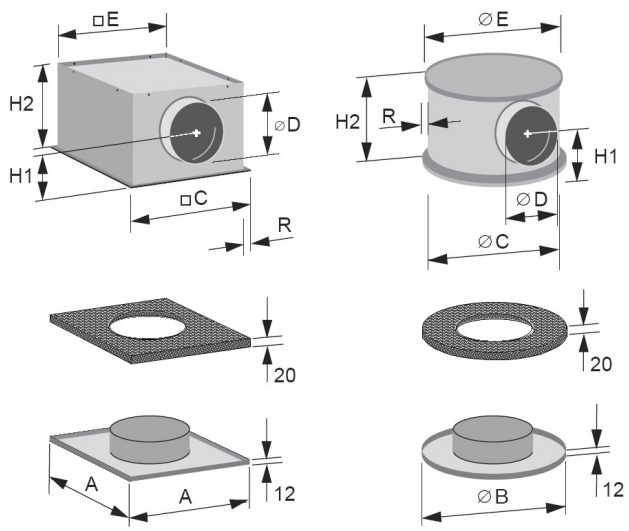


Dimensions for round and square plenum boxes

Size	□ A	⌀ B	□⌀ C	□⌀ E	⌀ D	R	H1	H2
RQ 600	598	-	592	568	249	12	185	335
RQ 625	623	-	592	568	249	12	185	335
RR 600	-	600	592	568	249	12	185	335
RR 625	-	625	592	568	249	12	185	335

Type RQ **Type RR**

Plenum boxes with damper



Notes:

INDULTHERM-Mechanism

The INDULTHERM mechanism is maintenance-free under normal operating conditions. At extremely high switching frequencies, the INDULTHERM mechanism should be maintained regularly. It is available as a spare part and can be replaced, if required.

Control system

Thermo-mechanical drive (INDULTHERM)

Switching from heating to cooling should be occur gradually and slowly due to the response time of the thermo-mechanical actuator.

Electric drive (INDULTHERM-e)

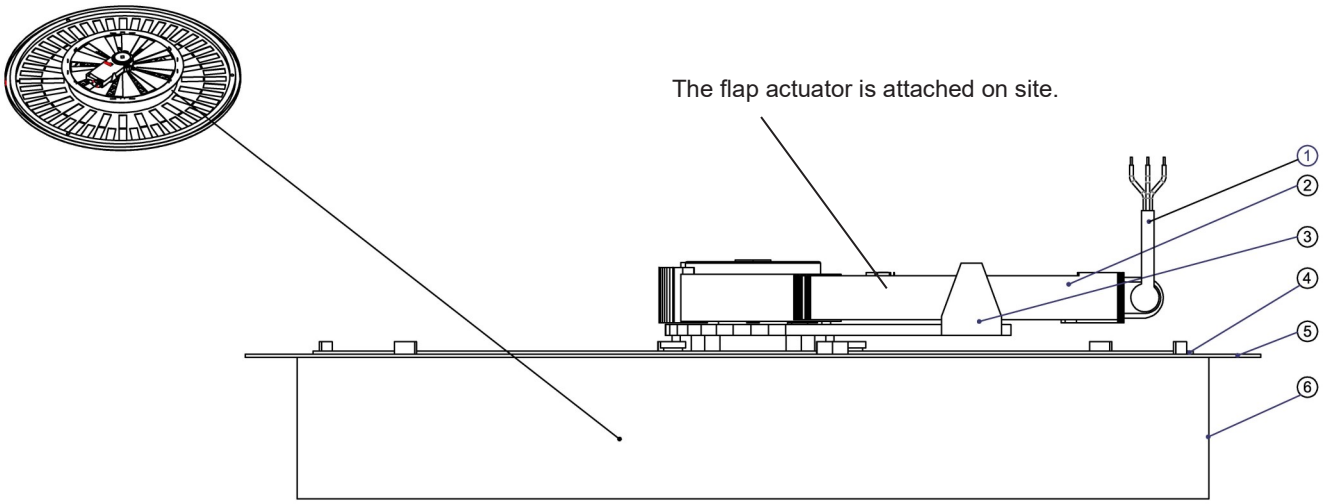
The electric drive allows a fast switching between the operating conditions and is also suitable for multi-split systems.

For both types of drives a permanent heating under comfort conditions according to DIN 13779 is not intended.

Pressure pad

The optional pressure pad increases the penetration depth of the supply air stream in heating mode and increases the required static pressure according to the formulas on pages 11 and 12. The pressure pad is subject to maintenance due to the possibility of it becoming soiled by the supply air.

Technical drawing



Pos. no.	Designation
1	Connecting cable L = 1000 mm
2	Flap actuator
3	Mounting plate

Pos. no.	Designation
4	Segment disc
5	Segment base
6	Spacer ring

Installation information

Installation of the flap actuator on the front plate of the INDULTHERM-e

Simple direct installation
The actuator is attached directly to the drive shaft (8 mm square) and mounting plate.

To install the flap actuator, it must be unlocked using the magnet supplied (see symbol on the actuator).

Manual adjustment
Manual adjustment with magnet possible (gear disengagement for as long as the magnet is attached to the magnet symbol). The magnet for gear disengagement is integrated into the position indicator.

Angle of rotation
Adjustable angle of rotation with mechanical end-stops. The end-stops for the angle of rotation are mechanically integrated into the front plate.

High functional reliability
The actuator is overload-proof, requires no limit switches and stops automatically at the end-stop.

Note!
The magnet must be removed before commissioning.

Electrical installation and control of the flap actuator

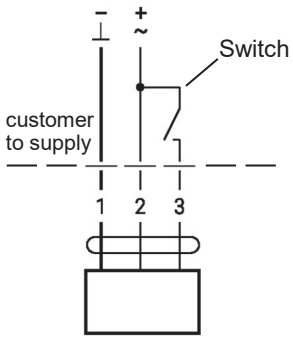
Power supply from the safety transformer.

Parallel connection of further actuators possible. Note the performance data.

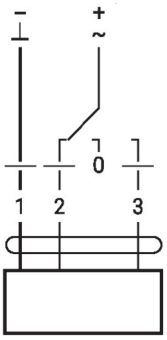
Wire colours:
1 = black
2 = red
3 = white

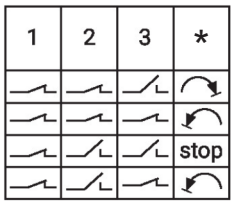
Connection diagrams

AC/DC 24 V, open/close



AC/DC 24 V, 3-point





*Direction of rotation as seen from above

On-site control of the flap actuator with switch:

Load case	Switch	Segment disc
Cooling	Open	Closed
Heating	Closed	Open

Safety instructions

- The flap actuator is designed for use in stationary heating, ventilation and air conditioning systems and must not be used for purposes outside the specified range of application.
- Outdoor use: only possible if the unit is not directly exposed to water (seawater), snow, ice, sunlight or aggressive gases and it is ensured that the ambient conditions remain within the limits specified in the data sheet at all times.
- Installation must be carried out by authorised technical personnel. The statutory and official regulations must be complied with.
- Cables must not be removed from the unit.
- The flap actuator contains electrical and electronic components and must not be disposed of as household waste. The local and currently valid legislation must be observed.

Note!

Flap actuator must be installed and attached to the front plate on site. See installation information for the flap actuator on page 6.

Technical data flap actuator

Electrical data	
Nominal voltage	AC/DC 24 V
Nominal voltage frequency	50/60 Hz
Power consumption operation	AC 19.2...28.8 V / DC 19.2...28.8 V
Power consumption neutral position	0.2 W
Power consumption dimensioning	1 VA
Power supply / control connection	Cable 1 m, 3x 0.75 mm² m
Parallel operation	Yes (observe power data)

Functional data	
Direction of movement Motor	clockwise
Manual adjustment	with magnet
Angle of rotation when installed	22°
Motor sound power level	35 dB(A)

Safety data	
Protection class IEC/EN	III, safety extra-low voltage (SELV)
Power source UL	Class 2 Supply
Protection class IEC/EN	IP54
Protection class NEMA/UL	NEMA 2
Enclosure	UL Enclosure Type 2
EMV	CE according to 2014/30/EU
Certification IEC/EN	IEC/EN 60730-1 und IEC/EN 60730-2-14
UL Approval	cULus according to UL60730-1A, UL60730-2-14 and CAN/CSA E60730-1 The UL marking of the drive depends on the production site, the device is UL-compliant in any case
Hygiene test	In accordance with VDI 6022 Sheet 1 / SWKI VA 104-01, cleanable and disinfectable, low-emission
Mode of operation	Type 1
Rated impulse voltage supply / control	0.8 kV
Pollution degree	3
Ambient humidity	Max. 95% RH, non-condensing
Ambient temperature	-30...50°C [-22...122°F]
Storage temperature	-40...80°C [-40...176°F]
Maintenance	maintenance-free

Ventilation design parameters

Supply air temperature 12 °C … 22 °C
In cooling mode, the high induction permits temperature differences of up to -12 K. This permits the volumetric flow to be reduced, resulting in a reduction in investment costs for the air conditioner and the ductwork.

Supply air temperature 22 °C … 28 °C
Switching phase between the cooling/heating air directions, limited comfort conditions.

Supply temperature 28 °C … max. 40 °C
In heating mode, the supply air should circulate deep into the room, if possible down to floor level. The penetration depth depends on the supply air volumetric flow and on the temperature difference between supply air and room air (see design diagram on pages 11 and 12).

Usual reverberation times									Sound pressure level acc.to EN 13779 [dB(A)]
T_N (s)	0,4	0,5	0,6	0,7	0,8	0,9	1,0	1,2	
Counter halls, Open-plan offices		←	—	—	→				40 … 50
Offices in general			←	—	→				35 … 40
Conference-, Meeting rooms				←	—	—	—	→	35 … 40
Canteens, Restaurants					←	—	—	→	40 … 55

Recommendation:

Room air velocity of: $\bar{v}$ = 0.12…0.15 m/s at seat height for highest demands.

Room air velocity of: $\bar{v}$ = 0.15…0.17 m/s at seat height for premium demands.

For VVS systems (variable volumetric flow systems), the flow through the supply air diffusers can be increased by 5 to 10%. The bandwidth of the sound pressure levels according to DIN 13779 can be utilised.

Note:

The acoustic diagrams on pages 11 and 12 indicate the average sound pressure level. For diffusers evenly distributed over the ceiling surface, the sound pressure level is also even.

Measurement methods and standards

According to DIN EN ISO 7730:2007, the "local air velocity" is measured at an arbitrary point in the common area and averaged over 3 minutes.

Permissible velocity:	DIN EN ISO 7730:2007
Measurement method:	DIN EN 13182:2002
Common area:	DIN EN 13779:2007

The limits of the "common area" and the maximum permissible "local air velocity" must be coordinated between the building owner and planners or installers.

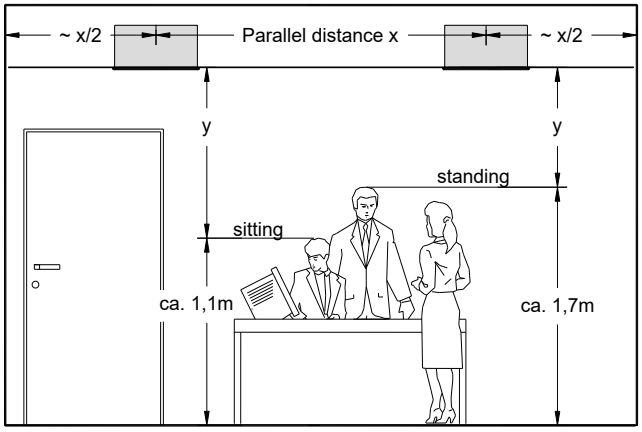
Our selection diagrams indicate the "average local air velocity" during cooling mode. It was determined from numerous measurement points distributed evenly in the room, of the reference level relevant to the design. 50% of the velocities are greater than the diagram value and 50% are less.

On the one hand, the actual "local air velocities" that occur can be influenced by the level of turbulence from mixed-air streams, and on the other hand by room air movements not caused by the air flow system, such as cold facades, heaters and the like.

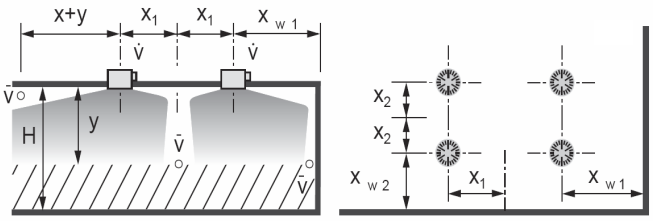
We supply products that comply with machine and equipment manufacturing standards where dimensional tolerances are in accordance with DIN ISO 2768 Part 1 and 2. By contrast, the extruded aluminium profiles used in many other products have tolerances in accordance with DIN EN 755-9:2008-06. Depending on the combination and surface treatment of the components and extruded profiles, additional dimensional deviations of 2 mm can occur. Due to manufacturing tolerances, the caloric performance is subject to a tolerance range of ± 10 %, and the acoustic values to a tolerance range of ± 2 dB.

Arrangement

For the layout, the smaller dimension of x_1, x_2. must be used. If there is only one diffuser in the room, the layout must be based on the smaller dimension of x_{w1}, x_{w2}.



Definition of jet path



Acoustic arrangement

Acoustic diagrams applied to:

Room height	H = 3.0 m
Reverberation time	T_N = 0.6 s
Socket velocity for open damper	≤ 5 m/s

Correction values ΔL_{HR} for other room heights

H_R [m]	2.5	2.7	3.0	3.5	4.0	4.5	5.0	6.0
ΔL_{HR} [dB(A)]	+0.8	+0.4	0	-0.7	-1.2	-1.8	-2.2	-3.0

Correction values ΔL_{TN} for other reverberation times

T_N [s]	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.2
ΔL_{TN} [dB(A)]	-1.8	-0.8	0	+0.7	+1.2	+1.8	+2.2	+3.0

A high level of room comfort is not only determined by a low room air velocity with as small temperature differences in the room as possible, but also an even air distribution in the common area.

Recommendation:
Set the parallel distances with $2 \cdot x_1$ or $2 \cdot x_2 \leq 4$ m for a room height of approx. 3 m. If possible, the diffusers should be arranged uniformly in the room and the load to which each one is exposed should be equally distributed.

- Wall distance x_{w1} or $x_{w2} \geq x_1$ or x_2
- Aim for symmetrical jet geometry and uniform arrangement of air diffusers in the room

Discharge characteristics in cooling mode:
a symmetrical distribution of the air diffusers in the room.

The discharge characteristics in cooling mode guarantee a stable room flow over a wide range of temperature differences of -12 K to 0 K and volumetric flows of 100…25 %.

The discharge characteristics in heating mode are characterised by a vertical supply air jet directed downward. You can find the penetration depth as a function of supply air volumetric flow and on the temperature difference between supply and room air in the design diagrams on pages 11 and 12. If the penetration depth is insufficient in individual cases, it can be increased by installing an optional pressure pad.

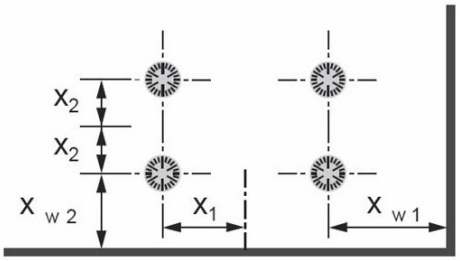
The pressure pad is subject to maintenance due to the possibility of contamination by supply air.

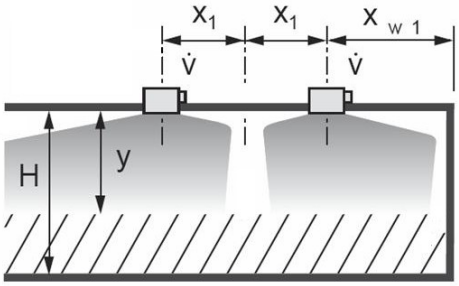
Design example

Given:

Surface area:	A	= 8 m x 12 m = 96 m^2
Room height:	H	= 3.5 m
Air flow rate:	$\dot{V}_{sup}$	= 4000 m^3/h
Reverberation time	T_N	= 1.2 s
Maximum sound pressure level in the room:	L_p	= 40 dB(A)
Jet path:	X_1	= 2.0 m
	X_2	= 1.5 m
Supply air temperature difference in heating mode	10 K	

Definition of jet path x





Selected:

Quantity: 8

Air diffuser: INDULTHERM RQ 600
Ambient air velocity reference level: 1.8 m

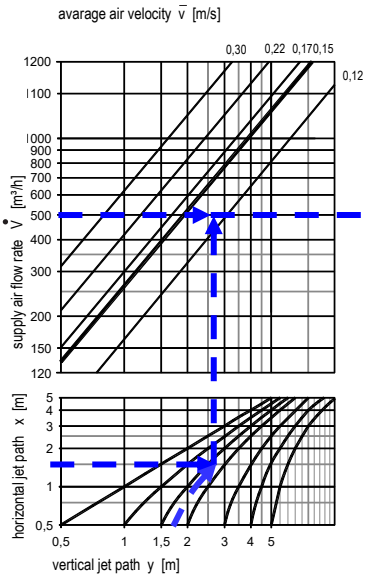
Calculated:

Spec. supply air flow rate: $\dot{V}_{sup} = \frac{4000 m^3/h}{8} = 500\ m^3/h$

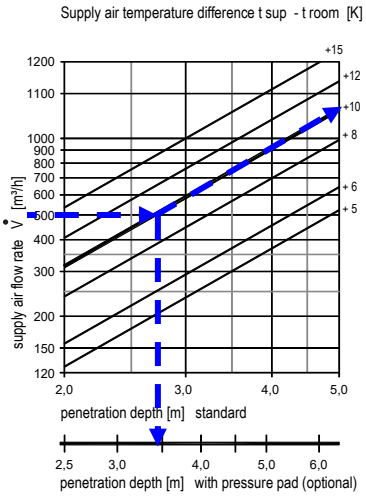
Spec. air exchange rate $L_{W\,spez.} = \frac{4000\ m^3/h}{96\ m^2} = 41.6\ m^3/hm^2$

Sound pressure level from diagram:	L_p = 35.0 dB(A)
Correction for other room heights:	ΔL_1 = -0.7 dB(A)
Correction for other reverberation times:	ΔL_2 = +3.0 dB(A)
Actual sound pressure level in the room:	$L_p \approx$ 37.3 dB(A)
Vertical jet path = room height – measurement level:	y = 3.5 m – 1.8 m = 1.7 m
Average room air velocity from diagram:	$\bar{v}$ = 0.14 m/s
Penetration depth in heating mode from diagram:	2.8 m (with pressure pad 3.5 m)

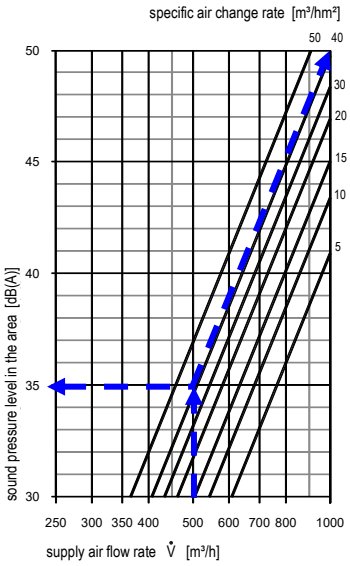
Cooling



Heating

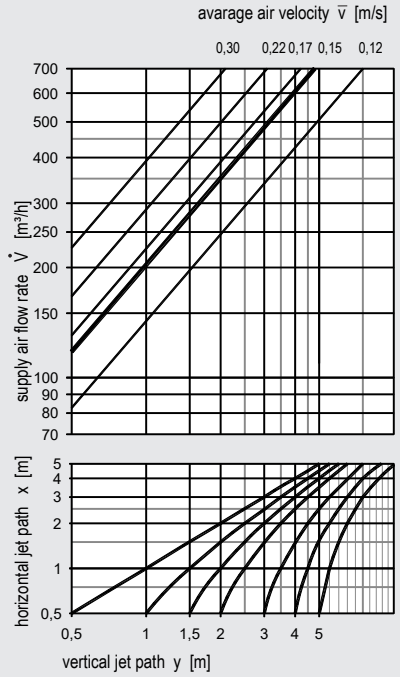


Acoustic layout

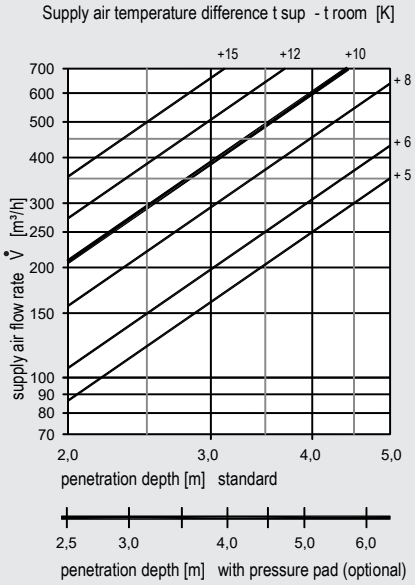


Ventilation design parameters – Hole pattern 500

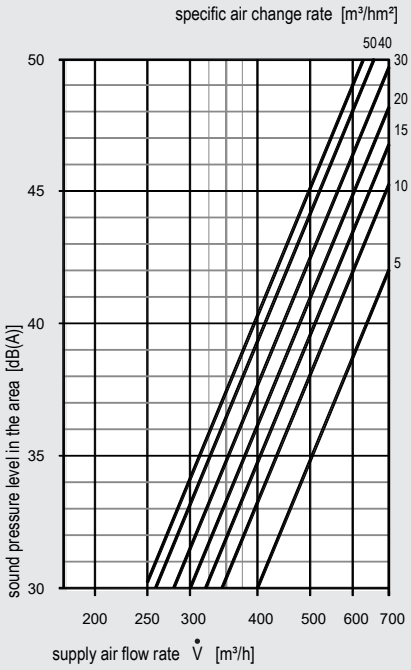
Cooling



Heating



Acoustic layout



Correction ΔL_{TN} for other reverberation times

T_N [s]	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.2
ΔL_{TN} [dB(A)]	-1.8	-0.8	0	+0.7	+1.2	+1.8	+2.2	+3,0

Correction ΔL_H for other room heights

H [m]	2.5	2.7	3.0	3.5	4.0	4.5	5.0	6.0
ΔL_H [dB(A)]	+0.8	+0.4	0	-0.7	-1.2	-1.8	-2.2	-3.0

Pressure loss cooling operations $\dot{V}$ [m³/h]

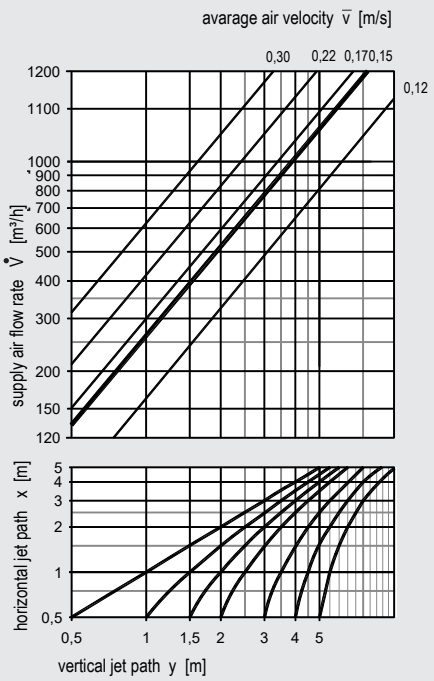
Standard version	$\Delta p_{St} = \dot{V}^2 / 6000$ [Pa]
With pressure pad (optional)	$\Delta p_{St} = \dot{V}^2 / 3200$ [Pa]

Acoustic diagrams apply for:
Room height: 3,0 m
Reverberation time: 0,6 s
for open damper

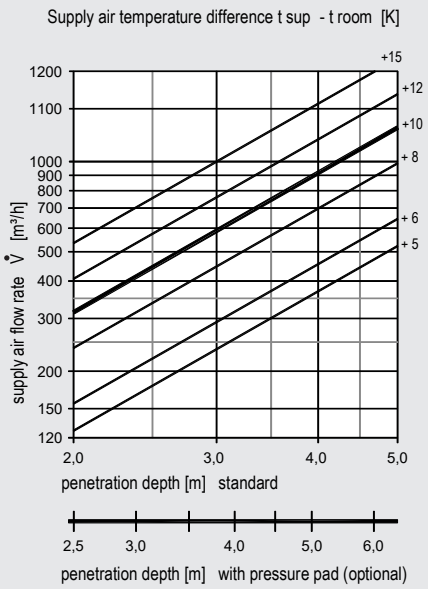
The design diagrams apply to air exchange rates from 1.5 to 12 h^{-1} and a temperature difference of -12 K when cooling.

Ventilation design parameters – Hole pattern 600

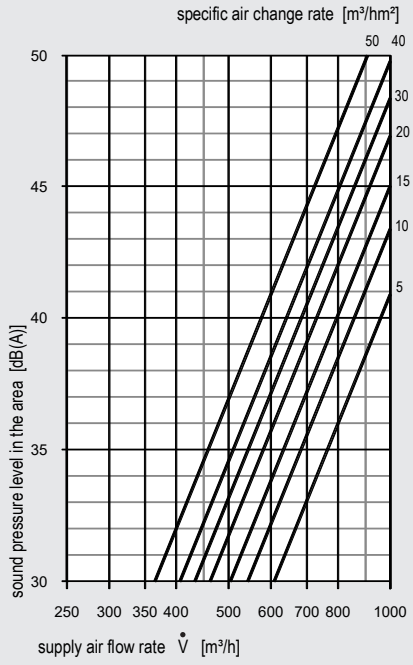
Cooling



Heating



Acoustic layout



Correction ΔL_{TN} for other reverberation times

T_N [s]	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.2
ΔL_{TN} [dB(A)]	-1.8	-0.8	0	+0.7	+1.2	+1.8	+2.2	+3.0

Correction ΔL_H for other room heights

H [m]	2.5	2.7	3.0	3.5	4.0	4.5	5.0	6.0
ΔL_H [dB(A)]	+0.8	+0.4	0	-0.7	-1.2	-1.8	-2.2	-3.0

Pressure loss cooling operations $\dot{V}$ [m³/h]

Standard version	$\Delta p_{St} = \dot{V}^2 / 22600$ [Pa]
With pressure pad (optional)	$\Delta p_{St} = \dot{V}^2 / 4800$ [Pa]

Acoustic diagrams apply for:
Room height: 3.0 m
Reverberation time: 0.6 s
for open damper

The design diagrams apply to air exchange rates from 1.5 to 12 h^{-1} and a temperature difference of -12 K when cooling.

☐ **Ceiling air diffuser INDULTHERM - Thermo-mechanical switching from cooling to heating**

Consiting of:

- highly inductive discharge elements INDULCLIP black and grey, similar to RAL 7035, active in cooling mode
- of a low-inductive outlet opening in the middle of the plate (open in heating mode), with honeycomb cover 15 x 15 mm. Colours black or grey.
- a galvanised sheet metal front plate, painted in RAL 9010
- a thermomechanically adjustable THERM insert, easily accessible, attached directly to the front plate.

Functions:

- Room cooling and ventilation in normal mode (cooling mode under comfort conditions)
- Room heating in startup mode (heat-up without comfort). The heating jet flows through the room according to layout
- Switching is controlled through supply air temperature without the need for an external energy source

☐ **Ceiling air diffuser INDULTHERM-e - Electrical switching from cooling to heating**

Consiting of:

- highly inductive discharge elements INDULCLIP black and grey, similar to RAL 7035, active in cooling mode
- of a low-inductive outlet opening in the middle of the plate (open in heating mode), with honeycomb cover 15 x 15 mm. Colours black or grey.
- a galvanised sheet metal front plate, painted in RAL 9010
- an electrically adjustable THERM insert, easily accessible, attached directly to the front plate

Functions:

- Room cooling and ventilation in normal mode (cooling mode under comfort conditions)
- Room heating in startup mode (heat-up without comfort). The heating jet flows through the room according to layout
- Switching is controlled through supply air temperature without the need for an external energy source
- Switching between cooling and heating mode by means of an electrical drive
- Switching is provided by the customer

Plenum box

For ceiling air diffuser INDULTHERM, made of Zincor sheet metal, 8 points of suspension Ø 9 mm, with round connection socket and butterfly damper operable from the room. For version INDULTHERM-e with cable bushing.

Type: ☐ **INDULTHERM** ☐ **INDULTHERM-e**

Type:

☐ Ceiling air diffuser Type RR (round front plate) - Three-point fastening at the plenum box

☐ Ceiling air diffuser Type RQ (square front plate) - Four-point fastening at the plenum box

Size

600/625 mm, connection socket Ø 249 mm

Nominal front plate dimensions	☐ 600 mm	☐ 625 mm
Hole pattern	☐ 500 mm	☐ 600 mm

Manufacturer: Kiefer Klimatechnik GmbH

Pos _____ Units _____ Individual Price _____

Additional cost for coating of front plate in selected RAL tones

Pos _____ Units _____ Individual Price _____

Additional cost for honeycomb cover coated in selected RAL tones

Pos _____ Units _____ Individual Price _____

Additional cost for pressure pad for enlarging the penetration depth in heating mode

Pos _____ Units _____ Individual Price _____

➡ **Tender text can be downloaded from www.kieferklima.de/en**

Data required for the technical design and offer preparation:

Recipient:

Phone: +49 711 8109-0

Kiefer Klimatechnik GmbH

Heilbronner Straße 380-396

70469 Stuttgart

Sender:

_____

_____

_____

_____

Ceiling air diffuser ☐ INDULTHERM
☐ INDULTHERM-e

Project:

_____

_____

Project No. Customer: _____ Date/Associate: _____ Project No. Kiefer _____

Room or module name		Sample room			
Number of these rooms/modules		1			
Spec. supply air volumetric flow	[m^3/hm^2]	10			
Room width	[m]	4			
Room length	[m]	5			
Area	[m^2]	20			
Room height	[m]	3			
Cooling capacity	[W/m^2]	80			
Room air temperature	[°C]	26			
Supply air temperature	[°C]	14			
Average room air velocity	[m/s]	0.15			
at room height	[m]	1.3			
Sound pressure level in the room	[dB(A)]	38			
at reverberation time	[s]	0.8			

Product Range

Components:
Linear, wall, ceiling and air outlet diffusers, chilled ceiling panels, recirculation coolers, cross-flow units, concrete core cooling with air. Axial and radial ventilators, hot-gas ventilators, plastic ventilators.

Systems:
Air conditioning plants of all kinds for comfort (office, administration, shopping centres, hospitals, libraries, museums, etc.) and industrial applications (machine construction, high-tech, textile, plastics, chemicals, automotive, soft drinks, food industry, etc.).

Services

Consulting and planning:
We provide advice concerning all aspects of our systems and create system analyses and cost estimates based on cooling load / pipe network / energy cost / efficiency calculations. We also develop proposals concerning suggested layouts for air distribution, lighting and ceiling systems; and compile lighting-related data using the latest software tools, as well as developing and implementing control-technology related concepts in our own MSR division.

We are furthermore able to draw on a wealth of experience from previous projects when it comes to designing innovative products and new projects.

Services

Laboratory:
Certificates, 1:1 room airflow laboratory analyses; acoustic and aerodynamic analyses of air-conditioning modules. Development of innovative air conditioning components. Caloric performance measurements of air and waterrelated components on test stands. On-site comfort measurements to assess thermal comfort and indoor air quality.

Maintenance and servicing:
All kinds of air-conditioning and climate control systems as part of maintenance and service contracts.

E1897-10/23

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