Active Chilled Beams

Type DID604

Air discharge four way

TROX® TECHNIK

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EUROVENT CERTIFIED PERFORMANCE

Contents · Description

DID604, Nominal size 600 × 600

DID604, Nominal size 1200 × 600

Active chilled beams Type DID604 using air-water systems provide a comfortable air conditioning of rooms with a high cooling load. They combine the aerodynamic properties of ceiling diffusers with the energy benefits of load dissipation using water.

Due to its low height construction, Type DID604 is particularly suited for low false ceiling voids in new buildings and for the refurbishment of existing buildings with clear room heights of approximately 2.6 m to 4.0 m.

Special characteristics

- High cooling capacity with low conditioned fresh air flow rates, low air velocities in the occupied zone and low sound power levels
- Adjustable control blades to control the air discharge direction
- Air discharge four way
- Vertically mounted heat exchangers with condensate drip trays for low chilled water flow temperatures
- Heat exchangers for two or four pipe systems
- Heating and/or cooling is possible

The active chilled beams contain an internal plate with punched nozzles, a vertical heat exchanger with condensate drip tray and a spigot for the connection of the conditioned fresh air.

Further, current information on design can be found on our Website and in our “Air-water systems” design manual.

Our “Easy Product Finder” online design programme is also available on the Internet for the design and selection of our products.

Certification of EUROVENT

TROX is participating in the Eurovent Certification Progamme for Chilled Beams. Products are certified under the number 09.12.432 and presented on the Eurovent Website.

Functional description

Active chilled beams supply conditioned fresh air (primary air) to the space from a central plant room to maintain indoor air quality whilst providing additional cooling and/or heating using heat exchangers.

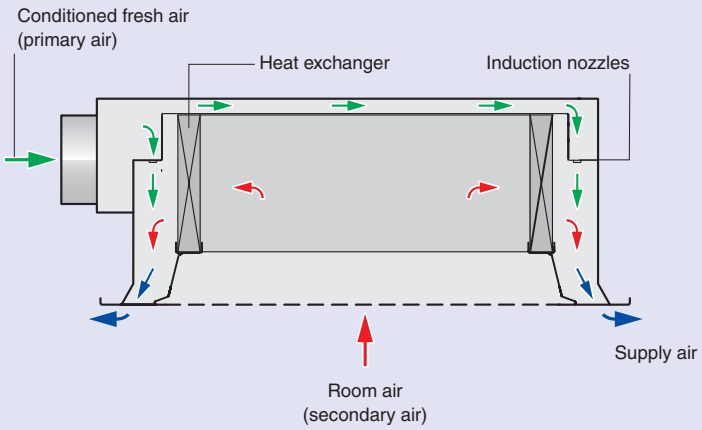
The primary air is discharged into the beam mixing chamber via nozzles. As a result of this secondary air is induced via an inlet grille and then passes through a vertically mounted heat exchanger into the mixing chamber. Both air flows mix and the total supply air is discharged horizontally into the space through four integral slot diffusers.

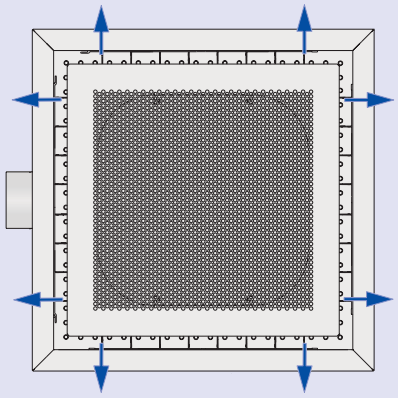
There are two nominal sizes each having three nozzle options. This allows the optimum selection to meet fresh air flow rate and thermal capacity requirements whilst exhibiting low differential pressures and sound power level characteristics.

There are two types of heat exchanger, one is a two pipe system for cooling, heating can be provided using a changeover mode. The other is a four pipe system which enables any room to be cooled or heated independently of other rooms.

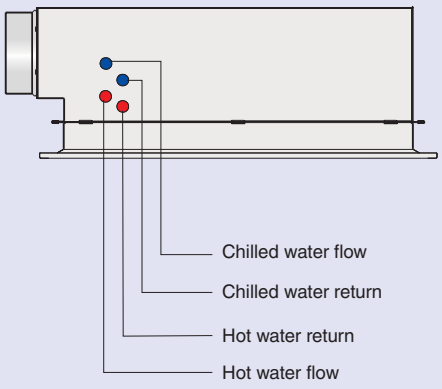
A condensate drip tray is located beneath the heat exchanger to collect any condensate resulting from undershooting the dew point temperature in the cooling mode. Long-term operation below the dew point (wet operation) must be avoided.

Principle of operation

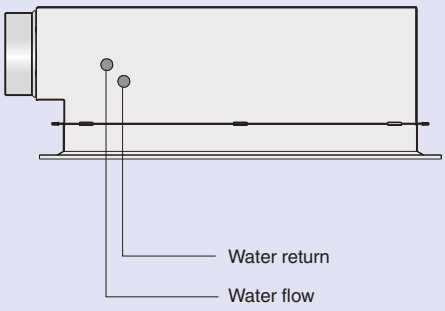




Four pipe system
Heating and cooling



Two pipe system
Heating or cooling



Construction · Dimensions

Characteristics

- Fresh air range 6 to 50 l/s, 22 to 180 m^3/h
- For clear room heights from approximately 2.6 to 4.0 m
- Flush ceiling installation
- Side entry fresh air connection
- Different unit sizes, thus suitable for all ceiling systems
- Easy removal of the induced air grille which is made of perforated sheet metal with circular holes
- Nozzles in three sizes to optimise induction
- Nozzles punched in sheet metal plate, non-combustible
- Optional adjustable control blades to control the air discharge direction
- Heat exchangers for two or four pipe systems with condensate drip tray for low chilled water flow temperatures
- Maximum operating pressure: 6 bar
- Maximum operating temperature: 75 °C

  Other operating pressures and temperatures upon request.

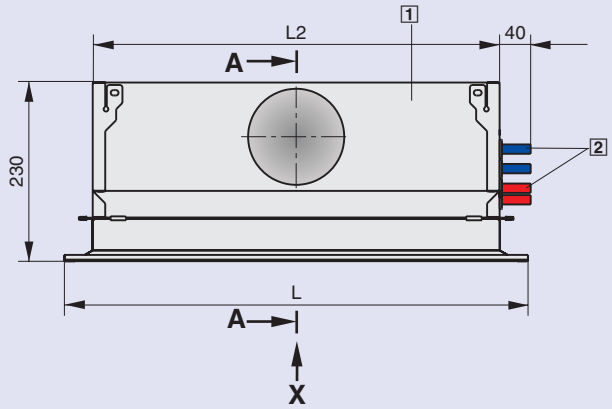
Construction features

- Spigot connections suitable for circular connecting ducts according to EN 1506 or EN 13180
- Induced air grille is fixed using circular magnets and for removal has safety wire supports
- Water connections, Ø12 mm plain end or with external thread G½", flat end seal

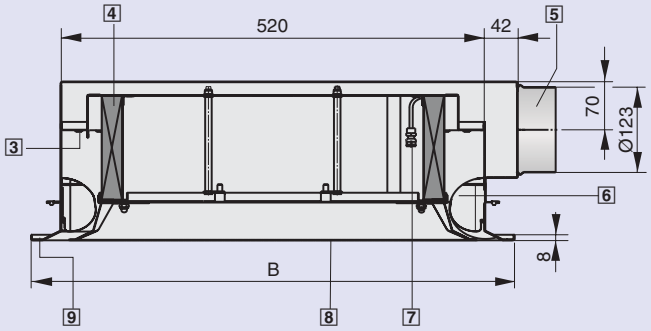
Materials

- Casing, face frame and induced air grille made of galvanised sheet steel, nozzle plate made of sheet steel.
- Heat exchanger made of copper tubes and formed aluminium fins
- Control blades made of polypropylene, flame retardant (V0) to UL 94
- Visible surfaces powder-coated white (RAL 9010) or another RAL colour
- Casing and heat exchanger untreated, alternatively black (RAL 9005)
- Nozzle plate black (RAL 9005)

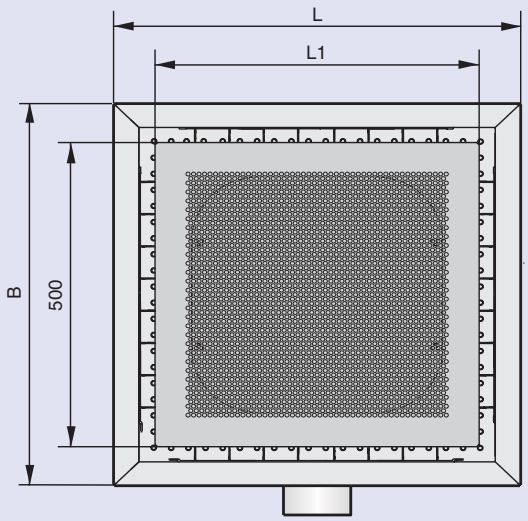
Dimensions



View A – A



View X

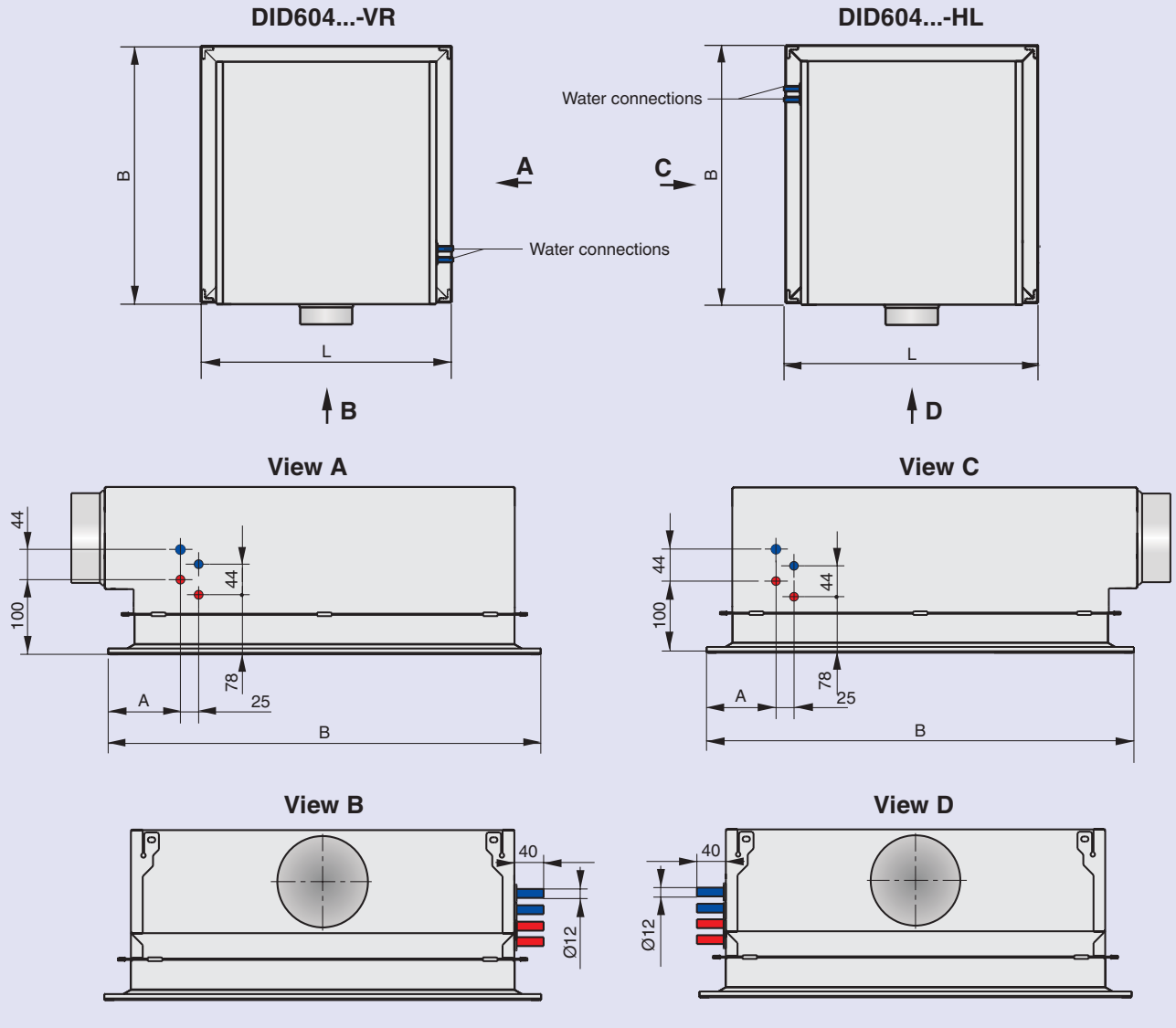


1 Casing
2 Water connections
3 Nozzle plate
4 Heat exchanger
5 Side entry spigot (primary air)
6 Adjustable control blades to control the air discharge direction (option)
7 Vent valve
8 Induced air grille
9 Face frame

Dimensions in mm				
Nominal size	L	B	L1	L2
600 × 600	593	593	500	520
	598	598	500	520
	618	618	500	520
	623	623	500	520
1200 × 600	1193	593	1100	1120
	1198	598	1100	1120
	1243	618	1100	1120
	1248	623	1100	1120

Dimensions in mm	
B	**A**
593	99
598	102
618	112
623	114

Water connections



The two pipe system heat exchanger has only connections for chilled water

Installation

The customer must install the active chilled beams, make all connections, and provide the hanging system, connection and sealing materials.

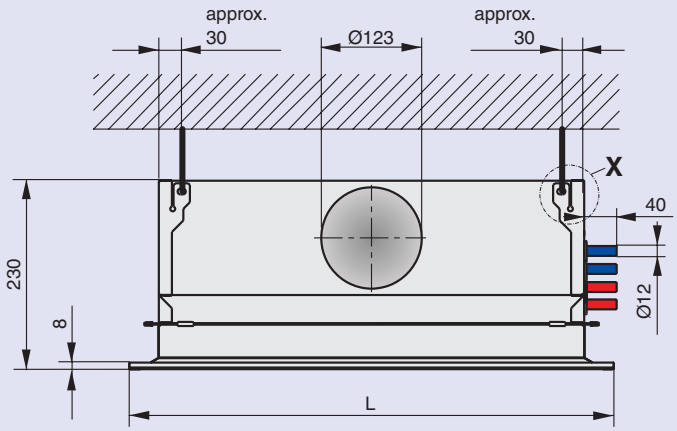
Only trained expert personnel should install and make the appropriate connections.

All legal regulations for site work must be complied with.

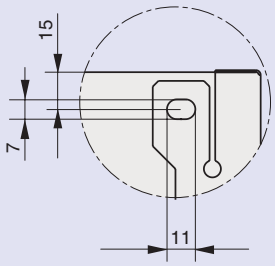
The active chilled beam has four hanging brackets for suspending the unit from the ceiling slab using threaded rods, wires or metal hangers. Use only certified hanging systems.

The primary air is connected to the inlet spigot. The heat exchanger has common flow and return connections on the side of the unit (four connections in the case of a four pipe system). The actual connections can either be rigid – soldered or screw, or flexible – using push fit hoses. It is important to ensure adequate venting and draining facilities are provided.

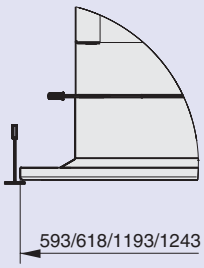
Flexible hoses can be supplied as accessories see separate technical leaflet.



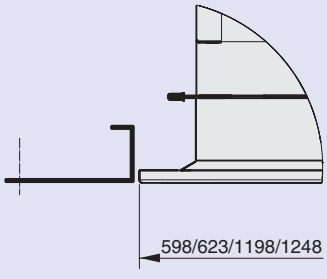
Detail X



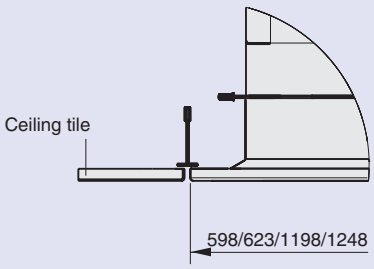
Installation into T-bar ceilings



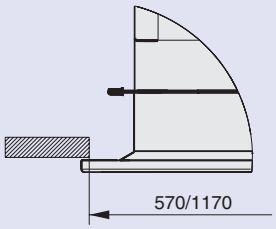
Installation into grid ceilings



Flush installation into T-bar-ceilings



Installation into plasterboard ceilings



Maintenance

As is the case with all diffusers that induce room air, depending on the cleanliness of the room air, deposits may accumulate on the surfaces of the diffuser. If required, clean the diffuser with commercial, non-aggressive cleaning agents.

Clean the heat exchanger with an industrial vacuum cleaner. For maintenance, also see VDI 6022, Sheet 1 – “Hygiene Requirements on Ventilation Systems”.

Removal of the induced air grille

The heat exchanger is accessible when the induced air grille has been removed.

The induced air grille is magnetically fixed. Therefore it is very easy to remove and to reinstall. When reinstalling the grille make sure that the alignment angles are located on the corners of the drip tray – see below.

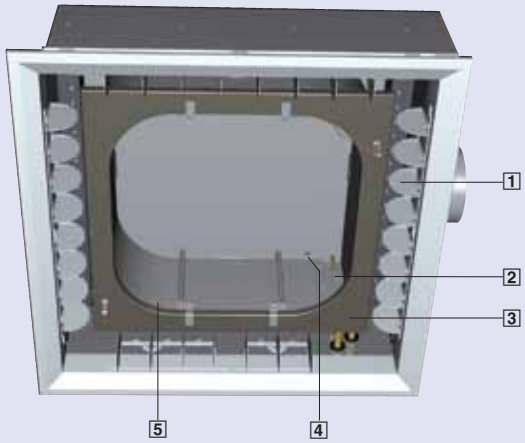
For removal the induced air grille has two safety wire supports.

Measurement of reference pressure

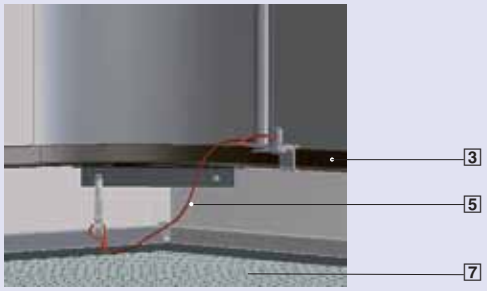
The DID604 has tapping for the measurement of reference pressure which allows the easy setting up of flow rate. For measurement remove the plug. When measurement is finished reseal the tapping with the plug.

If required, please ask for the pressure/flow rate characteristic.

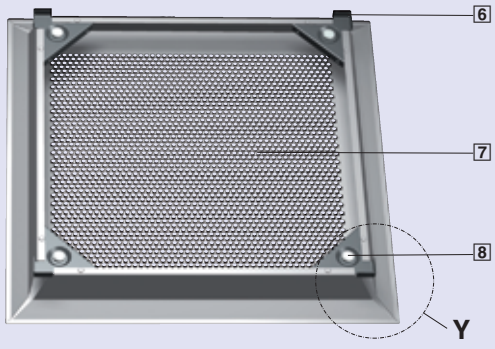
Casing



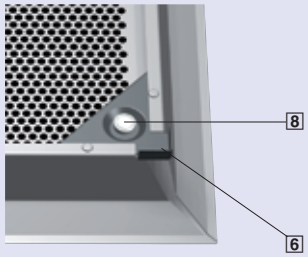
Casing with induced air grille



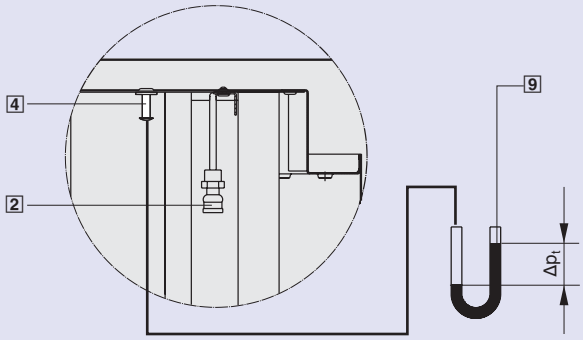
Induced air grille



Detail Y



Measurement of reference pressure



1 Air control blades
2 Vent valve
3 Condensate drip tray
4 Measurement tapping with plug
5 Safety wire
6 Alignment angle
7 Induced air grille
8 Circular magnets for fixing grille into the casing
9 Manometer

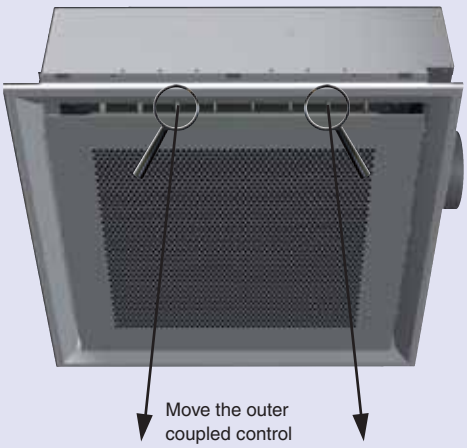
Adjustable air discharge direction

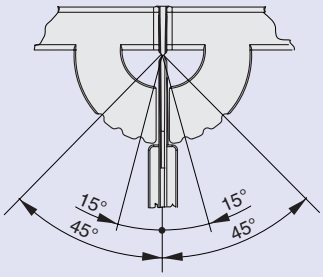
If a large cooling capacity is required in a very small space with active chilled beams, the use of an adjustable horizontal air discharge can still result in acceptable air velocities in the occupied zone. The spread of the air discharge can be increased dependent on room geometry. In case of change of use the air discharge can be optimised by subsequent adjustment.

- Several control blade elements are linked together to provide a uniform adjustment
- For finer adjustment of individual elements cut the connection strip (plastic) between control blade elements
- To adjust the coupled control blade elements at the outer parts of the slot diffuser two hands should be used
- Maximum possible adjustment is 45° to the right or left in steps of 15°
- The units are delivered with an air discharge direction set to horizontal and at right angles to the slot

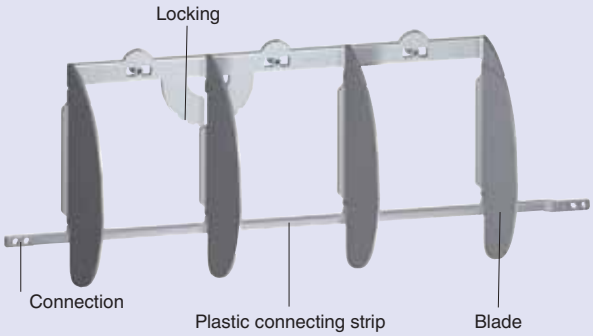
Different air discharge directions reduces the water-side capacity. At 45° a loss of 5 % can occur.

Adjustment of the control blades

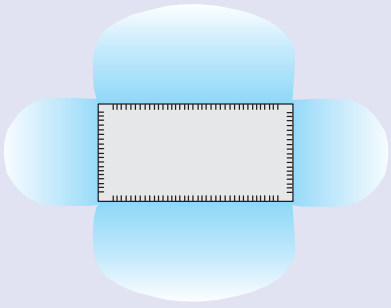




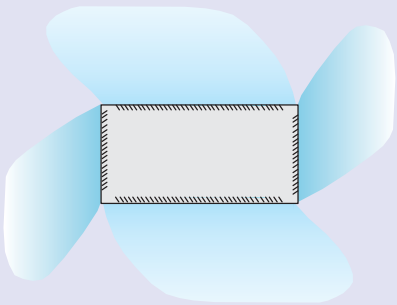
Single control blade element



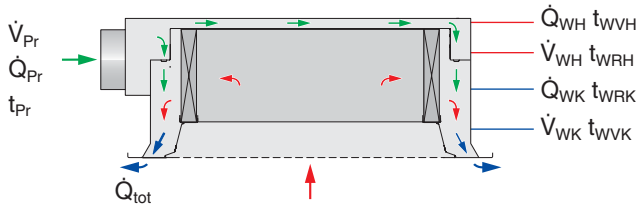
Horizontal air discharge at right angles to the slot

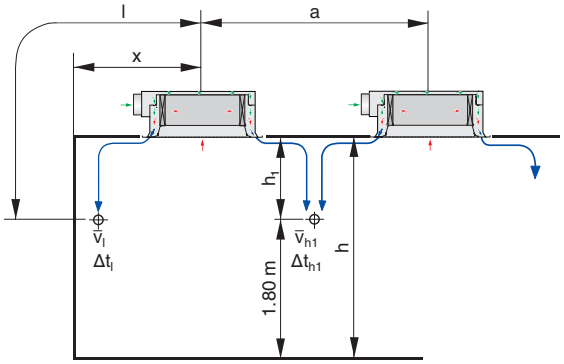


Angled horizontal air discharge



Nomenclature





Δt_l	in K :	Temperature difference between room air and core at distance $l = x + h_1$
Δt_{h1}	in K :	Temperature difference between room air and core at distance $l = a/2 + h_1$
Δt_{Pr}	in K :	Temperature difference between room air and conditioned fresh air
Δt_W	in K :	Temperature difference between water flow and return
Δt_{RWV}	in K :	Temperature difference between room air and water flow
Δp_t	in Pa :	Total differential pressure
Δp_W	in kPa :	Water-side pressure differential
t_R	in °C :	Room temperature
t_{WVK}	in °C :	Water flow temperature – cooling
t_{WRK}	in °C :	Water return temperature – cooling
t_{WVH}	in °C :	Water flow temperature – heating
t_{WRH}	in °C :	Water return temperature – heating
t_{Pr}	in °C :	Temperature of the conditioned fresh air
$\dot{Q}_{WK}$	in W :	Water cooling capacity
$\dot{Q}_{WH}$	in W :	Water heating capacity
$\dot{Q}_{tot}$	in W :	Total cooling capacity $\dot{Q}_{Pr} + \dot{Q}_{WK}$
$\dot{Q}_{Pr}$	in W :	Conditioned fresh air cooling capacity
$\dot{V}_{WK}$	in l/h :	Water flow rate – cooling
$\dot{V}_{WH}$	in l/h :	Water flow rate – heating
$\dot{V}_{Pr}$	in l/s :	Conditioned fresh air flow rate
$\bar{v}_l$	in m/s :	Maximum time average air velocity at wall at distance $l = x + h_1$
$\bar{v}_{h1}$	in m/s :	Maximum time average air velocity between two diffusers at distance $l = a/2 + h_1$
L_{WA}	in dB(A) :	A-weighted sound power level
a	in m :	Spacing between two diffusers
l	in m :	Horizontal plus vertical distance from diffuser, discharge down the wall (1.8 m above the floor), $l = x + h_1$
h_1	in m :	Distance from the ceiling to the occupied zone (1.8 m above the floor)
h	in m :	Room height
x	in m :	Distance from the diffuser centre line to the wall

All sound power levels are based on 1 pW.
All noise levels determined in a reverberation chamber.
Technical data based on an air density of 1.2 kg/m^3.

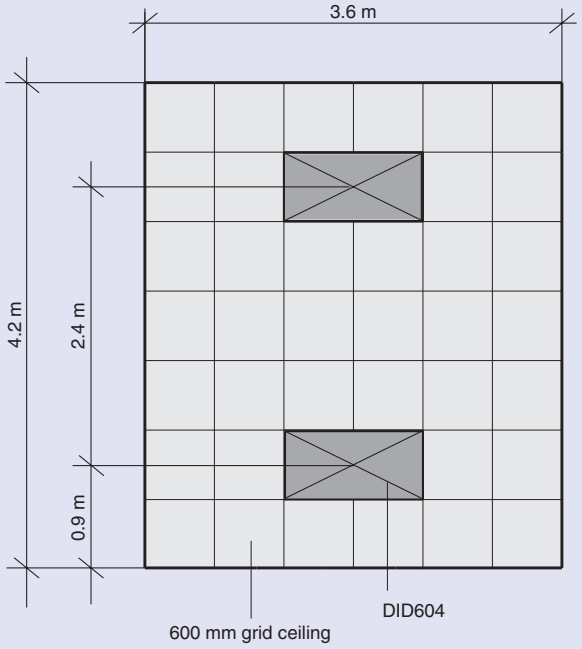
Selection example

First step in selecting active chilled beams is based on the quick selection table (Page 12).
Listed capacities are valid only for the reference values.

Second step, if the operating values differ from the reference ones, corrections must be made using diagrams and tables pages 13 to 15.

Our “Easy Product Finder” online design programme is also available on the Internet for easy and detailed design of our products.

Following example shows the unit selection using this leaflet.



Given

Modular office

Room width:	3.6 m
Room depth:	4.2 m
Room height:	2.8 m
Occupancy:	2 persons
Cooling load:	80 W/m²
Room temperature (Summer):	26 °C
Conditioned fresh air temperature:	16 °C
Chilled water flow temperature:	16 °C

Fresh air flow rates

According to EN 15251, low-pollution building, Category II,

Building:	0.7 (l/s)/m²
People:	7.0 (l/s)/Person

Calculation procedure

Fresh air flow rate:

15.1 m² × 0.7 (l/s)/m²	= 10.6 l/s
2 persons × 7 (l/s)/person	= 14 l/s
Total	= 24.6 l/s
Cooling load: 15.1 m² × 80 W/m²	= 1208 W

Data for quick selection, page 12

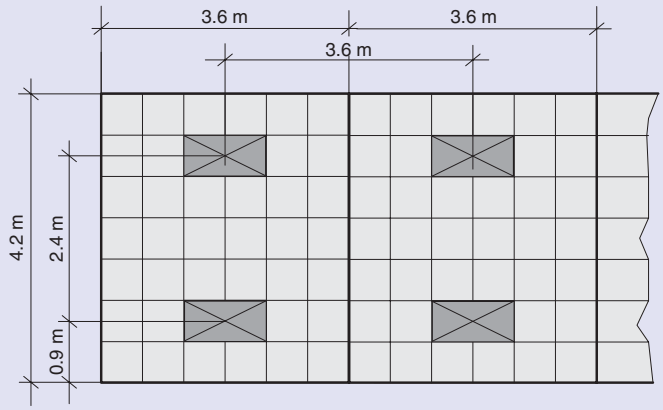
DID604 2 units
Each unit:

Fresh air flow rate	24.6/2	= 12.3 l/s
Cooling capacity	1208/2	= 604 W

Selected type:

Nominal size: 1200 × 600
Type of nozzle: Z
Two pipe system
Each with a fresh air flow rate of 12 l/s

DID604-DE-LR-2-Z-VR/1198 × 598/LE



Arrangement of beams in multiple rows

In many large zones the active chilled beams are arranged in multiple rows. To determine the air velocity entering the occupied zone mid way between two beams the minimum beam spacing should be considered (i.e. 2.4m in this case) as this will give the maximum value. A larger spacing will produce a lower velocity into the occupied zone.

Selection example

Result of design				
Capacities and comfort parameters	**Source**	**Formula**	**Calculation**	**Value**
Selected nominal size	Quick selection			1200 × 600
Total cooling capacity each unit	Quick selection			563 W
Cooling capacity too low, thus increase of water flow rate, try 170 l/h				
Water cooling capacity at 170 l/h	Quick selection			418 W
Air cooling capacity		$\dot{Q}_{Pr} = \dot{Q}_{tot} - \dot{Q}_{WK}$	563 – 418	145 W
Correction factor for 250 l/h	Page 13			1.11
Water cooling capacity at 250 l/h			418 × 1.11	464 W
Total cooling capacity each unit		$\dot{Q}_{Pr} + \dot{Q}_{WK}$	145 + 464	609 W
Water-side temperature difference	Diagram 1			approx. 1.6 K
Water-side pressure differential	Diagram 2			approx. 6.2 kPa
Spacing between two diffusers				2.4 m
Distance between two diffusers and the occupied zone		$a/2 + h_1$	2.4/2 + 1	2.2 m
Air velocity between two diffusers	Diagram 14	$\bar{v}_{h1}$		< 0.1 m/s
Temperature reduction	Diagram 14	$\Delta t_{h1}/\Delta t_{Pr}$	0.17 × 10	approx. 1.7 K
Supply air temperature in the occupied zone		$t_R - \Delta t_{h1}$	26 – 1.7	24.3°C
Distance from diffuser to the occupied zone at the wall		$l = x + h_1$	0.9 + 1.0	1.9 m
Air velocity at the wall	Diagram 11	$\bar{v}_l$		approx. 0.16 m/s
Air velocity in the occupied zone (0.5 m from the wall)		approx. 50% of $\bar{v}_l$	approx. 0.5 × 0.16	< 0.1 m/s
Temperature reduction	Diagram 11	$\Delta t_l/\Delta t_{Pr}$		0.21
		$\Delta t_{Pr} \times \Delta t_l / \Delta t_{Pr}$	10 × 0.21	2.1 K
Supply air temperature in the occupied zone		$t_R - \Delta t_l$	26 – 2.1	approx. 23.9 °C
Sound power level	Quick selection			15 dB(A)
Fresh air pressure differential	Quick selection			75 Pa
Selected Type: DID604-DE-LR-2-Z-VR/1198 × 598/LE				

Note:
In the above example the local velocities $\bar{v}$ determined from diagrams 11 and 14 both demonstrate values throughout the occupied zone less than 0.1 m/s.

Note about aerodynamic data

The tabulated air velocities $\bar{v}_l$ and $\bar{v}_{h1}$ are based on a regular distribution of heat loads in the space. Strong asymmetric distribution will result in variations to the tabulated values.

The air velocities are based on horizontal discharge at right angles to the beam. Local air velocities can be significantly reduced by adjusting the control blades.

Quick selection

Reference values – Cooling

t_R = 26 °C
t_{Pr} = 16 °C
t_{WVK} = 16 °C
$\dot{V}_{WK}$ = 170 l/h

Reference values – Heating

t_R = 22 °C
t_{Pr} = 22 °C (isothermal)
t_{WVH} = 50 °C
$\dot{V}_{WH}$ = 50 l/h

Two pipe system

Nom. size	Type of nozzle	Fresh air $\dot{V}_{Pr}$		Fresh air Δp_t	Cooling $\dot{Q}_{tot}$	Cooling $\dot{Q}_{WK}$[1] (water)	Cooling Δt_W	Cooling Δp_W (water)	Heating $\dot{Q}_{WH}$[1]=$\dot{Q}_{tot}$ (water)	Heating Δt_W	Heating Δp_W (water)	Air-regenerated Noise L_{WA}
		l/s	m³/h	Pa	W	W	K	kPa	W	K	kPa	dB(A)
600 × 600	Z	6	22	49	306	233	1.2		493	8.5		<10
		10	36	137	467	347	1.7		734	12.6		20
		14	50	269	618	449	2.3		954	16.3		30
	M	12	43	85	498	353	1.8		699	12.0		17
		18	65	192	700	483	2.4	2.4	889	15.2	0.21	29
		22	79	287	826	561	2.8		989	16.9		35
	G	20	72	68	655	414	2.1		674	11.6		20
		29	104	143	889	540	2.7		753	12.9		32
		38	137	245	1092	634	3.2		799	13.7		40
1200 × 600	Z	12	43	75	563	418	2.1		808	13.8		15
		18	65	169	792	575	2.9		991	16.9		28
		22	79	252	931	665	3.4		1079	18.4		34
	M	20	72	91	778	537	2.7		991	17.0		23
		27	97	167	997	671	3.4	3.2	1155	19.7	0.28	32
		33	119	249	1170	773	3.9		1264	21.6		38
	G	30	108	62	873	512	2.6		900	15.4		26
		40	144	111	1112	630	3.2		1023	17.5		35
		50	180	174	1334	732	3.7		1115	19.0		42

Four pipe system

Nom. size	Type of nozzle	Fresh air $\dot{V}_{Pr}$		Fresh air Δp_t	Cooling $\dot{Q}_{tot}$	Cooling $\dot{Q}_{WK}$[1] (water)	Cooling Δt_W	Cooling Δp_W (water)	Heating $\dot{Q}_{WH}$[1]=$\dot{Q}_{tot}$ (water)	Heating Δt_W	Heating Δp_W (water)	Air-regenerated Noise L_{WA}
		l/s	m³/h	Pa	W	W	K	kPa	W	K	kPa	dB(A)
600 × 600	Z	6	22	49	297	225	1.1		395	6.8		<10
		10	36	137	451	331	1.7		526	9.0		20
		14	50	269	586	418	2.1		616	10.6		30
	M	12	43	85	467	322	1.6		494	8.5		17
		18	65	192	634	417	2.1	2.1	602	10.3	0.21	29
		22	79	287	736	471	2.4		658	11.3		35
	G	20	72	68	602	361	1.8		558	9.6		20
		29	104	143	812	462	2.3		661	11.3		32
		38	137	245	1004	546	2.8		735	12.6		40
1200 × 600	Z	12	43	75	509	365	1.8		356	6.1		15
		18	65	169	682	465	2.3		457	7.9		28
		22	79	252	789	524	2.6		517	8.9		34
	M	20	72	91	689	448	2.3		447	7.7		23
		27	97	167	864	538	2.7	2.5	539	9.3	0.28	32
		33	119	249	1006	608	3.1		612	10.5		38
	G	30	108	62	795	433	2.2		472	8.1		26
		40	144	111	1010	528	2.7		575	9.9		35
		50	180	174	1218	615	3.1		668	11.5		42

[1] Different air discharge directions reduces water side capacity. At 45° a loss of 5 % can occur.

Water-side capacity

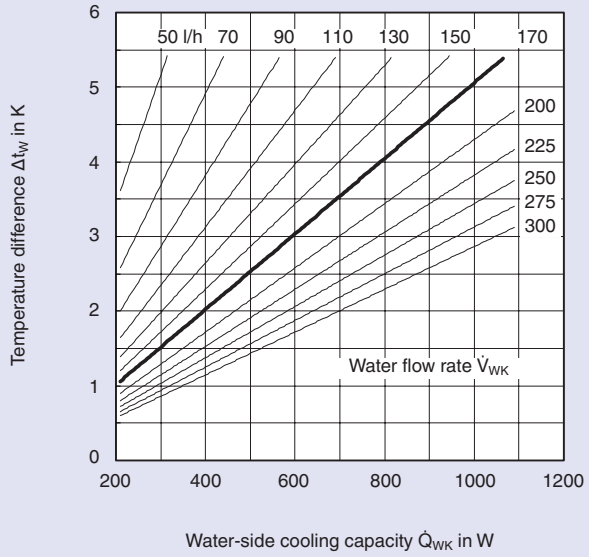
Correction factors – Cooling									
Two pipe system									
$\dot{V}_{WK}$ in l/h		40	60	90	110	130	170	250	300
Nominal size	600	0.55	0.67	0.79	0.86	0.91	1.00	1.12	1.17
	1200	0.50	0.64	0.79	0.86	0.91	1.00	1.11	1.16

Four pipe system									
$\dot{V}_{WK}$ in l/h		40	60	90	110	130	170	250	300
Nominal size	600	0.48	0.61	0.76	0.83	0.90	1.00	1.15	1.21
	1200	0.58	0.68	0.79	0.85	0.90	1.00	1.15	1.23

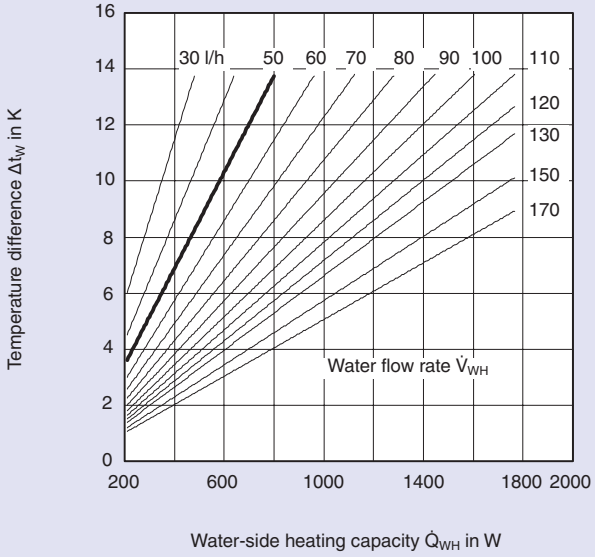
Correction factors – Heating									
Two pipe system									
$\dot{V}_{WH}$ in l/h		30	50	70	90	100	120	150	160
Nominal size	600	0.76	1.00	1.18	1.33	1.39	1.50	1.63	1.67
	1200	0.72	1.00	1.20	1.36	1.43	1.53	1.66	1.70

Four pipe system									
$\dot{V}_{WH}$ in l/h		30	50	70	90	100	120	150	160
Nominal size	600	0.72	1.00	1.21	1.37	1.44	1.57	1.72	1.77
	1200	0.83	1.00	1.13	1.24	1.28	1.37	1.48	1.52

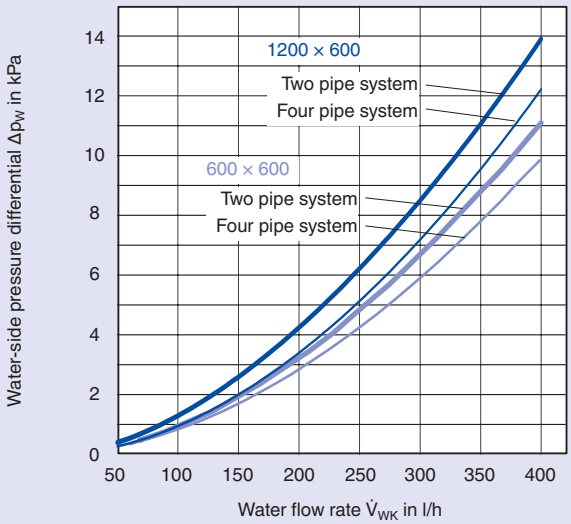
1 Cooling



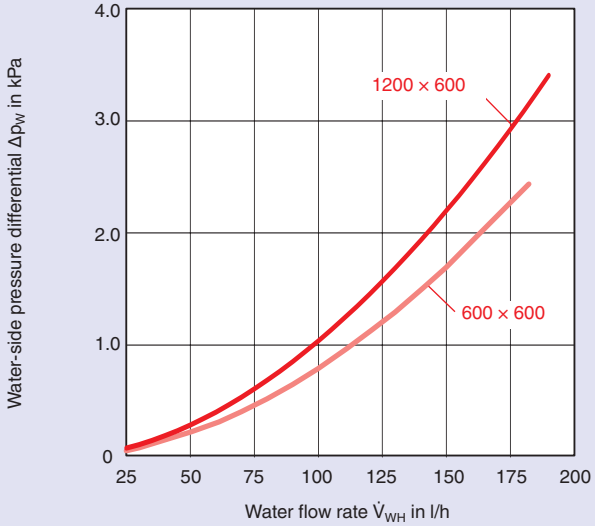
3 Heating



2 Cooling



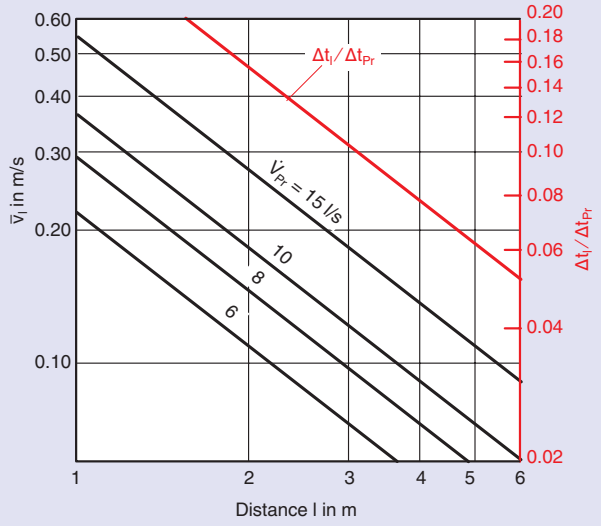
4 Heating



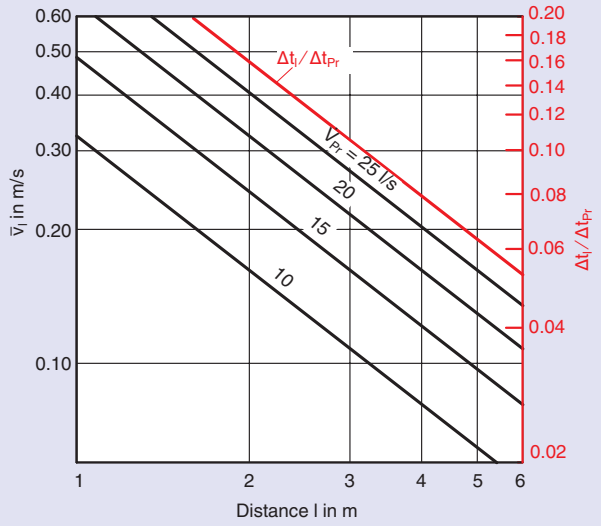
Aerodynamic data

Nominal size 600 × 600

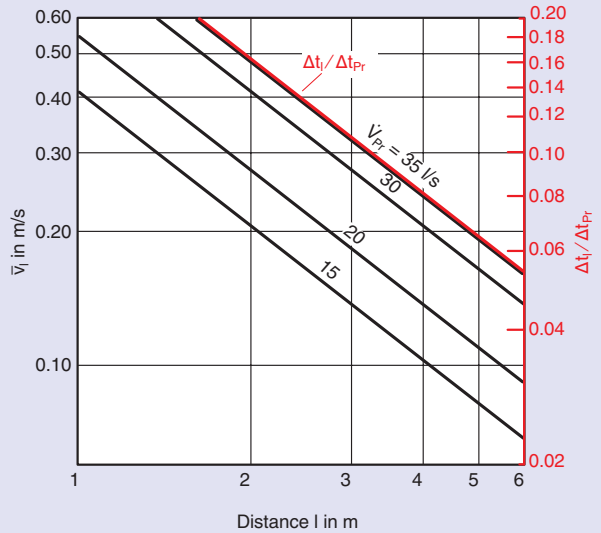
5 Nozzle type Z



6 Nozzle type M

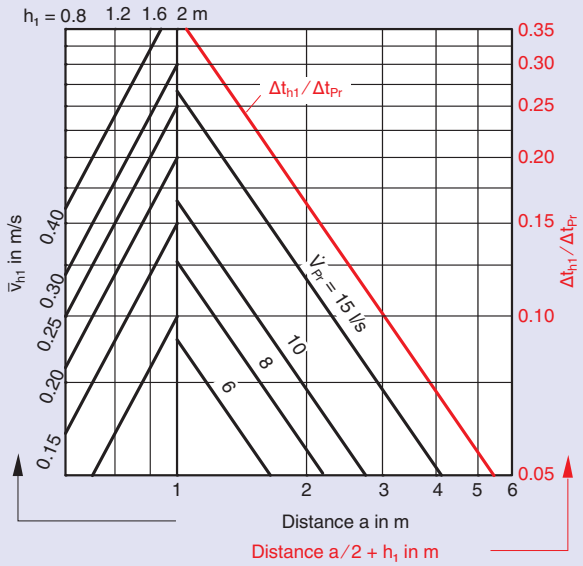


7 Nozzle type G

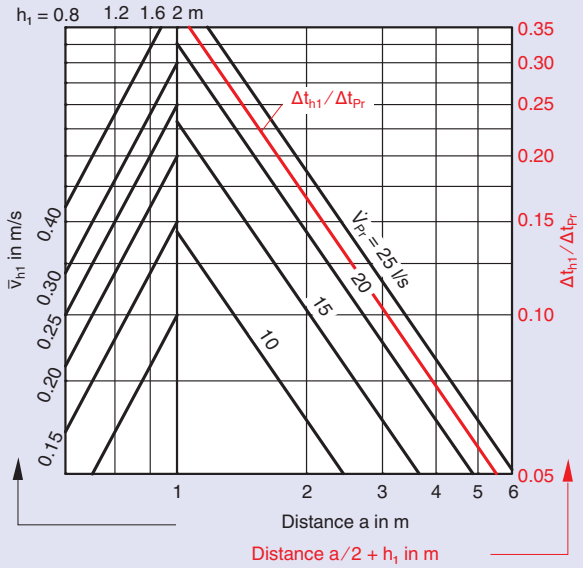


Re aerodynamic data please refer to note on page 11.

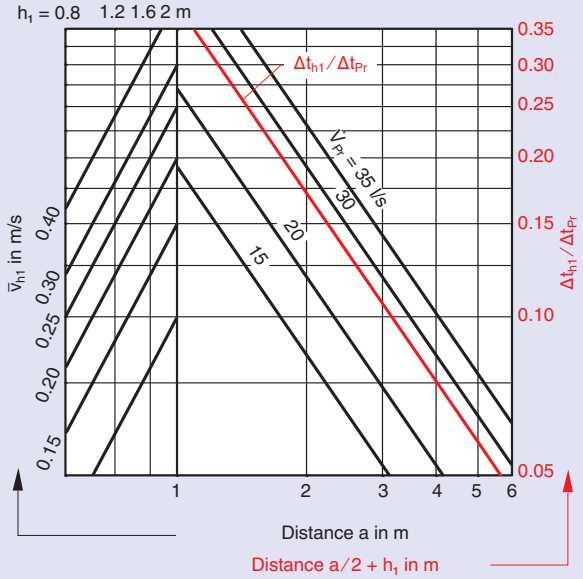
8 Nozzle type Z



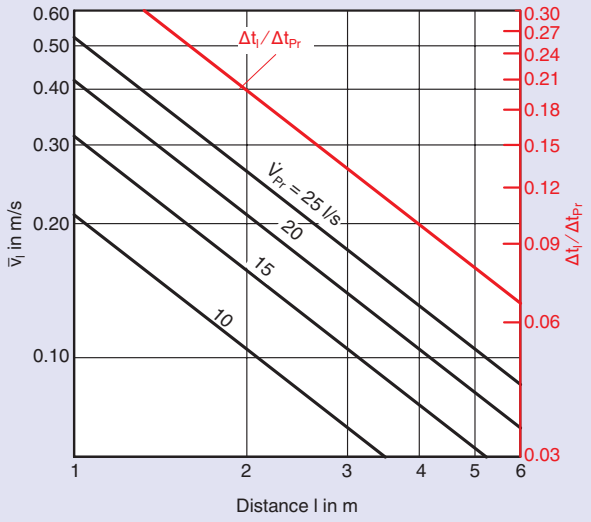
9 Nozzle type M



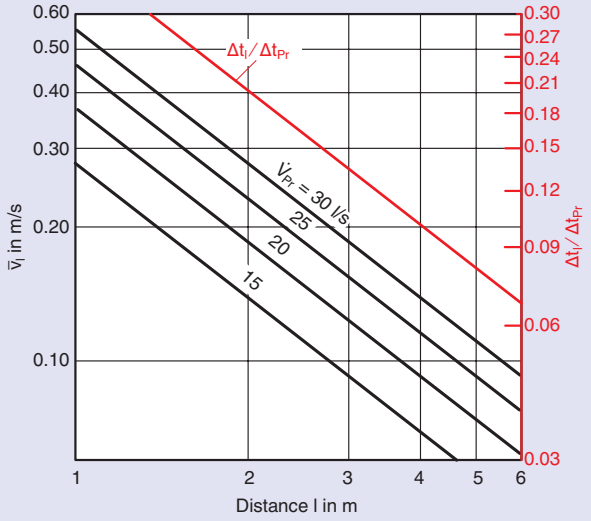
10 Nozzle type G



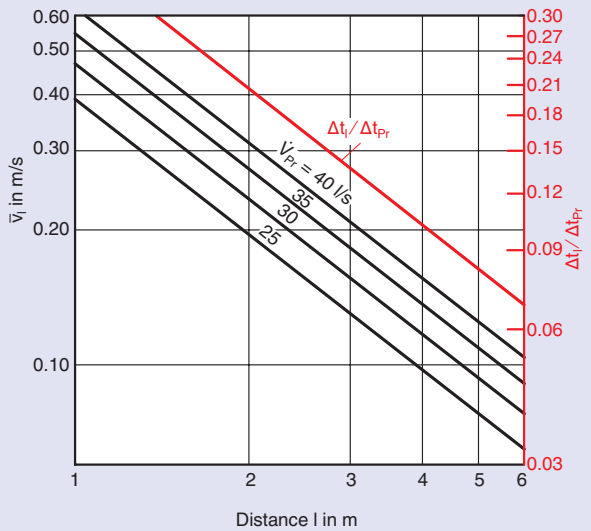
11 Nozzle type Z



12 Nozzle type M

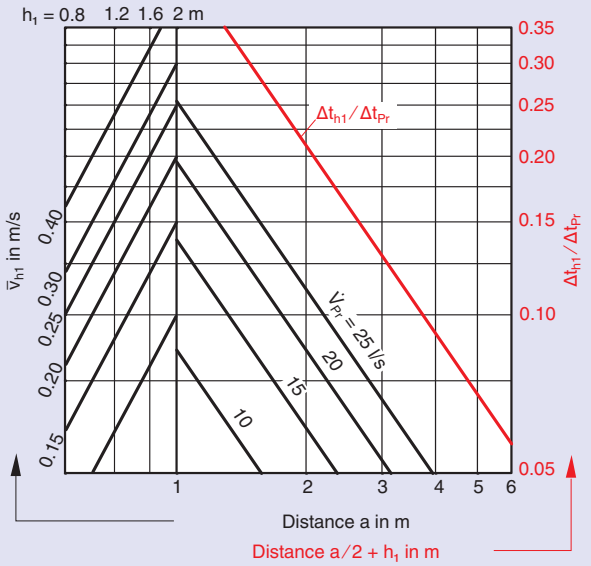


13 Nozzle type G

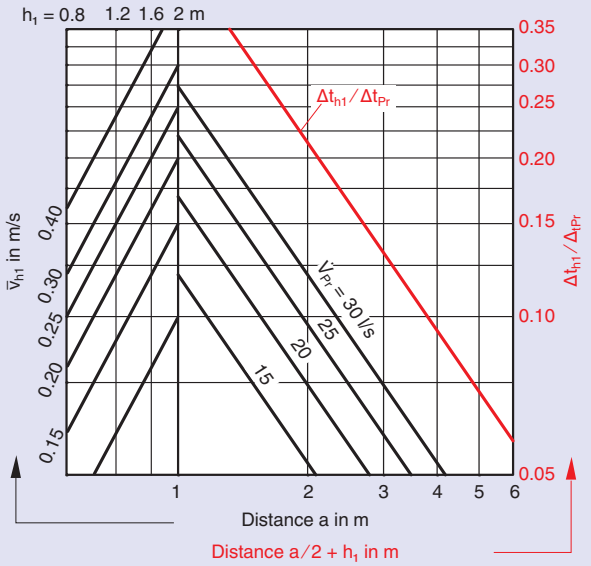


Re aerodynamic data please refer to note on page 11.

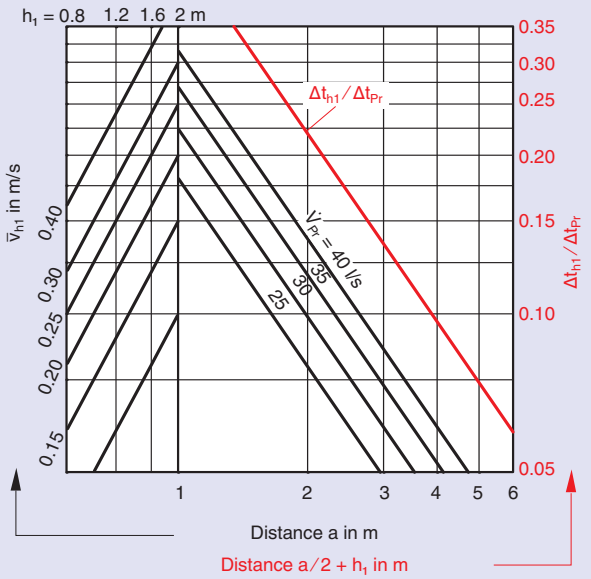
14 Nozzle type Z



15 Nozzle type M



16 Nozzle type G



Order Details

Specification text

Active chilled beams with high thermal capacities using air-water systems. Suited for flush ceiling installation in rooms with heights from approximately 2.6 to 4.0 m. Consisting of a casing with hanging brackets, connecting spigot, non-combustible nozzles and heat exchangers.

Special characteristics:

– Air discharge four way
– Heat exchangers for two or four pipe systems
- Heat exchanger with condensate drip tray for low chilled water flow temperatures
– Induced air grille is fixed using circular magnets and for removal has safety wire supports

Nozzles in three sizes to optimise induction. Water-side connecting tails with 12 mm outer diameter plain end.

Beam options:

– Water-side connecting tails with G½" external thread, flat end seal
– With adjustable control blades to control the air discharge direction

Materials

Face frame, casing and induced air grille made of galvanised sheet steel. Nozzle plate made of sheet steel. Heat exchanger made of copper tubes and formed aluminium fins. Control blades made of polypropylene, flame retardant (V0) to UL 94.

Visible surfaces of the face of the beam powder-coated white (RAL 9010) or other RAL colour. Heat exchanger optionally black (RAL 9005). Nozzle plate black (RAL 9005).

Order code

DID604 - DE - LR - 4 - M - VR - A1	/	1193 × 593	/	P1	/	RAL 9006	/	G1	/	LE
1 2 3 4 5 6		7		8		9		10		11

1 Type

2 Induced air grille
-LR Perforated metal (circular holes)

3 Heat exchanger
-2 Two pipe system
-4 Four pipe system

4 Nozzle variant
-Z
-M
-G

5 Arrangement of the water connections
-VR Front right
-HL Rear left

6 Water connections
Pipe end Ø12 mm, smooth, no entry required
-A1 External thread G½", flat end seal

7 Overall face dimensions for nominal size

593 × 593	600 × 600
598 × 598	
618 × 618	
623 × 623	
1193 × 593	1200 × 600
1198 × 598	
1243 × 618	
1248 × 623	

8 Exposed surface[1]
Powder-coated, white (RAL 9010, gloss level 50 %), no entry required
P1 Powder-coated RAL ...

9 Colour
For P1 only
RAL 9006 white aluminium, gloss level 30 %
RAL ... other colours, gloss level 70 %

10 Surface of casing and heat exchanger
Untreated, no entry required
G1 Black (RAL 9005)

11 Control blades
Without control blades, no entry required
LE With control blades

[1] Colours in RAL CLASSIC collection

Order example

Make: TROX
Type: DID604 -DE -LR -4 -M -VR -A1 / 1193 × 593 / P1 / RAL 9016 / G1 / LE