

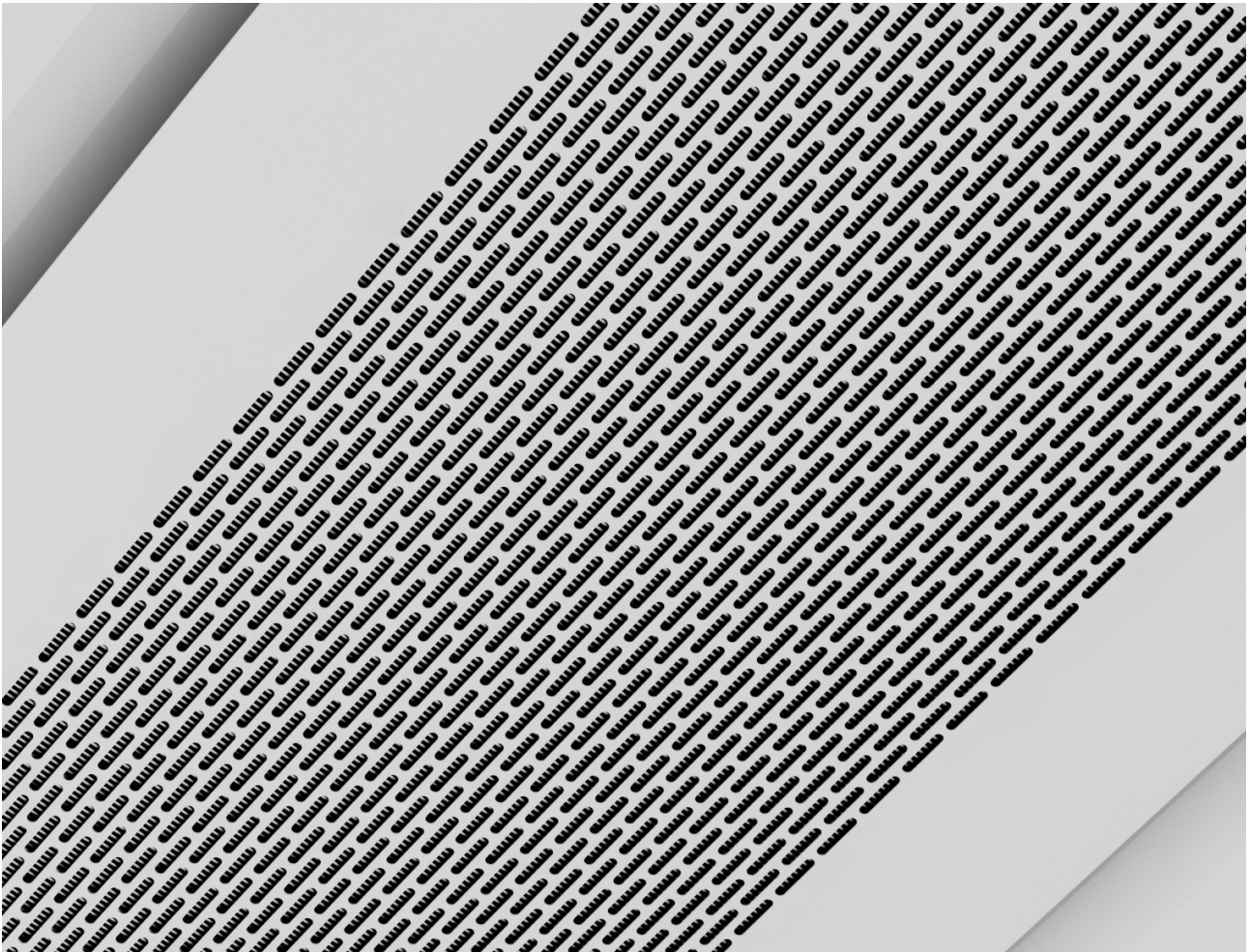
# Lindab **Solus**

Active chilled beam



# Active chilled beam

# Solus



## Use

Lindab Solus is specially designed as a combined HTC and LTH beam—High Temperature Cooling and Low Temperature Heating. Due to the customized coil, the Solus beam delivers an outstanding cooling and heating effect per degree temperature difference between the water circuit and the room temperature. This means that you get great capacities, at a relatively high running temperature. All in all, the Solus beam can save a lot of the energy cost on cooling and heating.

## Installation

Solus I-60 is installed into a false ceiling, and can be suspended by hangers or threaded rods. As standard Solus is delivered for a 600 x 600 T24 false ceiling. Solus can also be delivered with a variety of different Clip-in options, making the beam suitable for other types of false ceilings.

## Worth noting

The Angled Nozzle system secures a perfect air spread pattern, available in a number of factory preset angles.

Cost saving high output beam that delivers an excellent capacity for both cooling and heating, while running the same temperature set for both functions. Pressure authority in the beam means that regulation of the air pressure is a fast and easy task.

Lindabs active chilled beams are Eurovent-certified and tested according to EN-15116.



## Key figures

Length:	1800, 2400, 3000, 3600 mm
Width:	600 mm (ceiling adaption available)
Height:	200 mm
Capacity:	Cooling: 1120 W Heating: 460 W

### Calculation setup

Room temp: 25°C/21°C, Water temp: 20-23°C/23-22°C,  
Air temp: 20°C/23°C, Nozzle air pressure: 100 Pa,  
Air flow: 15 l/s/m.

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## Great effect through induction

Solus is based on the induction principle. Ventilation air is released through the nozzles into a dispersal zone, thereby creating a low static pressure. The low pressure causes the room air to be induced into the ventilation air through the coil. The volume of the room air is two to seven times that of the ventilation air. The air is cooled or heated as it passes through the coil, which consists of aluminium fins with copper pipes filled with running water. While passing through the coil, the induced room air will either be cooled or heated, according to the need in the room.

## High temperature cooling

The Lindab Solus beam presents a whole new perspective on cooling, heating and ventilation.

Minimizing the figures on the energy account, by reclaiming the cooling and heating energy in the AHU air temperature recovery unit is a natural part of any ventilation system of today. Why not do the same on the water circuit?

Compared by weight, water can carry approximately 3400 times as much heat energy as air. In most buildings, the need for cooling and the need for heating are two independent factors that do not have a direct relation to each other. There may be a need for cooling on the south façade and a need for heating on the north façade at the same time.

Normally this scenario will be handled by running a cooling and a heating unit at the same time, to cool the rooms facing south and heating the rooms facing north. But why not use the in-house energy, by distributing the excess heat energy from the south façade to the north façade?

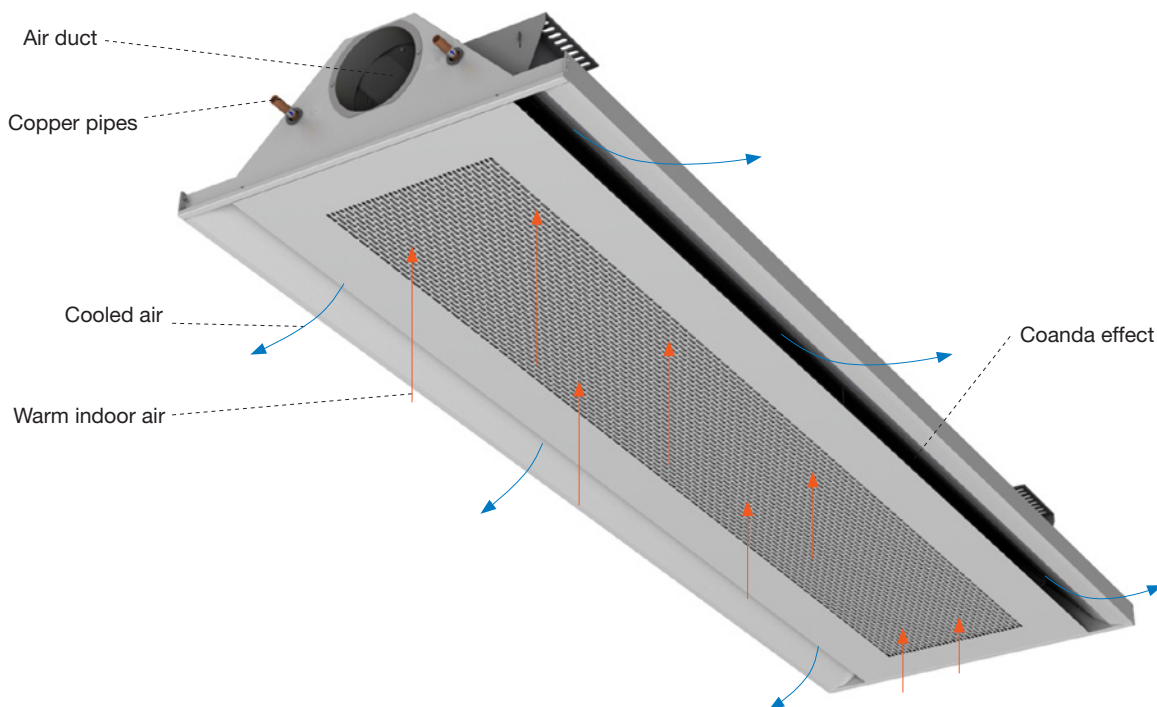
Previously no system has been able to deliver this functionality, but with Lindab Solus it is now possible.

By running an inlet temperature of 20-23°C, and an outlet temperature of 21-23°C for both heating and cooling, the energy needed to sustain the running temperature will in many cases be provided by the building itself. The specific temperature set will be dependant on the season. The temperatures should be defined for Winter, Summer and Autumn+Spring. Water coming back from the warm southern façade, will be mixed with the colder water from the north façade, thereby creating the desired output temperature once more.

In some cases it may be necessary to run either a cooling or heating unit to achieve an optimal output temperature, but it will never be necessary to run both at the same time with the Lindab Solus system ever again.

The result: Gain a great indoor climate, while saving both money and the environment.

Lindab Solus can be combined with any conventional heating or cooling source, including air-to-water and water-to-water heat pumps.



Picture 1. Solus is based on the induction principle.

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## Hygiene

### Everything is accessible for service

The Solus faceplate is simple to lower or remove. The faceplate is kept in place by four cotter pins. If two of the cotter pins, on one side of the faceplate are removed, the faceplate will open and hang from the other two pins. For complete removal, please see the installation instruction. When the faceplate is lowered or removed, the battery is accessible from below (see picture 3).

## Construction

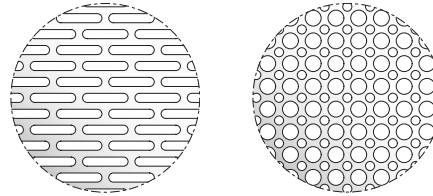
### Fixed and flexible

The general idea of a HTC system, is to run a fixed airflow at a fixed pressure. At the same time, the high capacity found in the water circuit and the beam coil will auto-regulate the temperature, both for heating and cooling.

The water pipes are made of copper. Nevertheless, the water should be oxygen-free to prevent corrosion.

## Perforation pattern

The beam is available in two perforation pattern. Slot 50% (standard) and Dotx2 50% (plus feature).



Slot 50%                      Dotx2 50%  
Picture 2. Available perforation.

## Initial settings

### Presetting Angled Nozzles

To achieve a desired air spread pattern the Solus beam is delivered with the Angled Nozzles air distribution system. The Angled Nozzles are a simple yet effective way of creating a divergent air spread pattern without the capacity issues normally related to an air deflector system. The Angled Nozzles can be delivered preset in one of the following standard settings:

- 30° (default setting)
- 16°
- 0°

**NB!** Please note that the Angled Nozzles are manufactured in a fixed position (default 30°) and cannot be retro-fitted or changed.



Picture 3. When the faceplate is lowered or removed, the battery is accessible from below.



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## Data

### Variants

The Solus beam is a 2-way active chilled beam and is specially developed for ventilation together with low temperature heating and high temperature cooling in a 2-pipe system.

**Lengths:** Solus is available in four fixed lengths: I-60/I-62: 1.8 m, 2.4 m, 3.0 m and 3.6 m.

**Width:** The beam is available in I-60 (592 mm) and I-62 (617 mm), according to different ceiling adaptations, see page 12.

**Height:** The height is 200 mm.

**Water connection:** The water connections for Solus are made of 12 mm copper pipes. As the same circuit is used for both heating and cooling, there is only one set of pipes (2-pipe system).

**Air connection:** Solus is supplied with a Lindab NPU -125 nipple for Lindab Safe® ventilation ducts.

**Angled Nozzles:** The Angled Nozzles are manufactured in a fixed position and cannot be retrofitted or changed (default is 30°). Other settings on request.

**Design:** Perforated with longitudinal slots (Slot 50%, see page 4).

**Surface treatment:** Solus is manufactured as standard from enamelled sheet metal.

### Colour

The product is available as standard, in signal white RAL 9003 or in pure white RAL 9010, gloss value 30. Other RAL colours on request.

### Plus features

Factory preinstalled.

**Adaptation for suspended ceilings:** The product can be adapted to suspended ceiling types X-60, Y-60 and Z-60 on request.

**Design:** There is another perforation pattern available (Dotx2 50%, see page 4).

**Air connection:** The beam is available with an additional Ø125 mm connection on the opposite side.

**Air boost:** Additional nozzles and plugs for future flexibility.

## Accessories

Delivered separately.

**Hangers:** For recommended installation principles (see: "[Solus Installation Instruction](#)").

All these different hangers are available at Lindab:

- pendulum hangers (in different sizes)
- threaded rods M8

For additional accessories please refer to the "Accessories" document on [www.lindab.com](http://www.lindab.com).

## Dimensioning

### Cooling capacity air $P_a$

1. Start by calculating the capacity required for the room, to keep a certain temperature. Lindab's TEKNOsim is an excellent tool for this.
2. Calculate which cooling capacity, or read in diagram 1, that is supplied by the ventilation air.
3. Remaining heat load needs to be cooled by the water circuit in Solus.

The formula for calculating the capacity of the air:

$$P_a = q_{ma} \times c_{pa} \times \Delta t_{ra}$$

Size comparison by  $t_r = 25^\circ\text{C}$  with:

$q_a$  = Primary air flow rate

$$P_a [\text{W}] = q_a [\text{l/s}] \times 1.2 \Delta t_{ra} [\text{K}] \text{ and}$$

$$P_a [\text{W}] = q_a [\text{m}^3/\text{h}] \times 0.33 \Delta t_{ra} [\text{K}]$$

### Minimum flows

Please note that flows below the recommended minimum flow, can result in unwanted air in the water pipes. Exceeding the nominal flows is not recommended as the capacity gains will only be minimal.

Pipe diameter	$q_{wmin}$	$q_{wnom}$
12 mm	0.025 l/s	0.038 l/s

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## Dimensioning

### Cooling capacity water $P_w$

Follow the instructions below to read off the effect from the diagram.

1. Calculate  $\Delta t_{rw}$ .
2. Product length  $L$  minus 0.2 m, to obtain the active length  $L_{act}$ .
3. Divide the primary air flow rate  $q_a$  by the active length  $L_{act}$ . Enter the result on the lower axis of diagram 2.
4. Follow the flow line to the right pressure, and then read off the specific cooling capacity  $P_{Lt}$  per active metre.
5. Calculate the temperature difference in water circuit  $\Delta t_w$  and find the capacity correction factor  $\epsilon_{\Delta t_w}$  in diagram 3.
6. Multiply the specific cooling capacity  $P_{Lt}$  that was read off by  $\epsilon_{\Delta t_w}$ ,  $\Delta t_{rw}$  and active length  $L_{act}$ .

### Definitions:

- $P_a$  = Cooling capacity air [W]
- $P_w$  = Cooling capacity water [W]
- $P_{tot}$  = Cooling capacity total [W]
- $q_{ma}$  = Air mass flow rate [kg/s]
- $q_a$  = Primary air flow rate [l/s]
- $q_w$  = Water flow rate [l/s]
- $q_{wmin}$  = Minimal water flow rate [l/s]
- $q_{wnom}$  = Nominal water flow rate [l/s]
- $c_{pa}$  = Specific heat capacity air [1.004 kJ/kg K]
- $t_r$  = Room air temperature [°C]
- $t_{wi}$  = Water inlet temperature [°C]
- $t_{wo}$  = Water outlet temperature [°C]
- $\Delta t_{ra}$  = Temp. diff., room air and primary air temp. [K]
- $\Delta t_{rw}$  = Temp. diff., room air and mean water temp. [K]
- $\Delta t_w$  = Temp. diff. water circuit [K]
- $\epsilon_{\Delta t_w}$  = Capacity correction for temperature
- $\epsilon_{q_w}$  = Capacity correction for water flow
- $P_{Lt}$  = Specific cooling capacity [W/(m K)]

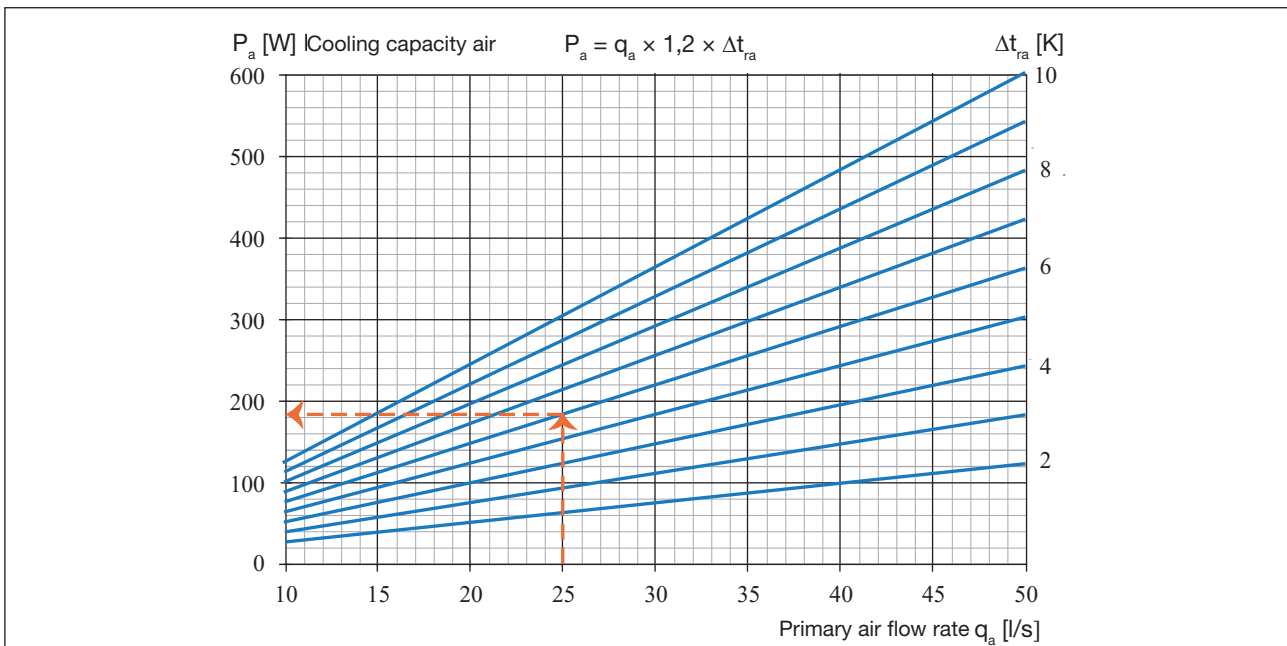


Diagram 1. Cooling capacity  $P_a$  as function of the air quantity  $q_a$ . If the air supply flow is 25 l/s and the temperature difference of the room air and the supply air is  $\Delta t_{ra} = 6$  K, then the cooling capacity in the chart is 180 W.

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## Example 1 Cooling:

### Summer

What is the cooling capacity of a 3.0 m Solus with 25 l/s and pressure of 100 Pa?

The room summer temperature is assumed to be  $t_r$  25.5°C. The cooling water temperature in/out of Solus is 20/23°C.

### Answer:

Temperature difference  $\Delta t_{rw} = t_r - (t_{wi} + t_{wo})/2$

$$\Delta t_{rw} = 25^\circ\text{C} - (20^\circ\text{C} + 23^\circ\text{C}) / 2 = 3.5 \text{ K}$$

Active length:  $L_{act} = 3.0 \text{ m} - 0.2 \text{ m} = 2.8 \text{ m}$

$$q_a / L_{act} = 25 \text{ l/s} / 2.8 \text{ m} = 9 \text{ l/s/m}$$

Read off, from diagram 2:  $P_{Lt} = 55 \text{ W/(m K)}$ .

Diagram 3 shows a capacity correction factor  $\epsilon_{\Delta tw}$ :

$$\Delta t_{rw} = t_{wi} - t_{wr} = 23^\circ\text{C} - 20^\circ\text{C} = 3\text{K}$$

$$\epsilon_{\Delta tw} = 0.968$$

Cooling capacity:

$$P_w = 55 \text{ W/(m K)} \times 0.968 \times 3.5 \text{ K} \times 2.8 \text{ m} = 522 \text{ W}$$

**NB!** The capacity diagram applies for the nominal water flow of  $q_{wnom} = 0.038 \text{ l/s}$ . To obtain the right cooling capacity  $P_w$  for other flows, read off the capacity correction factor  $\epsilon_{q_w}$  from diagram 4, and then multiply the calculated cooling capacity by this factor as shown in example 2 for heating.

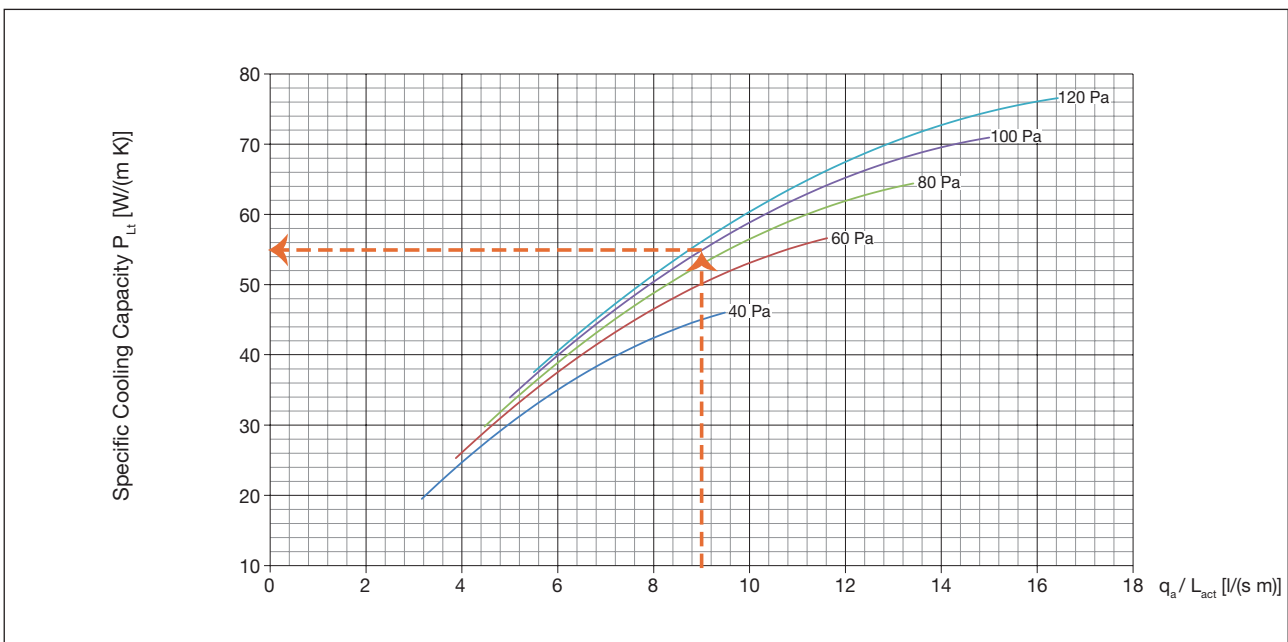


Diagram 2. Specific cooling capacity  $P_{Lt}$  as a function of primary air flow rate per active metre at nozzle pressures of 40, 60, 80, 100 and 120 Pa.

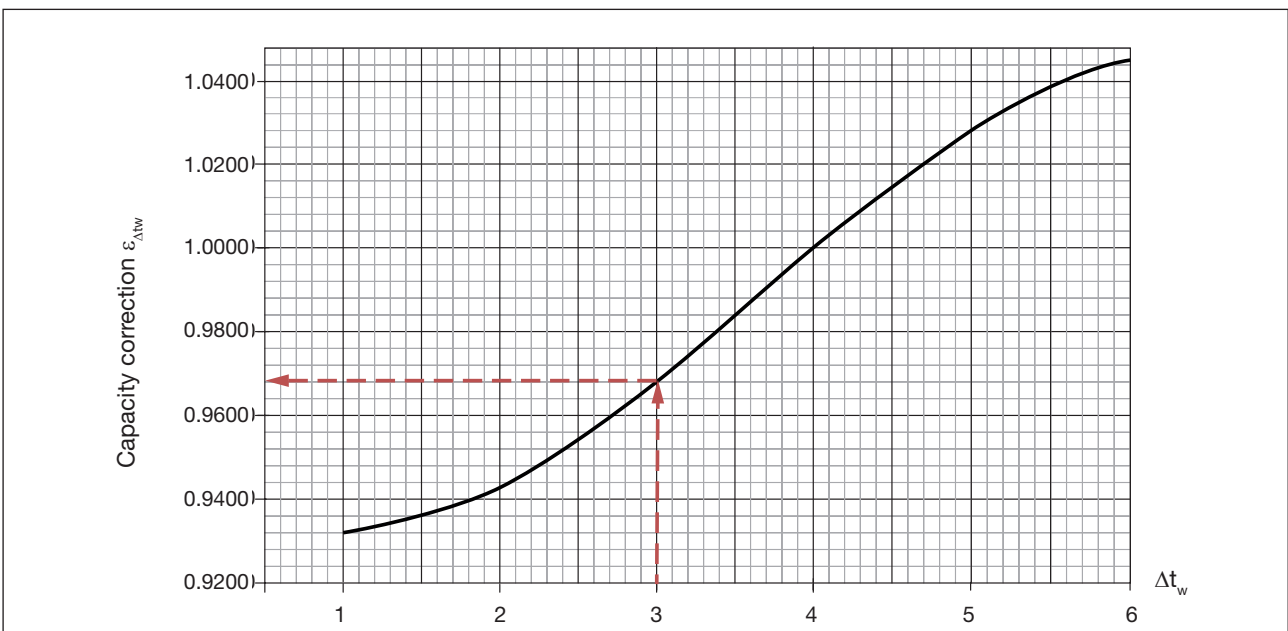


Diagram 3. Capacity correction  $\epsilon_{\Delta tw}$  as a function of  $\Delta t_w$ . Only applies for cooling.

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## Dimensioning

### Capacity correction for water flow $\epsilon_{qw}$

#### Example 2 Heating:

##### Winter

What is the heating capacity of a 3.0 m Solus with 25 l/s and pressure of 100 Pa ?

The room winter temperature is assumed to be  $t_r = 20^\circ\text{C}$ .  
The hot water temperature in/out of Solus is 23/21°C.

#### Answer:

Temperature difference:

$$\Delta t_{rw} = (t_{wi} + t_{wo}) / 2 - t_r$$

$$\Delta t_{rw} = (23^\circ\text{C} + 21^\circ\text{C}) / 2 - 20 = 2 \text{ K}$$

Active length:

$$L_{act} = 3.0 \text{ m} - 0.2 \text{ m} = 2.8 \text{ m}$$

$$q_a / L_{act} = 25 \text{ l/s} / 2.1 \text{ m} = 9 \text{ l/(s}\cdot\text{m)}$$

Read off, from diagram 2:  $P_{Lt} = 55 \text{ W/(m K)}$ .

$$\text{Water capacity: } P_w = 55 \text{ W/(m K)} \times 2 \text{ K} \times 2.8 \text{ m} = 308 \text{ W}$$

Use the calculated water capacity and calculate the

water flow:  $q_w = P_w / (c_{pw} \times \Delta t_w)$   
 $q_w = 308 \text{ W} / (4200 \text{ Ws/(kg K)} \times 3 \text{ K}) = 0.037 \text{ l/s}$

The capacity correction  $\epsilon_{qw}$  will then be 0.999 (see diagram 4) and the new capacity:

$$P_w = 308 \text{ W} \times 0.999 = 308 \text{ W}$$

Using the new heating capacity, a new water flow is calculated:

$$q_w = 308 \text{ W} / (4200 \text{ Ws/(kg K)} \times 2 \text{ K}) = 0.037 \text{ l/s}$$

Seeing that the flow is near stabile at this point in the calculation, the heating capacity is calculated to be 308 W.

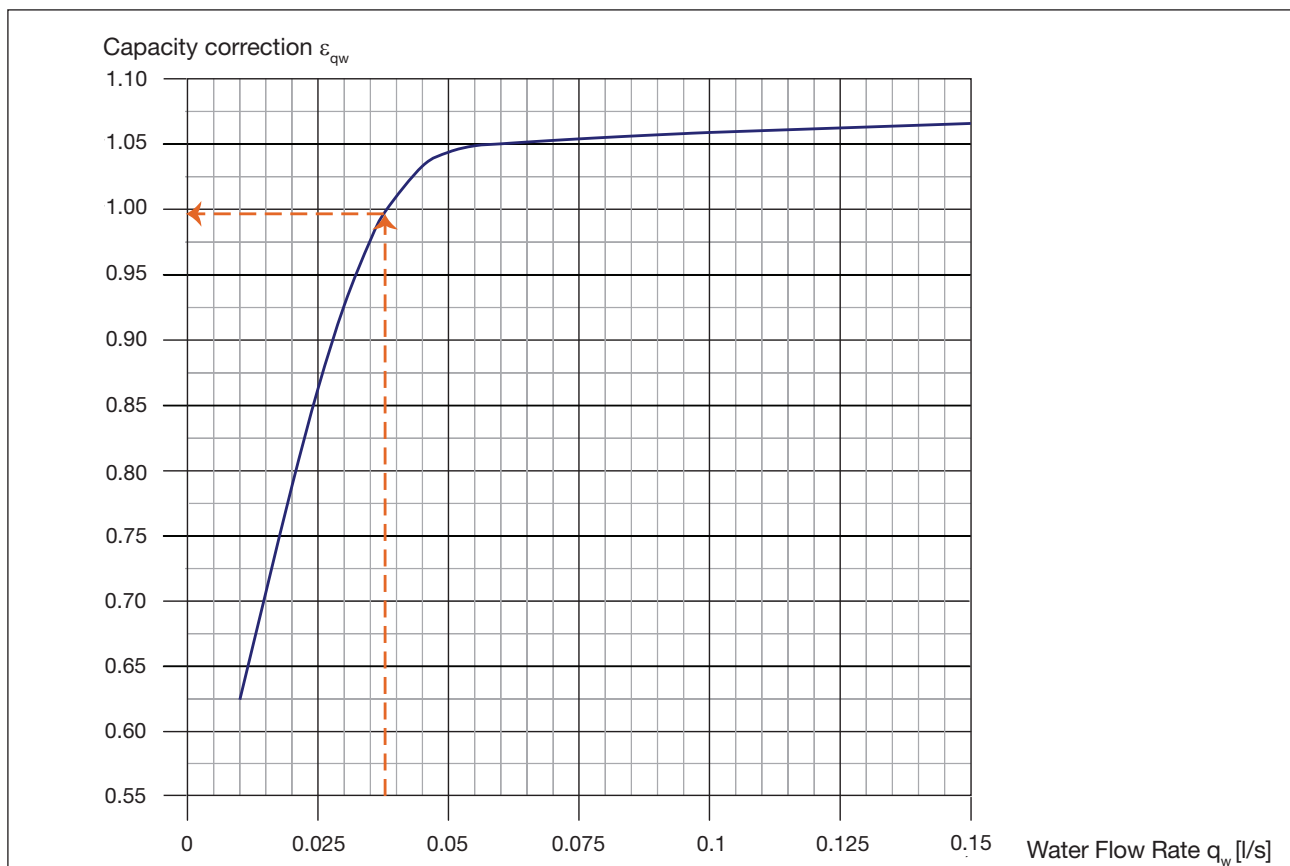


Diagram 4. Capacity correction  $\epsilon_{qw}$  for water flow.



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## Pressure drop in water circuit

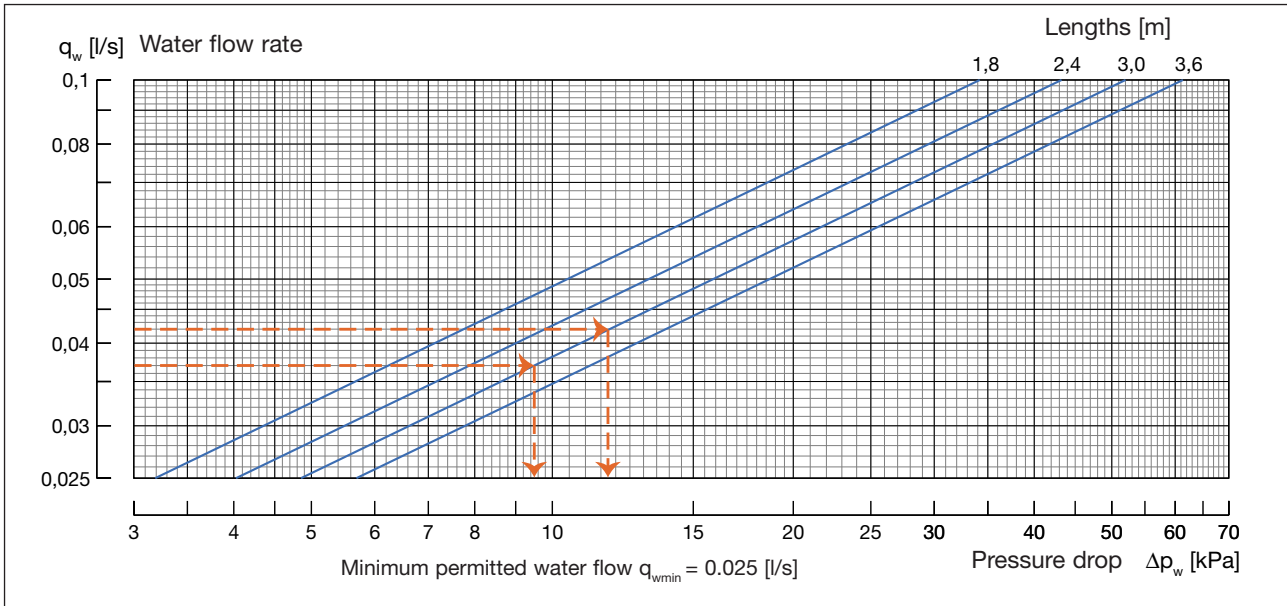


Diagram 5. Pressure drop  $\Delta p_w$  in water circuit at 20°C.

### Example 3 Cooling:

Solus 3.0 m, which provides on output of 531 W.

$$\Delta t_w = 3 \text{ K}$$

$$q_w = P_w / (c_{pw} \times \Delta t_w)$$

$$q_w = 531 \text{ W} / (4200 \text{ Ws}/(\text{kg K}) \times 3 \text{ K}) = 0.042 \text{ l/s}$$

The pressure drop in the water is read off as  $\Delta p_w = 11.4 \text{ kPa}$ .

### Example 4 Heating:

Solus 3.0 m, which provides on output of 308 W.

$$\Delta t_w = 2 \text{ K}$$

$$q_w = P_w / (c_{pw} \times \Delta t_w)$$

$$q_w = 308 \text{ W} / (4200 \text{ Ws}/(\text{kg K}) \times 2 \text{ K}) = 0.037 \text{ l/s}$$

The pressure drop in the water is read off as  $\Delta p_w = 9.5 \text{ kPa}$ .

### Definitions:

$q_w$  = Water flow rate [l/s]

$P_w$  = Cooling capacity water [W]

$c_{pw}$  = Specific heat capacity water [4200 Ws/(kg K)]

$\Delta t_w$  = Temperature difference water circuit [K]

$t_{wio}$  = Mean water temperature [°C]

$\Delta p_w$  = Pressure loss water circuit [kPa]

\* Diagram 5 is for a certain mean water temperature  $t_{wio}$ . for other temperatures please do your calculations in our waterborne calculator in [www.lindQST.com](http://www.lindQST.com)!

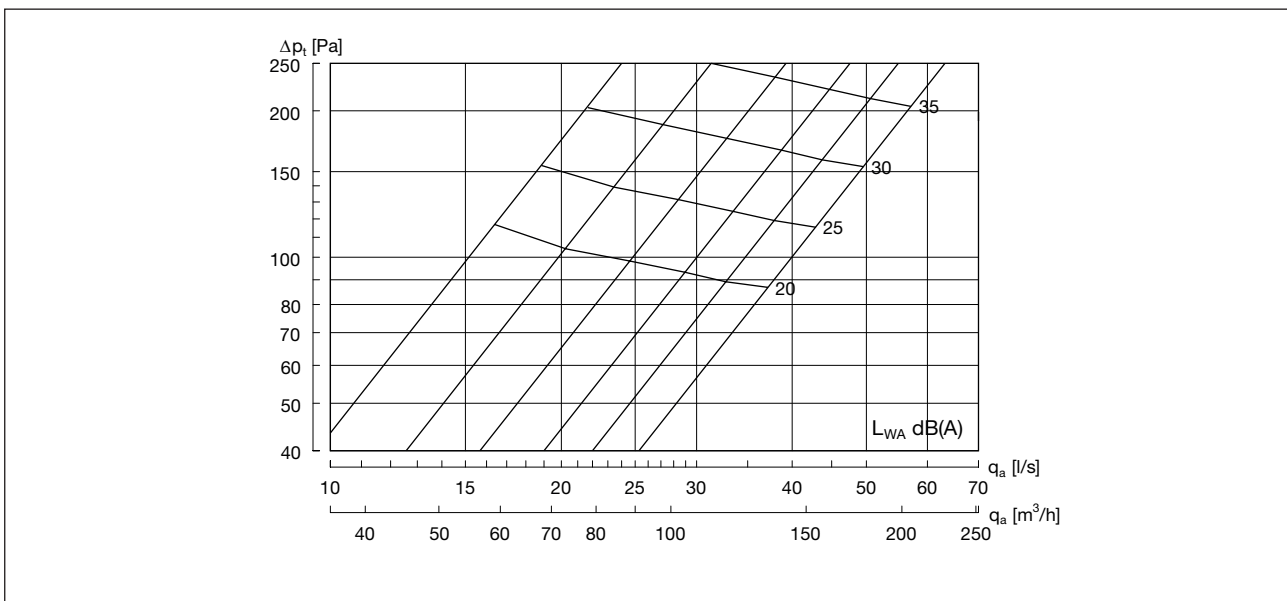


Diagram 6. Sound power level at different flows and pressures.

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## Dimensioning

### Pressure drop in air connection

Table 1 shows the pressure drop in the connection. After calculating the necessary pressure for the active chilled beam, add the connection pressure drop to the selected static pressure in the nozzles.

### Example 5:

Solus I-60-15-125-A1-3.0 with 25 l/s and static nozzle pressure of 100 Pa. This provides the necessary total pressure in the duct of 100 Pa + 1 Pa = 101 Pa.

Pressure drop $\Delta p_a$ in air connection							
Air flow (l/s)	20	25	30	40	50	60	70
Pressure drop (Pa)	0	1	1	1	2	3	4

Table 1. Air pressure drop in the connection to Solus I-60.

## Sound data

Internal sound dampening $\Delta L$								
Hz	63	125	250	500	1000	2000	4000	8000
dB	17	12	5	3	5	8	8	14

Table 2. Solus's internal sound dampening. Measured with a 3.0 m Solus beam, 25 l/s, 100 Pa.

## Noise level $L_{w_{oct}}$

For calculation of the noise level.

Correction $C_{oct}$ (dB) Octave band, average frequency (Hz) – Solus								
Hz	63	125	250	500	1000	2000	4000	8000
dB	13	-2	-1	0	-2	-6	-15	-17

Table 3. Solus's noise levels  $L_{w_{oct}}$  for each octave band in the beam, are calculated by adding the corrections  $C_{oct}$  from the table above to the sound power level  $L_{wa}$  dB(A). The noise levels are calculated using the following formula:

$$L_{w_{oct}} = L_{wa} + C_{oct}$$

## Weight and water volume

Type	Solus
Dry weight, kg/m	18
Water content, l/m	0.9
Copper pipes, quality	EN 12735-2 CU-DHP
Pressure class	PN10

Table 4. Solus's weight and water volume.

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## Water connections

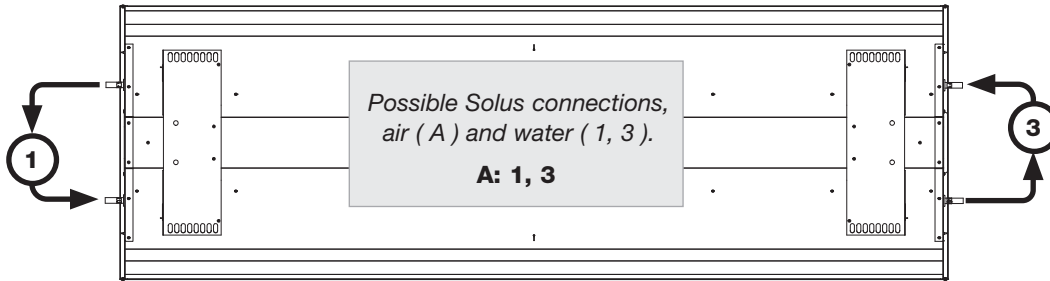
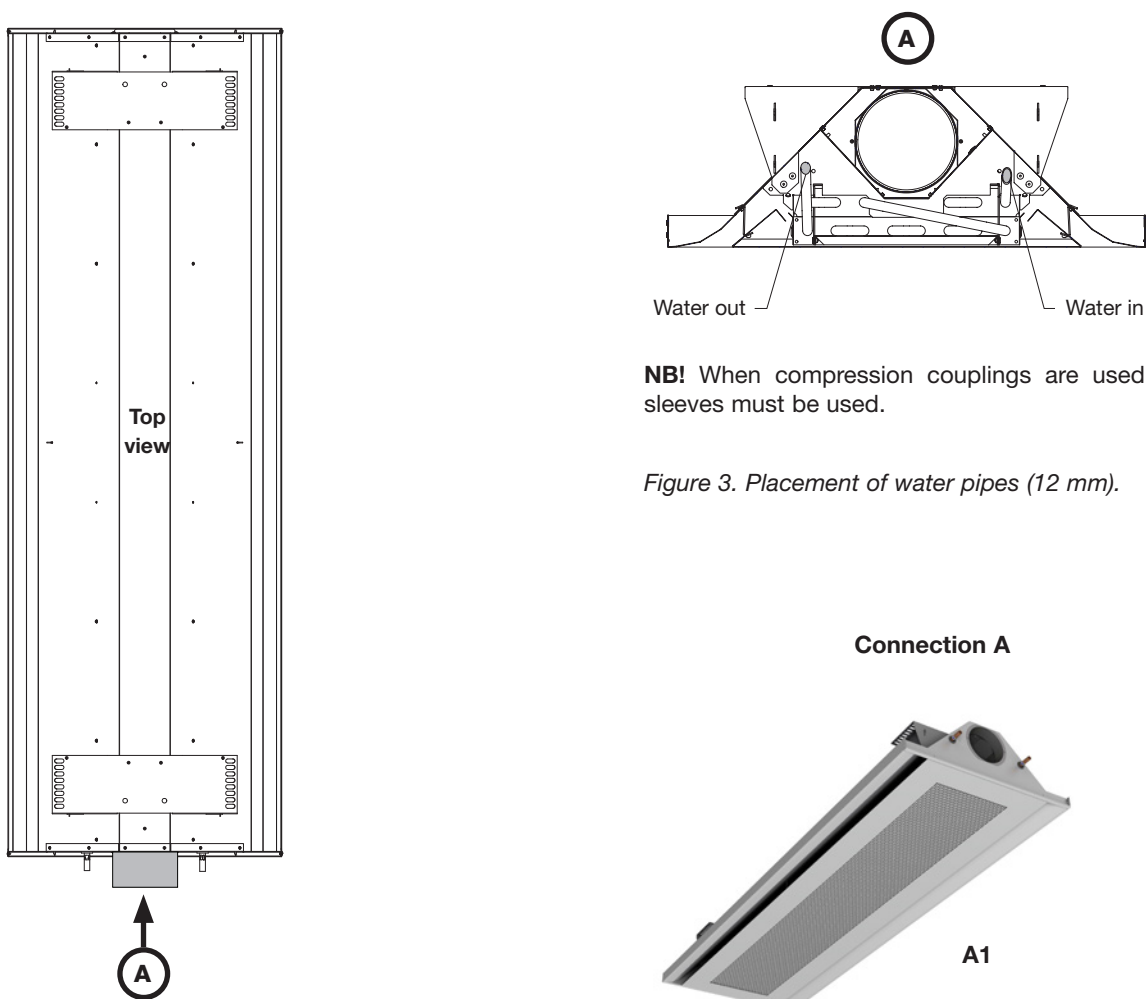


Figure 1. Possible connections, water.

## Ventilation connections



**NB!** When compression couplings are used, support sleeves must be used.

Figure 3. Placement of water pipes (12 mm).

Figure 2. For A connection, Solus is delivered with Lindab's standard nipple (NPU-125).

Figure 4. Connection example.

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## Dimensions

Examples below show Solus I-60 model with A air connection.

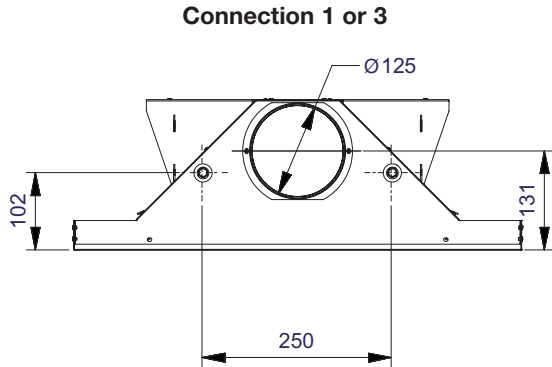
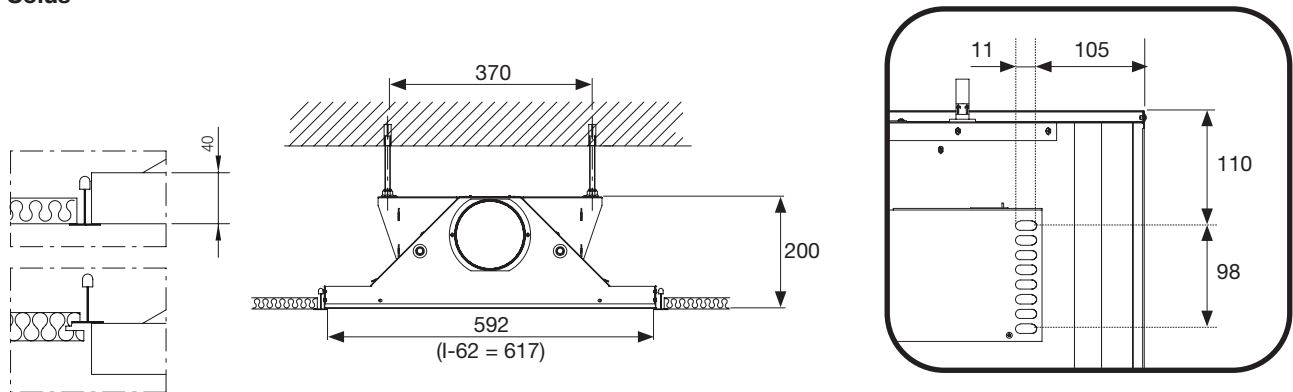


Figure 5. Solus I-60-A with possible water connections.

## Suspension

### Solus



I-60: L = 1800, 2400, 3000, 3600 mm; A = 1792, 2392, 2992, 3592 mm.  
 I-62: L = 1800, 2400, 3000, 3600 mm; A = 1867, 2492, 3117, 3742 mm.  
 L = Nominal length (order length).

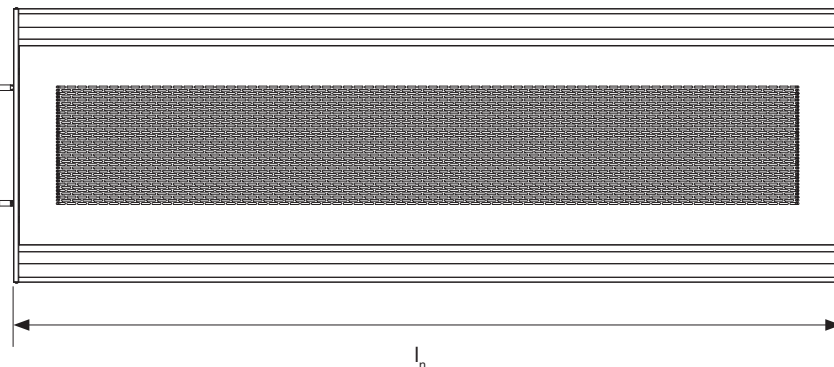


Figure 6. Solus I-60 suspension, dimensions. Suspension components are not supplied as part of the standard package.

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## Air patterns, Solus

The Solus Beam guarantees a good Coanda effect and a fan-shaped air pattern in all cases. The fan-shaped air pattern ensures air velocities in the living area that are half those obtained with a linear air pattern.

The measurements shown below were made with a cooled supply air ( $\Delta t$  room air – supply air) of 5°C and cooling in the water circuit ( $\Delta t$  – room air – average water temperature) of 3.5°C.

[www.lindQST.com/waterborne/calculator/default.aspx](http://www.lindQST.com/waterborne/calculator/default.aspx)

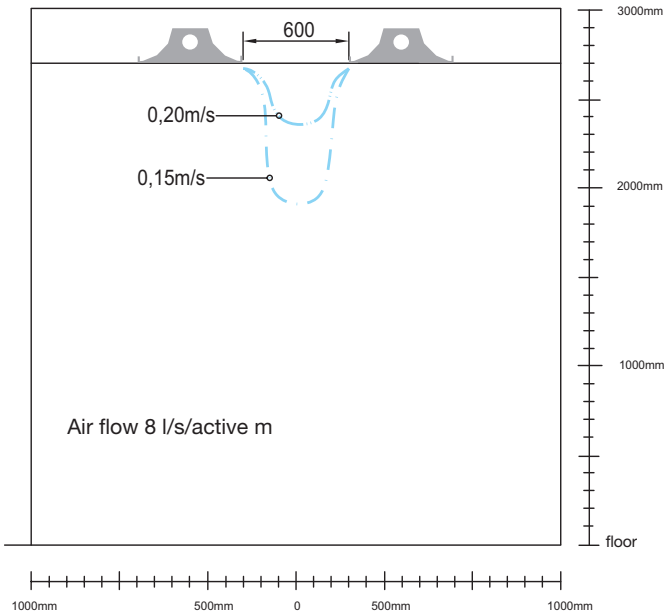


Figure 7.

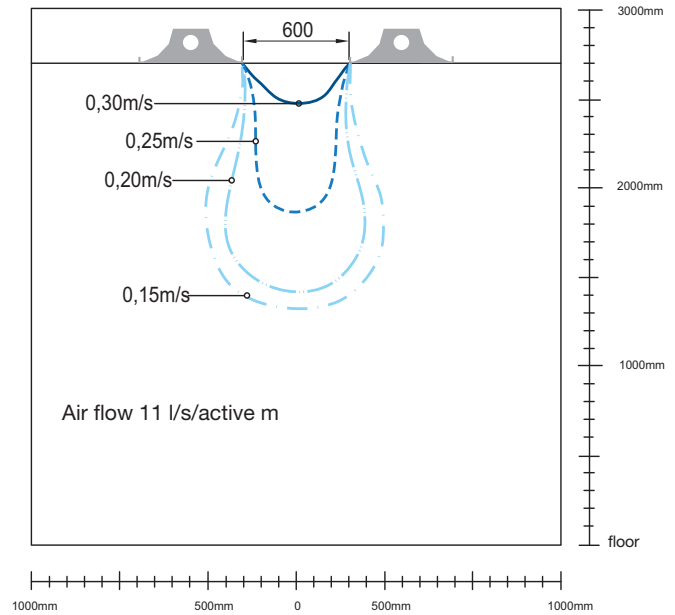


Figure 8.

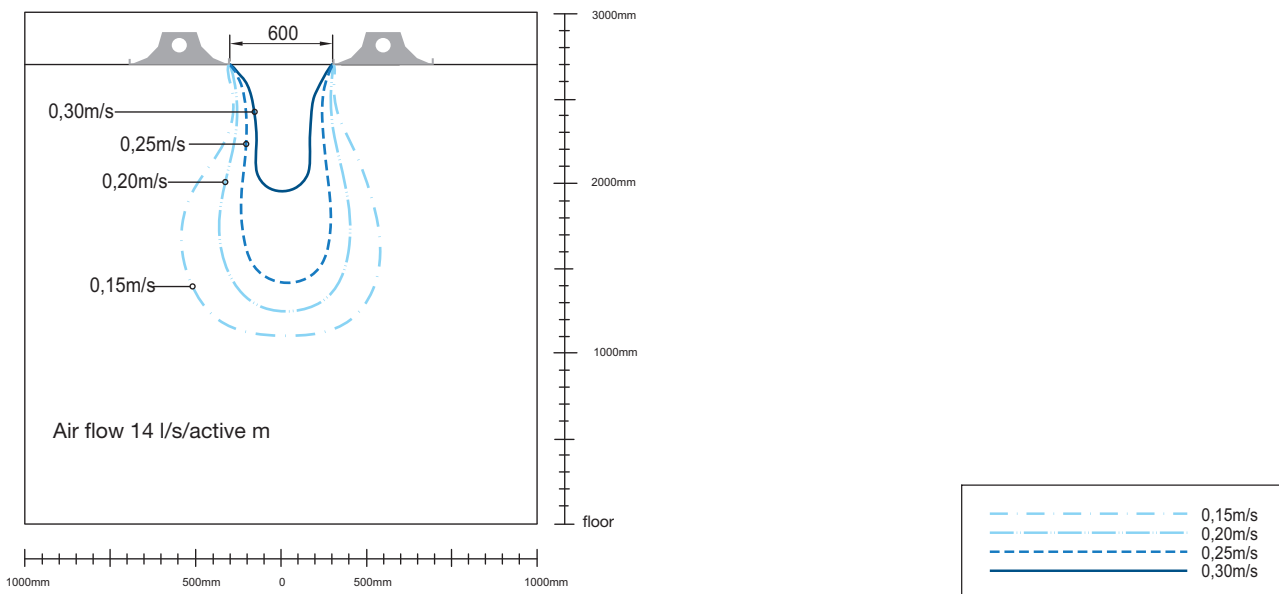


Figure 9.

Figure 7-9. Air velocities between active chilled beams at a separation of 600 mm. Nozzle pressure of 100 Pa.



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## LindQST - just a click away

The Lindab Quick Selection Tool, [LindQST®](#), is a very fast, easy-to-use and flexible online tool for your daily work.

[Calculate the Solus here](#)



Picture 4. LindQST - Indoor Climate Designer.

LindQST® helps you select the right waterborne products, e.g. active chilled beams, passive radiant chilled beams, radiant cooling- and heating panels and facade units and quickly finds the corresponding documentation.

In *Waterborne Documentation* you can easily find all available product documentation. Always in the latest version.

In *Waterborne Calculator* you can do a professional calculation based on your specific input data to finetune your choice or calculate different variants of the product. Smart warnings point out if a set-up will not work.

In *Waterborne Selector* you can compare the proposed products according to your specific requirements and select the one which fits best to your needs.

Not enough? With *Indoor Climate Designer* you can insert your selected waterborne product into your room and simulate the actual air distribution, optimize the placing in the ceiling taking into account the calculated air velocities and sound levels.

You can at anytime display your selection and calculations graphically. In addition, you can print or save all results and related documents for your documentation (incl. data sheets, dxf-files and room books).

With LindQST® you will easily find the most suitable product for your project.

It provides an easy and quick access to the latest product information, technical specifications and assembly instructions on the Internet, making it the ideal tool installers, consultants and architects alike.

[www.LindQST.com](http://www.LindQST.com)

- Fast product selection waterborne products in accordance to Eurovent (chilled beams and facade units).
- Easy access to all current documentation.
- Fast design of waterborne products.
- Indoor Climate Designer: Graphical representation of the spatial situation in 2D / 3D and floor plans from AutoCAD®.
- Calculation of capacities, sound power levels, pressure losses and flow conditions.
- 3D particles or smoke show the air distribution in the room.
- Diagram showing the time course of the CO<sub>2</sub> concentration in the room.
- Room book generation and data sheet for individual rooms and outlets or entire projects.
- Project can be saved and exchanged in its own project area.



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## Dimensioning air velocities

### Air distribution patterns

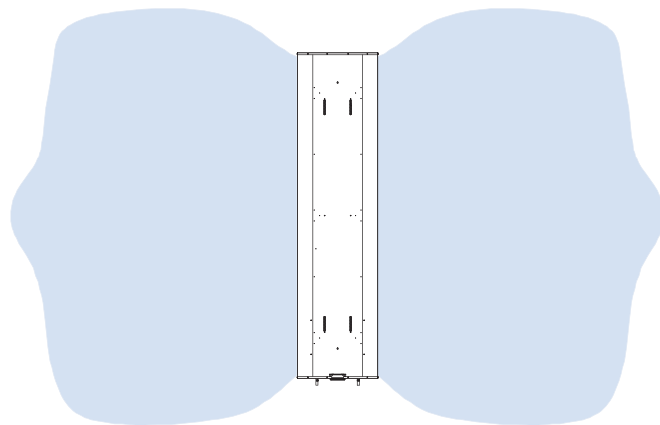
Solus and other induction beams utilise the pressure of the supply air to cause the room air to circulate through the cooling battery. This enables a high cooling capacity, but also creates significant air movements, which often result in long throw lengths. This is why Solus is supplied as default with a short air distribution that is angled outwards (30° angel nozzles). It significantly reduces both airtrow lengths and air velocities compared to the conventional linear nozzle technology.

Depending on the room conditions, Solus is available also with a medium (16°) or a long (0°) distribution profile. Below is an example of how the different distribution profiles affect the airtrow length.

**NB!** This is a principle only for visualizing the possible air distribution profile. To calculate the beam with your specific settings, please refer to the [waterborne calculator](#) or the [indoor climate designer](#) in [www.lindQST.com](http://www.lindQST.com).

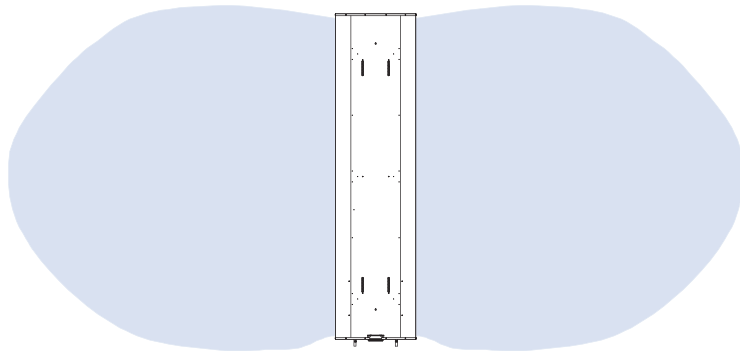
### Short air distribution

Solus is supplied as standard with a short air distribution that is angled outwards (30° divergent nozzles).



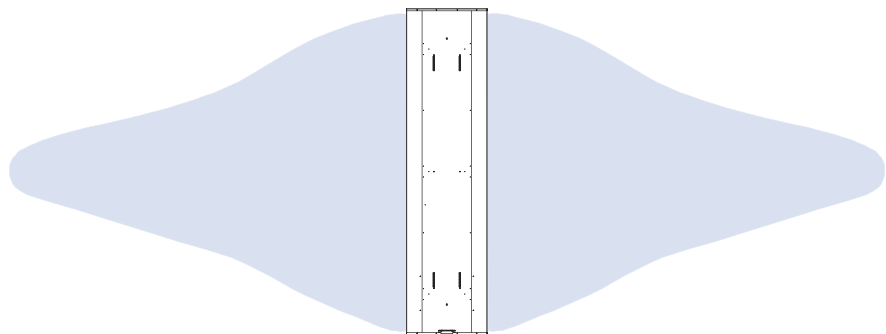
### Medium air distribution

The medium air distribution pattern (16°) provides an airtrow in between the long and the short air distribution pattern.



### Long air distribution

The long air distribution pattern (0°) is used when a long airtrow is needed. e. g. when the beam is placed centrally with long distances to the walls or several beams are installed in one line, to avoid overlapping air distribution pattern which will result in even longer airtrows.



Picture 8. Air distribution patterns.

# Active chilled beam

# Solus

## Designations

<b>Product/Version:</b>	Solus I
<b>Type:</b>	60, 62
<b>Connection diam. water, [mm]:</b>	12
<b>Connection diam. air, [mm]:</b>	125
<b>Coupling options:</b>	A
<b>Water:</b>	1, 3
<b>Length, [m]:</b>	1.8 m, 2.4 m, 3.0 m and 3.6 m

## Programme text

Active chilled beam designed for high temperature cooling and low temperature heating. Water and air connections must be accessible from below.

### Active chilled beams from Lindab Qty

<b>Product:</b>	Solus I-60-12-125-A3-1.8 m	40
Air quantity:		25 l/s
Nozzle pressure:		100 P <sub>a</sub>

## Order code

Product	Solus	I-60	12	125	A1	1.8	100	25
Type:								
I-60								
I-62								
I = Integrated, lay-in								
Water connection:								
12 mm								
Air connection:								
Ø125 mm								
Connection type:								
A1, A3								
Product length:								
1.8 m, 2.4 m, 3.0 m and 3.6 m								
Static nozzle pressure (Pa):								
Air volume (l/s):								



Most of us spend the majority of our time indoors. Indoor climate is crucial to how we feel, how productive we are and if we stay healthy.

We at Lindab have therefore made it our most important objective to contribute to an indoor climate that improves people's lives. We do this by developing energy-efficient ventilation solutions and durable building products. We also aim to contribute to a better climate for our planet by working in a way that is sustainable for both people and the environment.

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