4. Sizing, introduction

The flow pattern for the inlet air into the room is influenced by the cooling capacity per running meter along with the outlet velocity through the textile. The outlet velocity through the textile can be described as a linear function between the airflow and the surface area of the textile duct.

Depending on the temperature difference between inlet air and room air, the air velocity in the main area increases by a factor of two to three times the initial outlet velocity, as the denser inlet air accelerates downwards. For this reason it is important to observe the outlet velocity through the textile when sizing a system, as you can end up with velocities in the occupied zone 3 times higher than the initial velocity through the textile!

When the inlet air reaches the floor, it will spread out evenly over the floor area, and will at some point meet with a source of thermal load (typically persons, computers, production machinery, etc). The thermal load means that there will be an impulse in an upward direction, directly over the heat source. This motion causes the following string of events: the upward moving airflow will induce some of the static air at floor level. The colder inlet air (now at floor level) will flow in the direction of this area, to replace the air that was induced upwards. This cycle will continue as long as the thermal load is present and inlet air is being supplied.

It can be difficult to give an exact estimate of the velocities occurring in the occupied zone, as there are many outside variables also playing a part in the equation. However, the diagram “characteristic flow diagram” on chart 1 will give a very good estimate of velocities in the occupied zone, based on calculations done, and years of field experience.

If you turn to Chart 2, you will find a simplified graphic showing the typical air patterns that can be expected at various differential temperatures.

Explanation, Chart 2, Picture 1
For isotherm inlet through a textile outlet, the flow direction can not be determined. The inlet air follows the movements of the ambient air, as it itself has no other impulse imparted upon it than the one provided from the surrounding air.

Explanation, Chart 2, Picture 2
When the inlet air is introduced to the room at a differential temperature of < - 3°K compared to the room temperature, or represents a cooling capacity of <350 Watt/linear meter, the inlet air will only experience a very short throw, before it deflects downwards, due to its higher density. At an outlet velocity through the textile of <0,1 m/s, no changes in the level of comfort in the occupied zone is noticeable, i.e. draught will not be experienced.

Explanation, Chart 2, Picture 3
When the inlet air is introduced to the room at a differential temperature of < - 5K compared to the room temperature, or represents a cooling capacity of <500 Watt/linear meter, the inlet air will experience almost no throw, immediately deflecting downwards. The higher the cooling capacity per linear meter, the higher velocities will occur. These relatively high velocities can cause the airflow pattern to take the shape of a column, directly under the textile outlets. It is worth noticing that the comfort level under a textile outlet is proportionately decreasing with an increase in cooling capacity. Where comfort levels are not a major issue, very large cooling loads can be introduced to a room without causing turbulence.

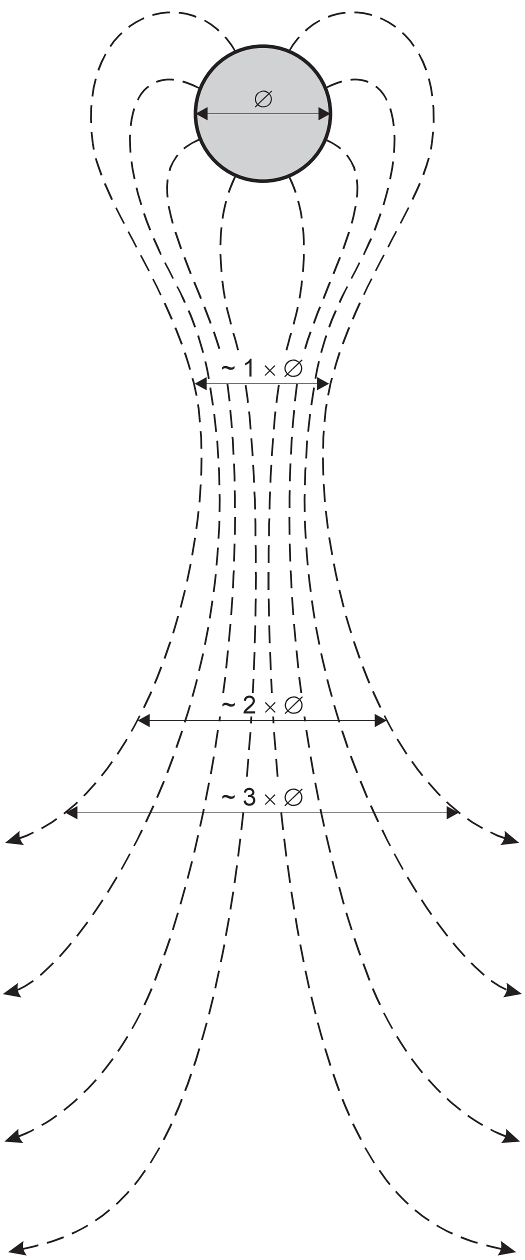
Explanation, Chart 2, Picture 4
The standard diffuse type outlet is not recommend for supplying heated inlet air. Picture 4 shows the airflow pattern that will occur with a differential temperature > + 2°K compared to the room temperature. In this case the air will immediately deflect upwards, merely heating the ceiling area. For introducing heated inlet air, please turn to chapters 2.2-2.5.

Sizing, Chart 1

Characteristic flow pattern

The illustration below depicts the typical air movement found directly under a Euro Air textile outlet. The air velocity under the outlet, as well as the flow patterm is highly dependant upon the chosen room catagory, i.e the inlet air temperature, and the cooling capacity per running meter of outlet.

$$v_B = v_{QA} \times F \quad [\,m/s\,]$$

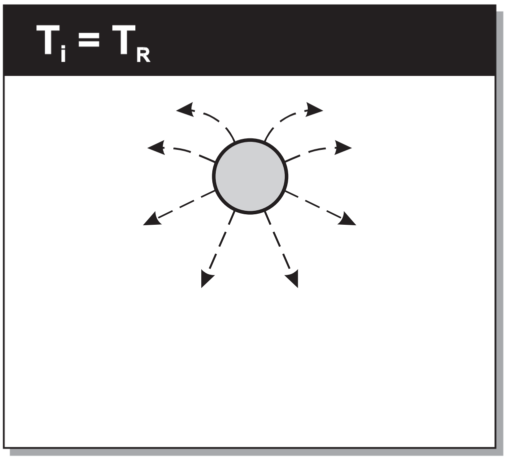


Height	Area	Air velocity factor F Room type I	II	III
~ 0,5 × ∅ 1 × ∅ ~ 1,5 × ∅	Displacement area	1 to 1,25	1 to 1,5	1 to 2
~ 2,5 × ∅	Main area	1,25 to 1,5	1,5 to 2,5	2 to 4
~ 4 × ∅	Occupied area	1,5 to 2	2,5 to 3	>4

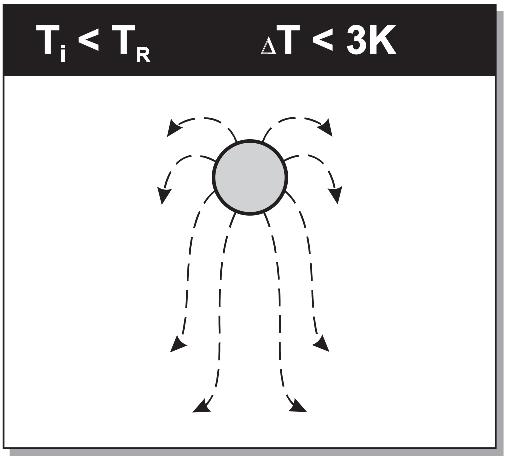
v_B = Flow velocity in the occupied area
v_{QA} = Velocity out of textile
F = Air velocity factor

Sizing, chart 2

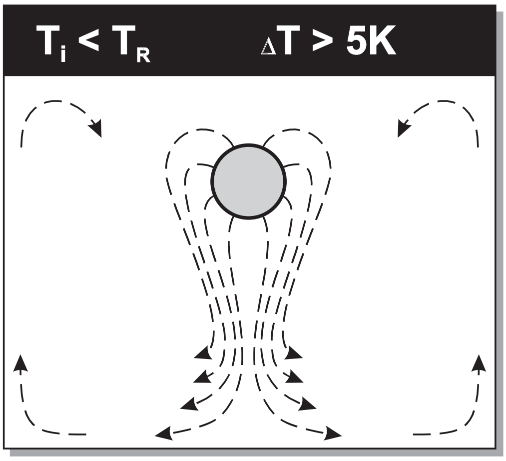
Airflow patterns, diffuse round outlets



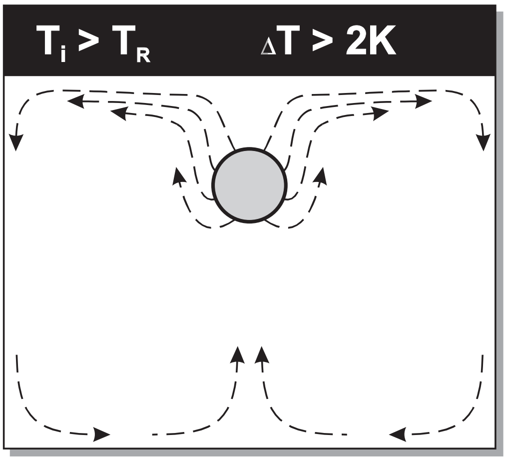
Picture 1



Picture 2



Picture 3



Picture 4

T_i = Temperature inlet
T_R = Temperature room