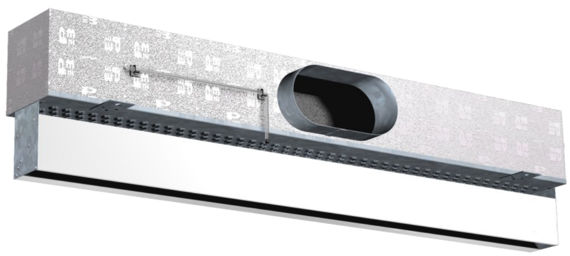
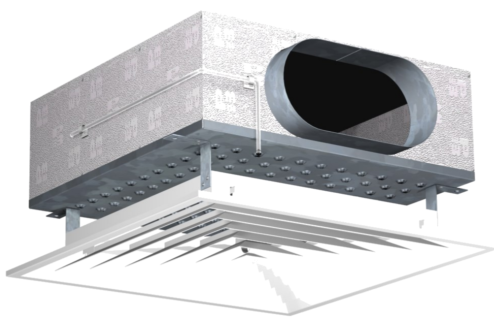
DADANCO

Breathing Life Into Your Building



IDL20e
(2 — way discharge)



IDS60e
(4 — way discharge)

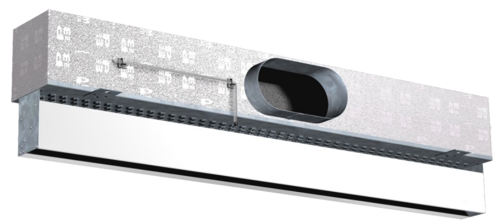
UDI
(vertical discharge)

Inffusers

Frequently Asked Questions

INFFUSER® FREQUENTLY ASKED QUESTIONS

The following are frequently asked questions (FAQ's) on DADANCO Inffusers. To assist you in finding an answer to your question, the FAQ's have been put into the following groupings:



1. Introduction to DADANCO Inffusers
2. Comparing Systems using Inffusers and other Alternatives
3. Heating
4. Commissioning

To gain the most benefit from the FAQ's, please take the time to read them all. This will provide a far better understanding of Inffuser performance. If you have a question that is not covered here, please feel free to contact us at (413) 564 - 5657.

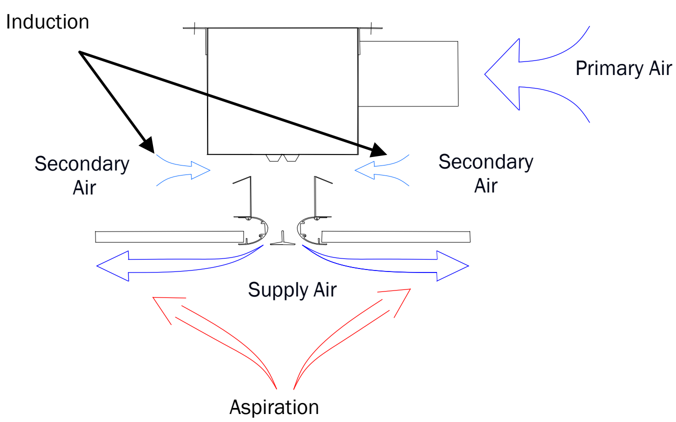
1. INTRODUCTION TO DADANCO INFFUSERS

1.1 What is an Inffuser?

An Inffuser is an induction diffuser that delivers an increased quantity of tempered supply air by inducing secondary room air into the primary air before discharging the mixed supply air through the air outlet to the conditioned space.

The air supplied by the central air handler to the Inffuser is called **primary air**. The primary air is supplied to the Inffuser at a relatively low static pressure (typically 0.1- 0.3" w.c.).

Within the Inffuser the primary air is discharged from the primary air plenum into a mixing chamber through a series of nozzles. A zone of relative low pressure is created within the mixing area, thereby inducing room air (either directly from the room or from the return air ceiling plenum) into the mixing area. The induced room air is called **secondary air**. The secondary air mixes with the primary air, and the mixed **supply air** is delivered to the room through a conventional diffuser outlet. A certain additional amount of room air is aspirated into the supply air at the unit discharge.



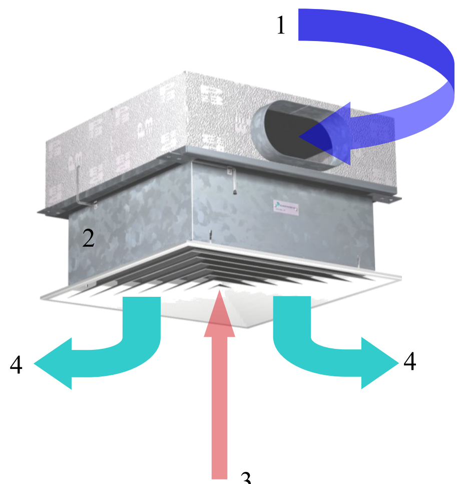
1.2 What is the entrainment ratio?

Entrainment ratio is the ratio of secondary (induced) air volume to primary air volume. This ratio is typically in the order of 1.0 to more than 2.0 for the Inffuser induction diffusers. When used in VAV systems, the induction ratio remains constant as the VAV unit modulates.

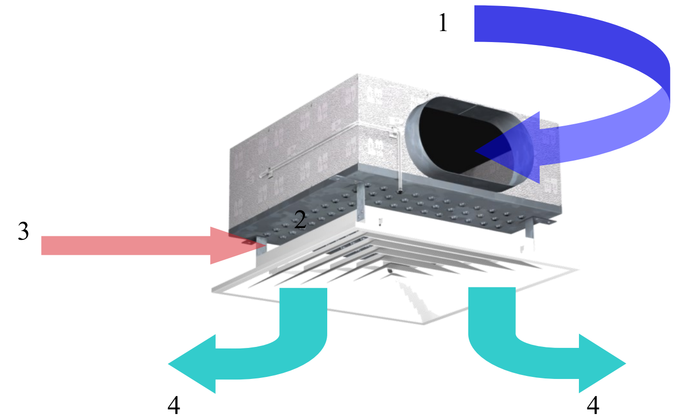
1.3 What is the difference between internal and external entrainment?

Inffusers can induce the room air either directly from the room through a portion of the diffuser grille assembly (internal entrainment) or indirectly from the ceiling return air plenum (external entrainment).

Internal Entrainment



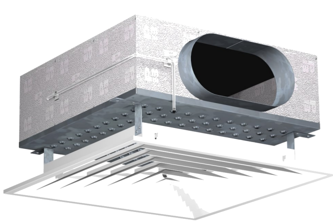
External Entraiment



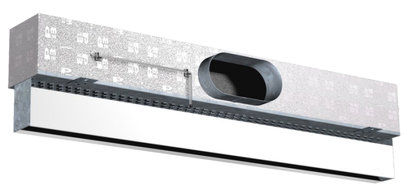
1. Primary Air
2. Mixing Chamber
3. Secondary Air
4. Supply Air

1.4 What types of Inffuser models are available?

Many models are available. A sampling of standard model types available include:



Square 1, 2, 3 or 4-way discharge
2 x 2 Foot



Linear slot 1 or 2-way discharge
4 Foot or continuous slot

Under-floor vertical discharge
To match the floor tile sizes

As Inffusers use conventional diffusers for the discharge outlet, almost any diffuser can be incorporated into an Inffuser design.

1.5 What are common applications of Inffuser induction diffusers?

Any air distribution system where an increase in the quantity of supply air delivered to the room at a more temperate temperature is of benefit is a candidate for Inffusers. The Inffuser makes effective use of the ability of the induction nozzles to entrain air from the occupied space, either directly from the room (internal entrainment) or from the return air ceiling plenum (external entrainment) to increase the total supply air delivered to the occupied space.

The Inffuser induction diffusers also enable the use of lower primary air temperatures and thereby lower primary air quantities for a given sensible cooling load. The use of 45-50 °F primary air can reduce the primary airflows by 20-30% as compared to conventional system designs without concerns over cold drafts/dumping, particularly a concern in variable air volume systems at low load, high turndown conditions. The primary air is mixed with the secondary room air and the mixed supply air is discharged into the room at temperatures about 60-65 °F.

With lower primary air temperatures humidity control is much improved through the higher latent cooling capacities, particularly beneficial in variable air volume systems at low sensible load conditions. Air buoyancy is improved in the cooling mode resulting in improved air outlet performance. Also the risk of stratification when in the heating mode is also reduced through the more temperate discharge temperatures.

Inffusers are ideal for buildings and zones with low-medium sensible cooling and heating load densities. Common applications include offices, universities, hospitals, schools and libraries for both new construction and existing building renovations. Buildings most affected by space constraints where the reduction in the size of the central air handlers and ductwork system serving the terminal units can greatly simplify and facilitate the installation are also ideal candidates.

Finally due to the energy savings possible with Inffusers when used in low temperature systems, probably the most common application is in those buildings that are striving to achieve LEED certification (as developed and administered by the US Green Building Council).

Type	Application	Solution
Existing Building	Improve the energy performance of an existing VAV or CAV system.	Replace the existing diffusers with Inffusers. Reduce the primary airflow rate and corresponding temperature leaving the cooling coil to maintain the cooling capacity required. Fan power consumption decreases by the cube of the reduction in primary air flow.
	Air distribution/movement of the existing system is inadequate and existing ductwork sizes are not large enough to permit supply airquantities to be increased.	Retain the existing ductwork and use Inffusers to increase the supply air quantity and air movement being delivered to the conditioned space.
	Cooling capacity of the existing system is inadequate and existing ductwork sizes are not large enough to permit supply air quantities to be increased.	Retain the existing ductwork and reduce the primary air temperature for increased cooling capacity using Inffusers to temper the air being delivery to the conditioned space.
	Replacement of fan-powered VAV units to eliminate fan energy and VAV terminal maintenance considerations.	Replace the existing VAV terminals with single duct VAV terminals, retaining the existing ductwork, and replace existing diffusers with Inffusers to increase the supply air being delivered to the conditioned space.
New Building	Displacement system designs requiring higher supply air temperatures where space for primary air ductwork infrastructure is limited.	Design the system for lower primary air temperatures and air quantities using Inffusers to deliver higher supply air temperatures and air circulation rates to the space.
	LEED certified designs where lower temperature primary air delivers benefits in fan energy savings and reduced system infrastructure.	Design the system for lower primary air temperatures and air quantities using Inffusers to deliver higher air circulation rates to the space.
	Where internal zone loads are very low (less than 10—15 BTUH/sq. ft. and good air circulation and good humidity control is required.	Design the system with medium temperature (50-55°F) primary air and flow rate of approximately 0.6 cfm/sq. ft. The INFFUSER can increase the air circulation rate in the space to over 1.2 cfm/sq. ft.

2. COMPARING SYSTEMS USING INFFUSERS AND OTHER ALTERNATIVES

2.1 Isn't an Inffuser similar to a "high aspiration" or "swirl" diffuser?

No. The induction process is significantly different from the aspiration of room air at the diffuser discharge which occurs to a varying extent with all types of diffusers. The amount of air being induced by the Inffuser can be closely controlled and measured by varying the number and size of nozzles within the unit. With the Inffuser the mixing of the primary and room air occurs within the unit before the mixed tempered supply air is discharged into the room. The aspiration process relies on mixing the supply and room air within the room, in essence using the room as a mixing chamber.

2.2 Are the fan operating pressures comparable in systems using Inffusers with those using conventional diffusers ?

The fan operating pressures are about the same or slightly higher. Inffusers are typically selected at 0.1 — 0.3" w.c. inlet static pressure.

2.3 Are Inffusers only applicable to systems using low temperature primary air or variable air volume ?

No. Inffusers are suitable for use in any air distribution system where increased air movement and tempered primary air temperatures would be of benefit.

2.4 Are Inffusers quieter than typical diffusers?

Inffuser noise levels are typically comparable to or lower than conventional diffusers. The DADANCO Inffusers have an added advantage with respect to noise levels through the use of the patented multi-lobed DADANCO nozzles.

2.5 How does the use of low temperature primary air compare with conventional system designs?

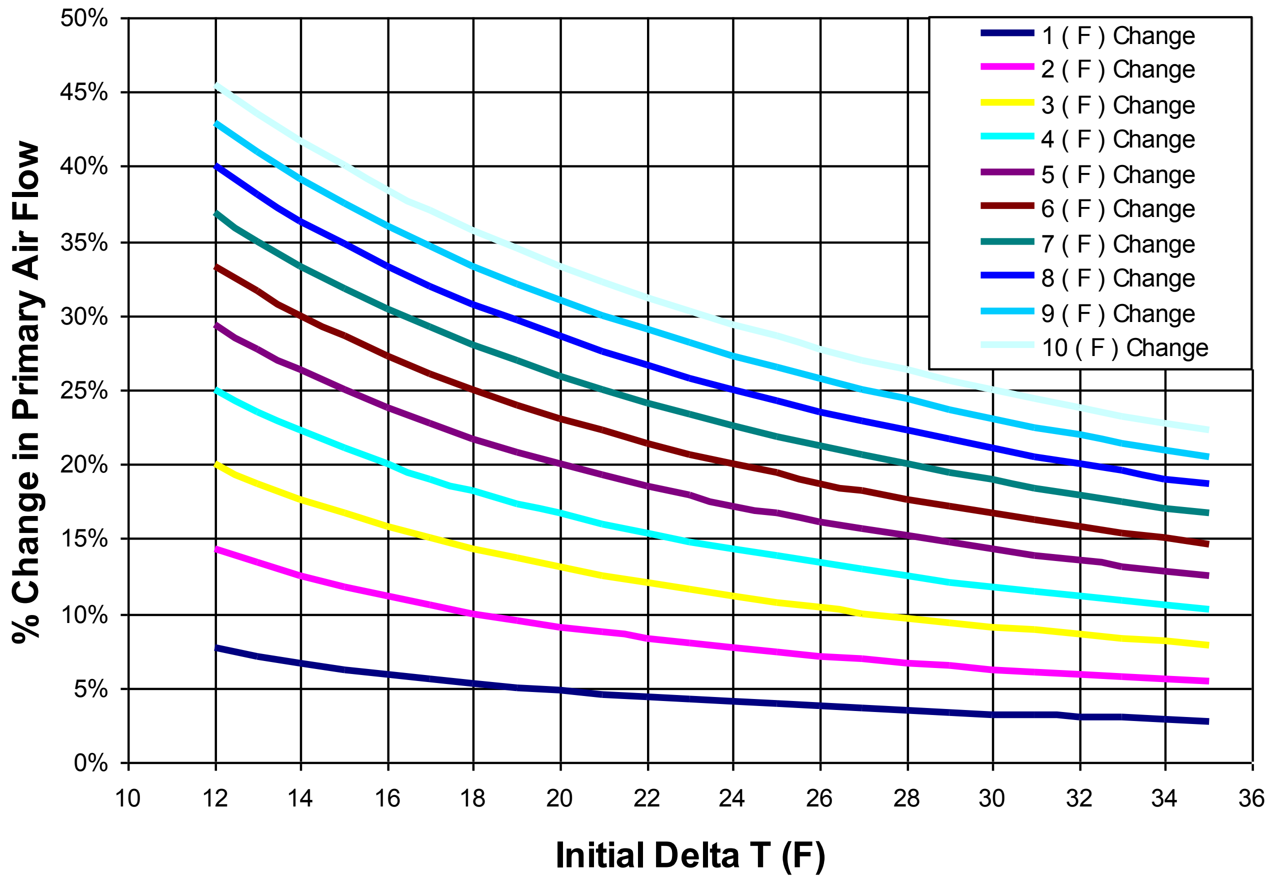
Both systems will generally have the same installed refrigeration and heating capacities and as a result, common chiller and boiler plants. The main differences are in the air handling systems. With the reduced primary airflows the fan energy savings of low temperature systems using Inffusers can be significant — typically 20 — 30% less.

With respect to installed cost of systems using Inffusers, the Inffusers units normally cost somewhat more than conventional diffusers. There are, however, offsetting installed cost savings in the system. The size and cost of the central air handlers and ductwork/risers in the low temperature system are significantly reduced due to the reduction in primary airflows. The cost of the building's overall electrical infrastructure may also be reduced due to lower fan power requirements.

	Conventional	Low Temp w/Inffusers	Net for Inffusers
Installed Costs			
Central air handlers size	Larger	Smaller	+ +
Ductwork/risers size	Larger	Smaller	+ +
Ceiling space required	Larger	Smaller	+ +
Operating Costs			
Fan energy	Higher	Lower	+ +
Refrigeration energy	Slightly lower	Slightly higher	-
Pump energy	Slightly higher	Slightly lower	+
Comfort			
Thermal control	Same/Slightly Worse	Same/Slightly Better	+
Humidity control	Worse	Better	+ +
Noise levels	Same/Slightly Higher	Same/Slightly Lower	+
Air Movement	Lower	Higher	+ +
Other			
Contribution to LEED credits	Little	Significant	+ +

2.6 To what extent can the fan energy required be reduced with a low temperature primary air system design?

For a given sensible cooling load as the primary air temperature is reduced, the amount of primary air needed to satisfy the same sensible cooling load is also reduced. Typically every 2 ºF reduction of the primary air temperature results in a 10% reduction in the primary airflow required to satisfy the same sensible cooling load.



The following example compares the operating conditions of a building zone of 5000 sq. ft. at a room design temperature of 75°F and a peak design sensible cooling load of 20 BTUH/sq. ft. of a conventional VAV system with a system using low temperature primary air.

System Comparison of Low Temperature versus Conventional System Designs			
	All-Air VAV System @ 55°F Primary Air	Inffuser System @ 48°F Primary Air	Inffuser Difference
Total primary airflow from the central air handler	4605 cfm	3410 cfm	- 26%
Supply airflow to the zone @100% of design cooling load	4605 cfm	8289 cfm	+ 80%
Supply airflow rate @ 100% of design cooling load	0.92 cfm/sq. ft.	1.65 cfm/sq. ft.	+ 80%
Supply airflow to the zone @ 60% of design cooling load	2763 cfm	4973 cfm	+ 80%
Supply airflow rate @ 60% of design cooling load	0.55 cfm/sq. ft.	1.0 cfm/sq. ft.	+ 80%
Primary duct size (for 0.0089" w.c. duct loss/foot)	35" x 16" (3.9 sq. ft.)	28" x 16" (3.1 sq. ft.)	- 20%
Central air handler coil face area (@ 500 fpm face velocity)	9.2 sq. ft.	6.8 sq. ft.	- 26%
Fan motor power required at 100% of design cooling load (@ 2.8" w.c. static pressure, 67% efficiency w/drive losses)	3.0 kW	2.2 kW	- 26%

2.7 The major energy savings with the low temperature system designs is in fan power. What is the situation with pumping and chiller energy?

If the chillers are providing lower water temperature to provide the lower primary air, the pumping energy required will be somewhat reduced and the chiller energy will be somewhat higher. The pump energy savings and chiller energy increase will be modest compared to the energy savings realized by the central air handlers providing the reduced quantity of primary air.

2.8 Should there be concerns about possible condensation on the face of the Inffuser due to the use of lower temperature primary air?

No, as long as the system is designed to provide sufficient latent cooling capacity. The cold primary air is tempered up to a warmer temperature by the room air before being discharged into the room through the diffuser.

Laboratory tests were conducted at varying primary air temperatures and room humidity levels. The tests results indicated that with a room design temperature of 75 ºF moisture did not form on the Inffusers face using 46 ºF primary air until the room's relative humidity reached 75%. With adequate latent cooling capacity being provided by the primary air, this condition will not occur.

3. HEATING

3.1 Can Inffusers be used successfully to provide heating from the ceiling or should heat from under-the-window (i.e. finned-tube radiation) be used?

This is a common question. The use of overhead heating from the ceiling as opposed to under-the-window heating is dependent on the buildings envelope and not directly related to the choice of an Inffusers. Research tests on this subject compared comfort levels using five alternative methods for distributing the heat as follows:

- Discharging the heated air horizontally into the room through a one-way slot located at the ceiling above the window
- Discharging the heated air vertically down the window though a liner slot located at the ceiling above the window
- Discharging the heated air horizontally both into the room and into the window from a 2-way discharge linear slot located 2 1/2 feet away from the window
- Radiant ceiling panels located above the window
- Finned tube radiation located below the window

While the results varied depending on the outdoor winter design conditions and the extent of glazing, the results generally indicated that there are no concerns with any of the methods tested if the heat loss along the perimeter is 300 Btu/lineal foot or less. Between 300 and 400 Btu/lineal foot heating from overhead was found acceptable only if the heated air is delivered toward the window horizontally (and hits the window at a velocity of around 75 feet per minute) or from below the window. Above 400 Btu/lineal foot the research found only finned-tube radiation or some other method of delivering the heat from under the window could be used to provide adequate comfort due to down draft issues.

This guidance applies not only to Inffusers, but to any system (such as an all air VAV system) when considering the use of overhead versus under-the-window heating.

4. COMMISSIONING

4.1 How is the primary airflow to the Inffuser measured during system balancing?

The way to accurately measure the primary air flow into the Inffuser is by reading the static pressure from the commissioning sampling tube on the unit. A primary air flow versus static pressure chart is provided for each unit. Do not utilize static pressure readings in the duct near the unit inlet and presume it will be the same as that in the unit's primary air plenum for commissioning purposes. This measurement could be up significantly different from that measured through the commissioned sampling tube.

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is jointly owned by subsidiaries of Dadanco Pty Ltd headquartered in Adelaide, Australia and Mestek, Inc. headquartered in Westfield, MA. Mestek is a diversified manufacturer of HVAC products with sales of over $400m. Mestek's HVAC companies include Smith Cast Iron Boilers, Hydrotherm, RBI Boilers & Water Heaters, Sterling, Vulcan, Airtherm, Applied Air, Anemostat, Air Balance, Arrow United, L. J. Wing, Lockformer and many others.

MESTEK, INC.

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