

# NAK PHID



## PERFORATED HIGH INDUCTION ROUND DUCT



AIR DISTRIBUTION PRODUCTS SINCE 1976

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

## 1.1 | DESCRIPTION

The **Perforated High Induction Round Duct ( PHID )**, is a high induction diffuser designed to address the ventilation needs of spaces with large and small volumes. The design of the perforation is achieved in accordance with the dimension of the served space where the PHID is to be installed. The PHID remain the ideal solution for applications where the technology must embrace the architectural design.

## 1.2 | AREAS OF APPLICATION

The PHID application extends to the following areas:

- **Commercial industry**
- **Manufacturing industry**
- **Food industry, Restaurants**
- **Warehouses**
- **Shops, Offices**
- **Shopping malls**
- **Sports complex :**  
Arenas | Swimming pools | Gymnasiums | Stadiums
- **Showroom**

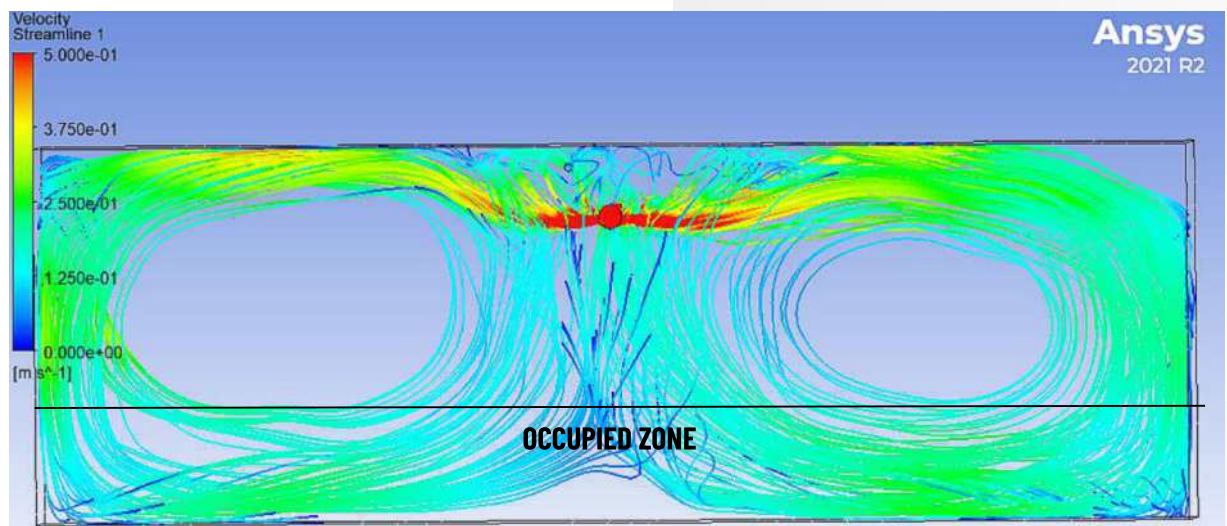
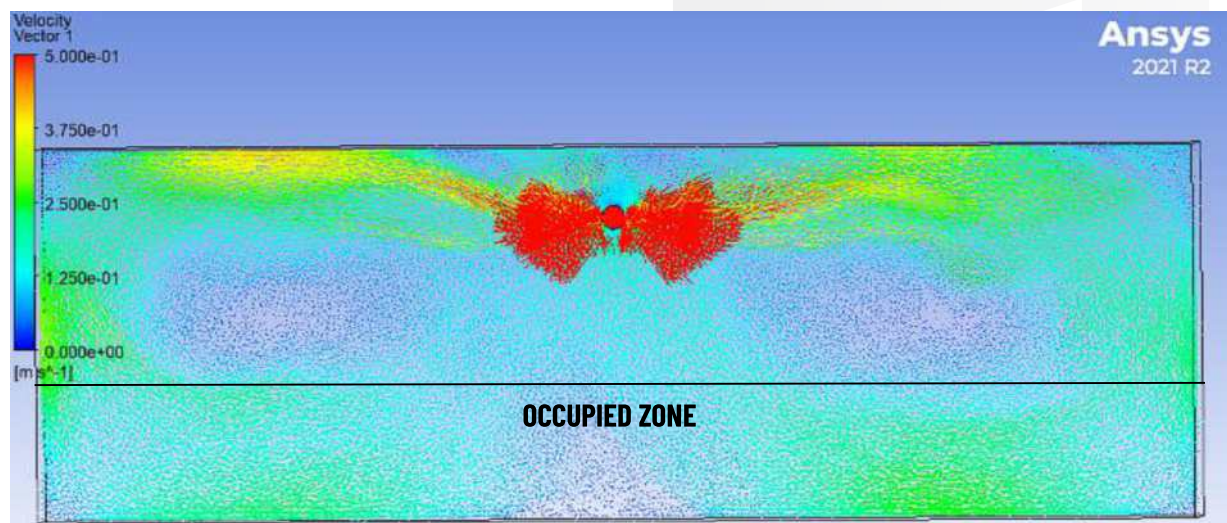
## 1.3 | BENEFITS OF THE PERFORATED HIGH INDUCTION ROUND DUCT ( PHID )

- High induction diffuser which homogenizes the indoor conditions of the served spa : **Temperature and Humidity**
- Increased comfort in the occupied zone :
  - » Comfortable air movement
  - » Low temperature differences
  - » Low noise
- Perforations adapted according to :
  - » The length, width, and height of the served space
  - » Volume of supplied air
- Easy to maintain
- Modular sections, easy to install.

## 1.4 | PERFORMANCE

- The PHID diffuser is designed to surpass the technical performance of traditional air diffusion systems.
- Its operation is based on the principle of high induction diffusion.
- The perforations of different diameters and their positioning on the PHID perimeter, promote the displacement of a large quantity of ambient air (refer to the following illustrations).
- The high inductive effect generated by the micro-turbulences of the air coming from the holes, causes a strong suction of air near the duct (Induction Ratio: 10 to 30), significantly increasing the quantity of the air in motion.
- The thermal exchange, between the supplied conditioned air and ambient air, occurs close to the PHID surface and the temperatures rapidly reach isothermal levels. The risk of stratification is eliminated, without creating drafts in the occupied zone.

### EFFECT OF THE HIGH INDUCTION GENERATED BY A PHID DIFFUSER



## 1.5 | PERFORATED HIGH INDUCTION ROUND DUCT MANUFACTURING

- The PHID diffuser can be supplied in galvanized steel (painted after manufacturing upon client's request), or in stainless steel AISI 304.
- The standard manufacturing length is 1000 mm.



**PAINTED PHID DIFFUSER**



**STAINLESS STEEL PHID DIFFUSER**

- Each PHID is fabricated with specific perforation design, based on the following criteria :
  - » Coverage area
  - » Duct location
  - » Supply air : volume and conditions.
  - » Duct diameter
  - » Available static pressure
  - » Height between the floor and the bottom of the duct
  - » Desired throw
- The precise perforations of the PHID are achieved by a special process cut, according to the data provided by a dedicated software.
- These perforations enable air diffusion and maintain homogeneity in terms of temperature and humidity, thus offering utmost comfort to people in the occupied zone.

## 1.6 | RIGHT TO ALTERATIONS

- As part of its continuous development and innovation program, **NAKHOUL CORPORATION** reserves its right to alter or amend any data or section of this manual without prior notice.



## 2.1 | PERFORATION

- The selection of the type of perforation depends on the criteria listed in Section 1.5.
- According to these criteria, the appropriate pattern of perforation, in terms of number of the holes, diameters of the holes, and distribution of the holes, is selected.

## 2.2 | ARRANGEMENT OF HOLES AND THROW CONFIGURATION

- Depending on the way the holes with different diameters are arranged, different throw configurations can be obtained.
- The holes with larger diameters drag a greater volume of air and therefore guide the component of the exit speed.
- Analyzing the air movement on a quarter of the round duct circumference, three types of throw configurations can be summarized as shown in table 2.1.

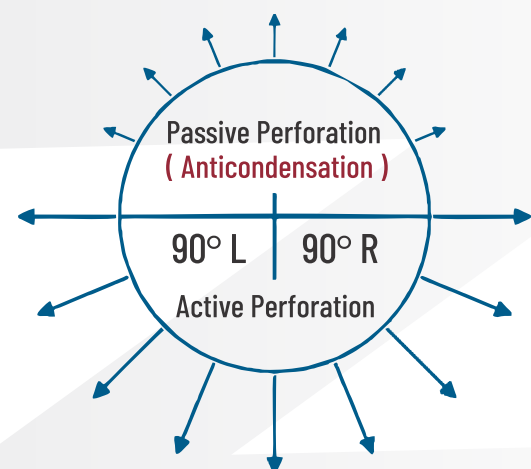
## 2.3 | ARRANGEMENT OF HOLES WITH DIFFERENT GEOMETRY

- Depending on the geometry of the space, it is possible to use only a quarter of the round duct circumference, or all the lower circumference of the diffuser.
- As such, referring to the following figures, it is possible to combine the three types of perforation, described in table 2.1 below, in order to obtain further throw configuration.

### COMBINED THROW CONFIGURATION

	90° R	90° L
Combined Configurations	A	A
	A	B
	A	C
	B	B
	B	C
	C	C

### ARRANGEMENT OF HOLES



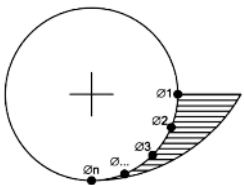
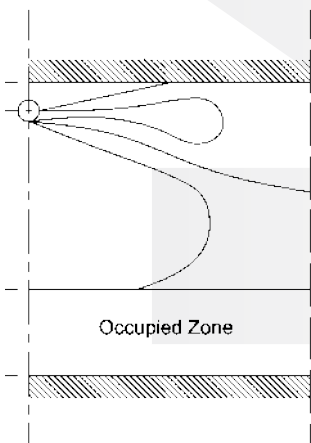
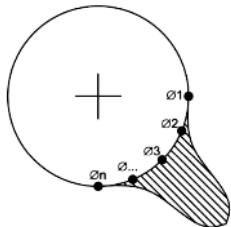
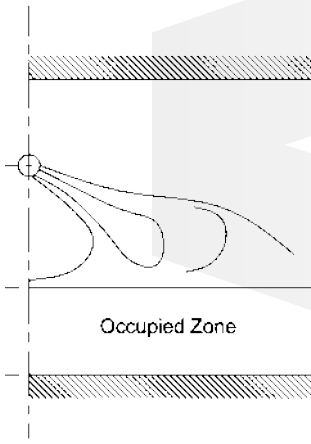
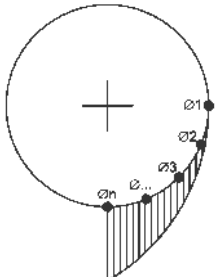
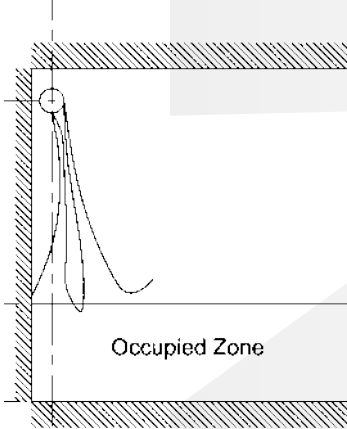
CONFIGURATION TYPE	SPEED PROFILE	T TYPE OF DISTRIBUTION	RECOMMENDATIONS
A			<ul style="list-style-type: none"> <li>• Rooms with heights up to 4.5 m.</li> <li>• Diffuser installed just below the ceiling.</li> <li>• Throw at 0° angle.</li> </ul>
B			<ul style="list-style-type: none"> <li>• Rooms with high ceilings.</li> <li>• PHID installed not close to ceiling.</li> <li>• Throw at 45° angle.</li> </ul>
C			<ul style="list-style-type: none"> <li>• Throw at 90° angle.</li> <li>• Use as thermal barrier (aircurtain) close to wall and windows.</li> </ul>

TABLE 2.1

## 2.4 | SIZE OF PERFORATION AND SPEED AT EXIT

- Diffusion in the room depends not only on the configuration (A, B, or C), but also on the exiting speed of supply air from the holes and the sizes of these holes.
- Depending on the air flow rate per linear meter of PHID, and the diameter of the PHID, three different patterns of perforation are available, defined below as Size of Perforation.

### SIZE OF PERFORATION

- **Fine Perforation**

Combination of Holes of the smallest diameters' sizes ( $\varnothing$  2 mm to  $\varnothing$  10 mm); usually applied for small rooms with limited heights.

- **Medium Perforation**

Combination of Holes of medium diameters' sizes ( $\varnothing$  5 mm to  $\varnothing$  15 mm). The Medium Perforation is used as standard for most application.

- **Large Perforation**

Combination of Holes of larger diameters' sizes ( $\varnothing$  5 mm to  $\varnothing$  15 mm); usually applied for large spaces and big heights.

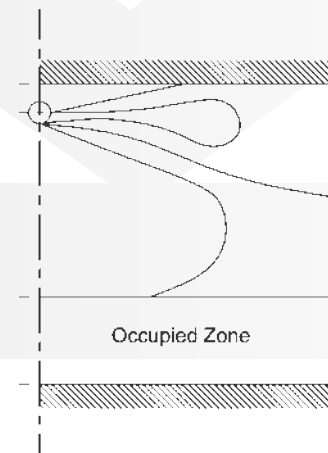
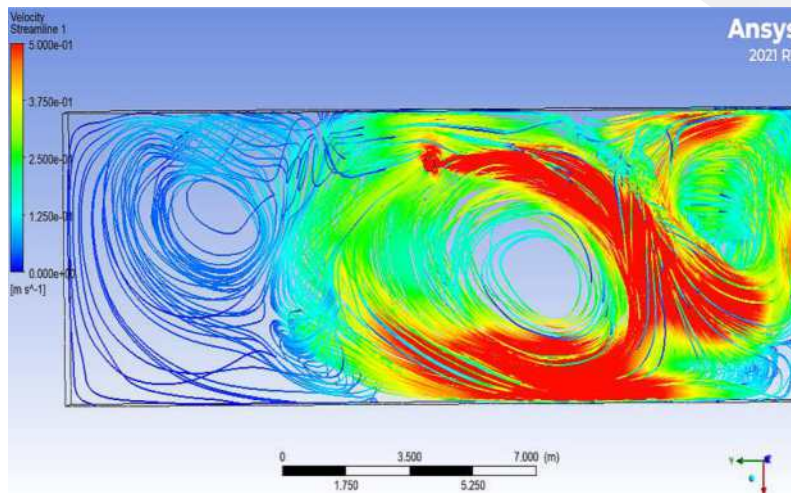
- In general, the PHID has constant cross-section with a plenum effect and homogenous perforation along its whole length.

### PHID CONSTANT CROSS-SECTION AND HOMOGENOUS PERFORATION

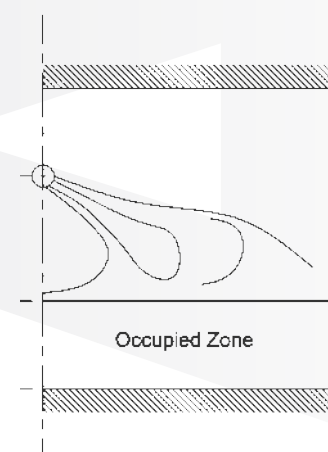
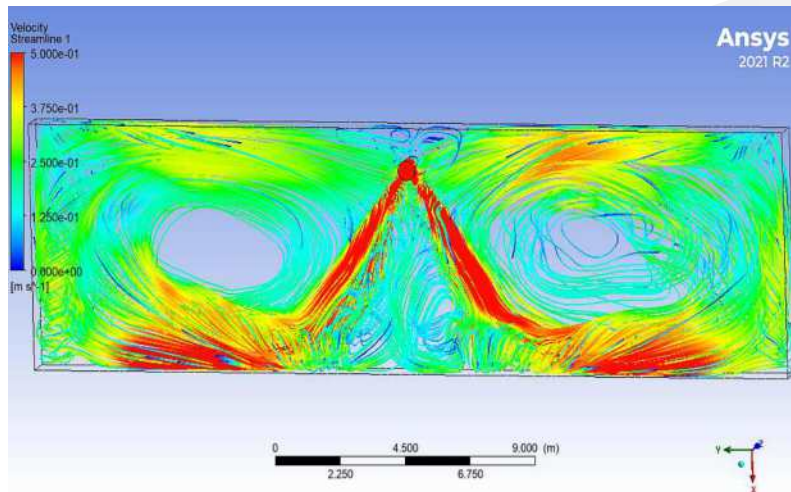


## 2.5 | DIAGRAM OF AREA OF INFLUENCE BY THROW CONFIGURATION

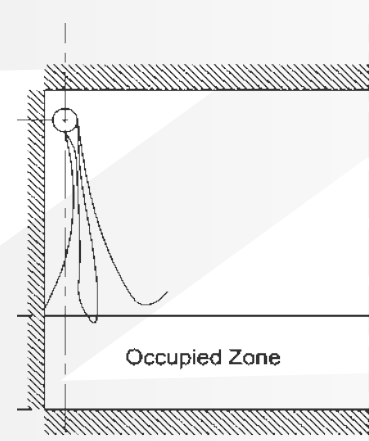
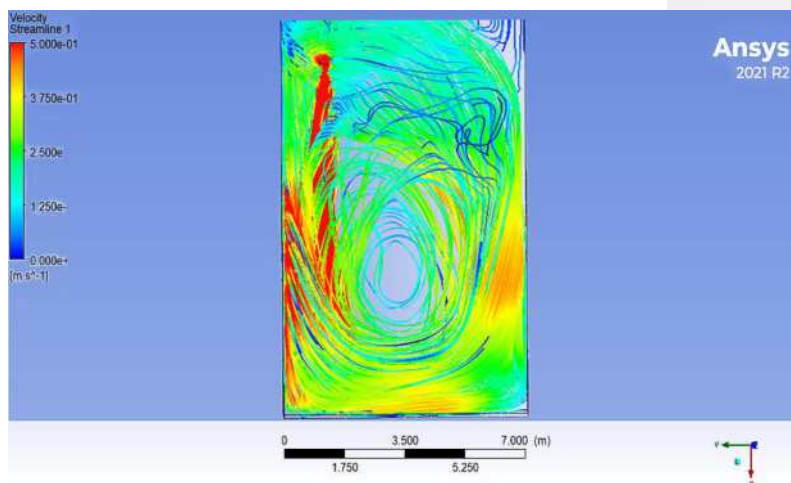
### TYPE A CONFIGURATION | 1 WAY 0° AIR DISCHARGE



### TYPE B CONFIGURATION - 2 WAYS 45° AIR DISCHARGE



### TYPE C CONFIGURATION | 1 WAY 90° AIR DISCHARGE





## 3.1 | SELECTION OF PARAMETERS

- To ensure the efficiency of the Perforated High Induction Round Duct system, the selection of the PHID diffuser's diameter, as well as its length and the perforation details, is achieved via specific software which can generate the required data.

### DIFFERENT PERFORATION DETAILS



## 3.2 | SAMPLE SOFTWARE PRINT - OUT

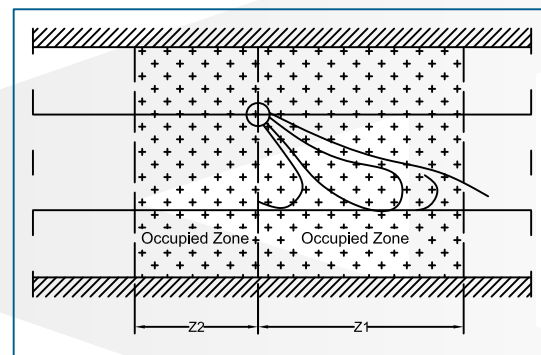
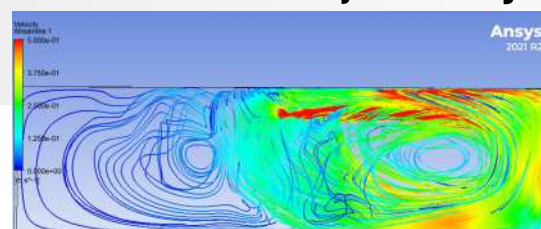
### SOFTWARE SELECTION

#### SELECTION DATA

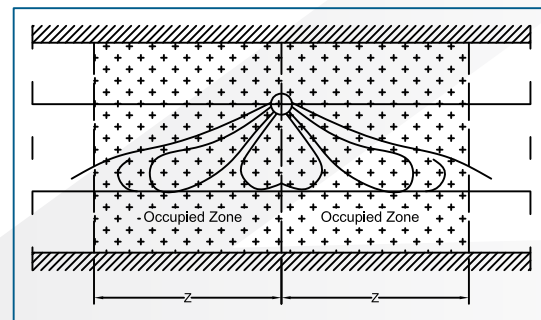
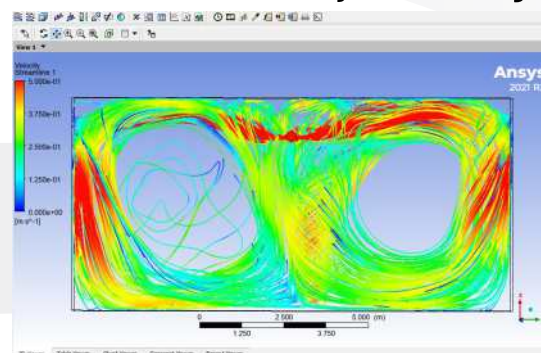
### Perforated High Induction Round Duct ( PHID )

Project					
Consultant					
Client					
Diameter Selection					
Q	2300	[m³/h]	Input Flow Rate		
ØN	630	[mm]	Selected Nominal PHID Diameter		
V <sub>d</sub>	2.0	[m/s]	Resulting Air Velocity		
Pressure Loss Calculation Through the Perforated Duct					
Q <sub>IN</sub>	2300	[m³/h]	Entering Flow Rate		
Q <sub>OUT</sub>	152	[m³/h]	Leaving Flow Rate (axis)		
ØN	500	[mm]	Nominal Diameter		
L	6	[m]	Duct Length		
Δp <sub>d</sub>	0.6	[Pa]	Resulting Pressure Loss Across the Length L		
Holes Sizing and Pressure Loss Across the Holes					
Q <sub>IN</sub>	816	[m³/h]	Total Air Flow		
Configuration of Perforated Duct*	Diameter of Duct	Length of Duct	Diameter of Holes	Arrangement of Holes	Direction of Holes
	ØN	L			
	[mm]	[m]			
1	710	1	MEDIUM	B	2 ways
2		0			
3		0			
4		0			
Zone of Influence:					
Recommended Specific Nominal Flow Rate per Linear Meter of Duct		Specific Flow Rate per Actual Linear Meter of Duct	zone of influence		
Q <sub>s</sub> NOM MIN	Q <sub>s</sub> NOM MAX	Q <sub>s</sub>	Z	Z'1	Z'2
[m³/h/m]	[m³/h/m]	[m³/h/m]	[m]	[m]	[m]
653	979	816	5.8		
Resulting Pressure Loss Across the Holes					
L <sub>T</sub>	1	[m]	Total Duct Length		
V <sub>f</sub>	10.0	[m/s]	Nominal Velocity Across the Holes		
Δp <sub>F</sub>	84	[Pa]	Pressure Loss Across the Holes		

#### Zone of Influence | 1 Way Air Discharge



#### Zone of Influence | 2 Ways Air Discharge



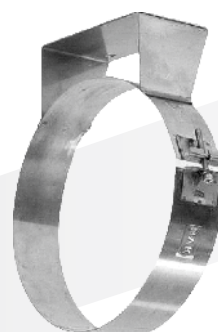
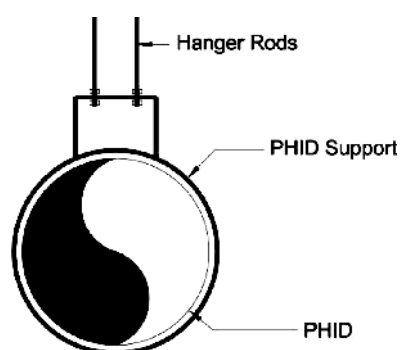
## 4.1 | PHID | FITTINGS

- The standard PHID fittings are manufactured according to the same thickness schedule and finishing as the corresponding duct ( elbows, reducers, branches, etc. )

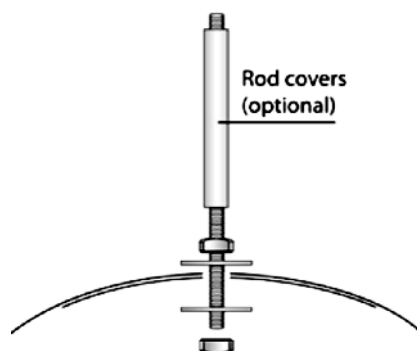
## 4.2 | PHID | INSTALLATION DETAILS

- The connection between 2 PHID duct pieces is secured via a special locking bond (refer to Detail 3).
- The suspension of the PHID diffuser is provided either by a special collar and threaded rods, or by an internal saddle and threaded rod (refer to details 1 and 2).

### PHID SUPPORT | DETAIL 1

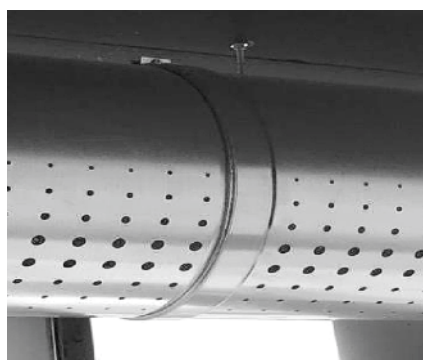


### PHID SUPPORT | DETAIL 2

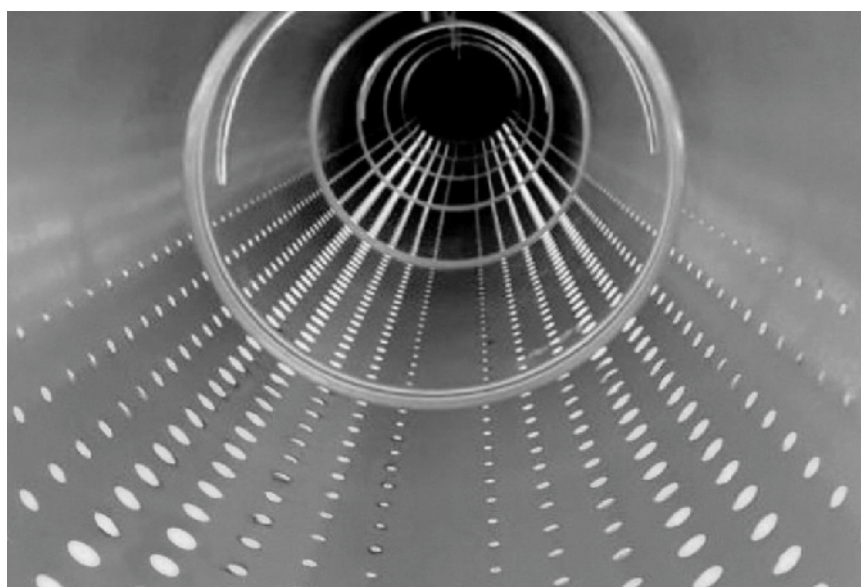


Suitable for small duct diameters, as long as duct shape is maintained.

### PHID | TRANSVERSAL JOINT | DETAIL 3



# AN AESTHETIC NOVELTY MEETING ENGINEERING CONFORMITIES



## NAK

### Offices Zouk Mikael

Tel. +961 9 225 888 • Fax +961 9 223 888

Mob. +961 3 195 082 | +961 76 560 003

P.O.Box 182 Zouk Mikael | Lebanon

### Factory Gharzouz

Tel. +961 9 791 442 | +961 9 791 443

Mob. +961 76 400 488

E.mail: [info@nakhoulcorp.com](mailto:info@nakhoulcorp.com)

