



APEX-delfino® Technology



APEX-delfino® Flow-Conditioner™

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APEX Group's Technological Innovation

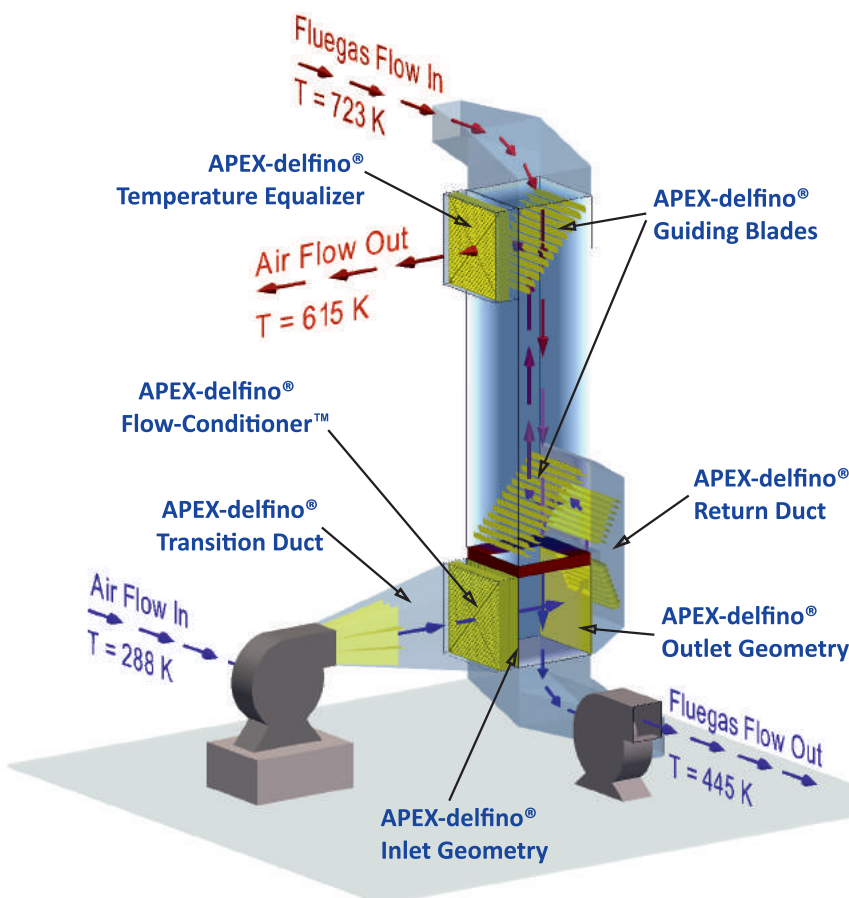
APEX Group successfully developed APEX-delfino® Technology. This new technology focuses on optimizing flow distribution and influences turbulence for improved operation of Free-flow™ APEX®&CORPEX® plate-type heat exchangers.

Large amounts of hot fluegas and air are guided through the custom-designed plate-type heat exchanger. The volume flow rates can easily exceed 2,000,000 kg/h with virtually 0% Leakage. The flow is guided in complex flow paths through the modular units such as conventional cross-flow or countercurrent flow arrangement and many novel configurations operating at low Reynolds number with increased heat transfer.

APEX-delfino® Technology increases the effectiveness and the lifetime of the unit, due to corrosion protection, easy-access cleaning and reduced pressure drop at high heat transfer rates. It is designed to achieve a streamlined and uniform flow, closely matching the ideal flow field characteristics with no flow separation.

APEX-delfino® Technology is an agglomeration of improvements along the path of a fluid element, which is traveling through the Heat Exchanger starting at the centrifugal fan. Amongst others, the APEX-delfino® Flow Conditioner™, as well as the APEX-delfino® Inlet Geometry and Guiding Blades, condition the flow distribution for improved operation of our Plate-type Heat Exchangers.

To sum up, this technology guarantees an uniform flow distribution, proper working conditions and increases the lifetime of the units, which ultimately results in lower energy consumption and smaller units.



1 APEX-delfino® Transition Duct

- Custom-design of the transition ducts
- Uniform velocity distribution at outlet
- Large static pressure recovery
- Low total pressure drop

2 APEX-delfino® Flow-Conditioner™

- Match design velocity distribution
- Reduction of velocity fluctuations
- Reduced risk of corrosion
- Reduced pressure drop
- Less power consumption
- Small plot space required

3 APEX-delfino® Inlet Geometry

- Low pressure drop
- Turbulent flow starting at $Re = 2200$.
- Well-defined transition
- Increased heat transfer in the low Re range
- Protection of plate and edge-welds
- Easy mechanical installation

4 APEX-delfino® Outlet Geometry

- Low pressure drop
- Large static pressure recovery
- No large-scale flow separation
- Uniform velocity distribution
- Easy mechanical installation

5 APEX-delfino® Return Duct

- Low pressure drop
- No large-scale flow separation
- Uniform velocity distribution
- Aerodynamically optimized design

6 APEX-delfino® Guiding Blades

- No large-scale flow separation
- Uniform velocity distribution
- Low pressure drop
- Guidance of complex flow paths
- Homogeneous static pressure distribution
- Aerodynamically optimized design

7 APEX-delfino® Temperature Equalizer

- Uniform temperature distribution
- Optimized Mixing
- Low pressure drop
- Small plot space

APEX-delfino® Flow-Conditioner™

Typical Process Design Dilemma

Industrial process equipment (e.g. heat exchangers, catalytic reactors, electrostatic precipitators) is usually designed with a specific design software.

The performance and accuracy of the design is based on a uniform velocity profile at the inlet of the equipment, considering no temporal fluctuations or directional deviations from the perfect streamwise flow direction. However, on-site experience, supported by in-house laser optical measurements, indicates that this flow uniformity is not always the case.

The negative influence of this maldistribution on the effectiveness of the equipment is dependent on the degree of deviation from the ideal flow conditions, which should be held, in practice, to a minimum possible extent.

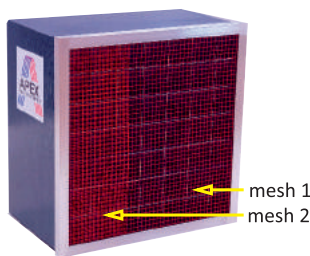


Fig. 1: Customized APEX-delfino® Flow-Conditioner™ module (300 mm x 300 mm x 170 mm) with two sets of meshes.

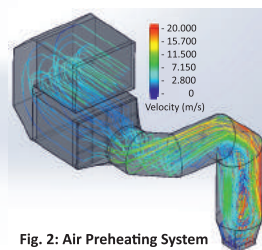


Fig. 2: Air Preheating System

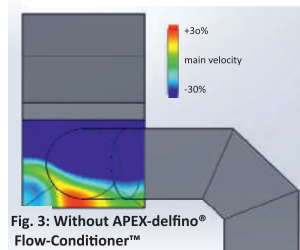


Fig. 3: Without APEX-delfino® Flow-Conditioner™

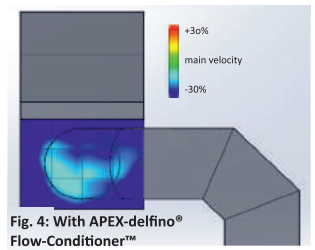


Fig. 4: With APEX-delfino® Flow-Conditioner™

Fig. 2-4: Simulation results of ducting upstream of a plate-type heat exchanger and resulting velocity distribution at the inlet of the plate-type heat exchanger with and without APEX-delfino® Flow-Conditioner™. The red indicates velocities larger than 30% above the mean velocity and blue indicates velocities lower than 30% of the mean velocity.

APEX Group's Solution

APEX-delfino® Flow-Conditioner™ generates optimum flow conditions with respect to low swirl, uniform velocity distribution and a defined turbulence level in the complete cross section immediately upstream of any equipment (e.g. Plate-type Heat Exchanger). Multi-modular construction will cover any large-duct cross section.

APEX-delfino® Flow-Conditioner™ Products:

- Customized size with set of meshes (<500 mm)
- Standard size (500 mm) with set of meshes
- Set of APEX-delfino® Flow-Conditioners™ of standard size with proposed set of resistances to achieve desired flow field based on a computational study.

Perforated Plate versus APEX-delfino® Flow-Conditioner™

Perforated Plate

- Due to the small thickness of the perforated plates, they cannot guarantee the removal of swirl and the removal of flow direction perpendicular and width-wise to the heat exchanger's channels.
- Perforated plates have a uniform resistance over the complete cross section, even though velocities vary over the air inlet cross section. This usually results in a much higher resistance than necessary and large pressure drop.
- The flow stagnates upstream of the heat exchanger and tends to move in the direction of the walls upstream of the equipment. The result is a strong temporal fluctuation and an increase in velocity non-uniformity.

APEX-delfino® Flow-Conditioner™

- Ability to match the design velocity distribution at the inlet of the heat exchanger. This means that the design efficiency of the equipment can be guaranteed.
- Reduction of spatial & temporal velocity fluctuations. As a result, the equipment faces reduced risk of corrosion; thus, its lifetime is increased.
- Reduced pressure drop compared to perforated plates. This is directly translated into reduced power consumption of the existing centrifugal fan.
- Reduced plot space required for its installation compared to multiple-sheet perforated plates, with similar performance. The width of the APEX-delfino® Flow-Conditioner™ is only 100-200 mm.

Particle Image Velocimetry (PIV)

Example Inlet Flow:
Colour Coding: Magnitude in fluctuating velocity, Mean Velocity 4.5 m/s



The orange indicates large fluctuations in a free duct and the blue indicates low fluctuations in the duct equipped with the APEX-delfino® Flow-Conditioner™, as shown in Fig. 7

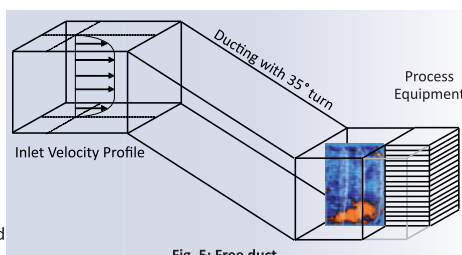


Fig. 5: Free duct

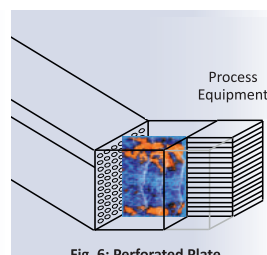


Fig. 6: Perforated Plate

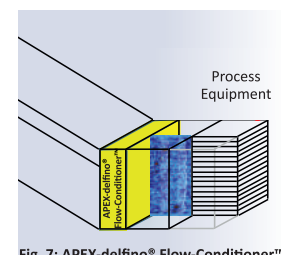


Fig. 7: APEX-delfino® Flow-Conditioner™

Fig. 5-7: Particle Image Velocimetry results downstream of a 35° turn with different devices integrated into the ducting.



Technology Inspired by Nature

Company Profile

APEX Group is specialized in designing and manufacturing high quality heat transfer equipment. CORPEX®, A-CORREX® & APEX-delfino® plate-type and tubular exchangers are designed to bear the most extreme requirements. We provide innovative engineering solutions for high performing heavy-duty gas/gas and gas/liquid equipment for heat recovery and environmental projects.

Experience and Vision

We encompass 45+ years of experience and expertise of our founder, Mr. Mircea Dinulescu, and share his vision - **to research, create and provide engineering solutions** for heat transfer industrial applications. To this day, our *Credo* remains unchanged, creating the strong foundation for APEX Group's position in the international market:

Started in 1990 as a small independent business, APEX GROUP will grow into a reputable designer and manufacturer of high quality low-priced industrial heat transfer and combustion equipment for the international market operating according to the quality principles laid out by international standard ISO 9001.

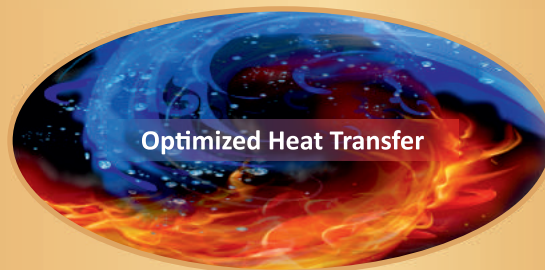
M. Dinulescu, 1991

Origin of "delfino"

APEX-delfino® Technology came into existence from the long-term obsession of the inventor and the developer of APEX Group's plate-type heat exchanger products, Mr. Mircea Dinulescu, of continuously perfecting the products by improving the flow uniformity, and, in particular and utmost, of eliminating the flow separation and dead-water regions.

By observing the dolphins playing in water practically without disturbing it at all, he exclaimed: **"We need a heat-transfer geometry similar to these dolphins!"** And so:

- the dolphin's nose became APEX-delfino® Inlet Geometry
- the dolphin's fins became APEX-delfino® Guiding Blades
- the dolphin's tail became APEX-delfino® Outlet Geometry
- the dolphin's streamlined body became APEX-delfino® Transition Duct
- APEX-delfino® Flow-Conditioner™ and APEX-delfino® Temperature Equalizer, exterior to the dolphin's body, came as logical extensions



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