



# V-FLEX® HEAT EXCHANGER

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## Combining the advantages of plate-type and tubular heat exchangers

In industries from petrochemical to water treatment and beyond, heat exchangers are essential for increasing system efficiency, as well as reducing energy consumption, CO<sub>2</sub> emissions and overall operational expenses.

The number of fields where heat exchangers are being applied is rapidly growing, which increases the demand for a service at higher differential pressure and more intensive heat transfer.

The traditional plate-type heat exchanger has long been valued for its compact size, minimal fouling tendency and its low operating pressure drop, which facilitates low energy consumption. However, it does have some limitations, such as low differential pressure resistance. Additionally, when constructed from ordinary materials, it offers low resistance to highly corrosive mediums in condensing flue gases.

In contrary, the tubular heat exchanger can resist higher differential pressures, but can't offer the same thermal efficiency as a more compact plate-type heat exchanger, and hence is prone to fouling. To meet the requirements of today's applications, another solution was needed. Therefore, the V-FLEX product line was developed.



V-FLEX Heat Exchanger with APEX Free-flow Technology

## V-FLEX: The best of both worlds

APEX Group applied its expertise in design and manufacturing high-quality, heavy-duty heat exchangers to develop the patented V-FLEX product line, which combines the advantages of both plate-type and tubular heat exchangers. These advantages are strengthened with the incorporation of the VORTI-FLEX technology.

### The efficiency of a plate-type heat exchanger

As a substitute for round tubes, elongated heat transfer elements are used to construct flat or undulated heat transfer panels. This allows our V-FLEX heat exchanger to gain all the advantages of the plate-type concept: compact size, low operating pressure drop, low fouling tendency and high thermal efficiency, compared to a conventional tubular heat exchanger. This has direct effect on *savings in energy consumption and maintenance costs, as well as reduction in CO<sub>2</sub> emissions.*

### The pressure resistance of a tubular heat exchanger

V-FLEX's elongated heat transfer elements ensure mechanical integrity at higher differential pressures between the two working fluids. They can support pressures from 0.5 barg up to 5 barg – whether the fluids are gaseous, liquid, or multi-phase. In contrast, plate-type heat exchangers have typical differential pressure limits of 1 barg.

### Easy maintenance with APEX Free-flow Technology

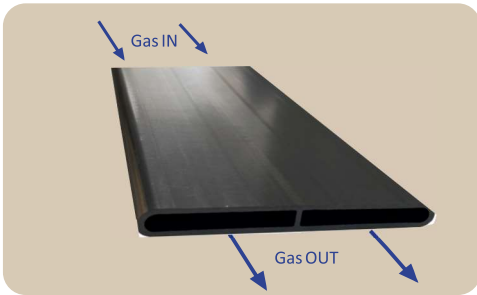
APEX Free-flow Technology is incorporated in the V-FLEX heat exchangers, which ensures that the heat transfer surfaces are easily accessible for cleaning. Furthermore, APEX Free-flow Technology prevents the formation of large and undesired flow recirculation zones inside the heat transfer core, minimizing risks of fouling and erosion issues. This delivers the extra benefit of saving costs due to low maintenance requirements.

*“The V-FLEX heat exchanger has dramatically improved the operational efficiency, even when using high differential pressure – in turn this will enable you to reduce CO<sub>2</sub> emissions and save significantly on energy costs.”*

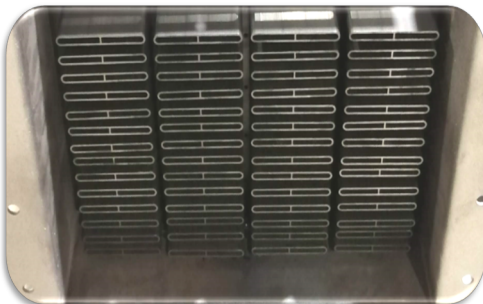
[Dr. Jens Kitzhofer, R&D Manager, APEX Group]

## Key benefits





The V-FLEX flat elongated heat transfer element



V-FLEX Heat Exchanger with A-CORREX Technology



Corroded metallic air preheater

### Unique configuration

V-FLEX heat exchangers are constructed from flat elongated heat transfer elements, which, when butted back to back along short sides, form a heat transfer panel with a pair of symmetrical, flat or undulated, heat transfer surfaces.

The pair of surfaces contain the fluid stream flowing through the channels inside the elements. The short sides of the elements are acting like continuous spacers, maintaining the required process channel size between the surfaces, as well as participating in the heat transfer process as extended surfaces.

Multiple heat transfer panels are stacked together one on each other in different possible configurations, making use of spacers installed in the gap created between the adjacent panels, to accommodate the flow of the second fluid.

### Opportunity to safely operate in corrosive environments

By applying A-CORREX Technology to V-FLEX products, we offer also the possibility to safely operate the V-FLEX heat exchangers in corrosive environments.

APEX Group has expanded its A-CORREX Technology by developing an improved type of acid resistant heat exchanger. The new product is constructed from heat transfer elements made of *high thermal conductivity and acid-resistant polymer composite known as PPS-GR*.

This opens new possibilities for their use in emerging technologies, such as carbon capture and storage (CCS), that require fluid gas temperatures to fall below the acid dew point.

Read more about it in our [Acid-Resistant Heat Exchanger Brochure](#).



*“The V-FLEX heat exchanger allows us to participate in the carbon capture movement by assisting the capture and storage on a large scale, without worrying about corrosion.”*

[Artur Gajda, Chief Technology Officer, APEX Group]

### What material choice would best suit my application?

The V-FLEX heat exchanger can be constructed from different materials, including a unique polymer composite, specifically for operations well below the acid dew point.

Material	Operational temperature
Carbon steel	Maximum flue gas temperature 500 °C, minimum > ADP
Stainless steel	Maximum flue gas temperature 900 °C, minimum > ADP
Glass-enameled steel	Maximum flue gas temperature 260 °C, minimum < ADP <sup>1)</sup>
Polymer composite	Maximum flue gas temperature 200 °C, minimum < ADP <sup>2)</sup>
	1) Low condensation rate 2) High condensation rate

## Designed to meet your application's requirements

The range of heat exchanger applications is growing rapidly. For instance, CCS, DeNOx, and DeSOx units are increasingly popular due to growing concern about the environmental and health impact of industrial operations, and more restrictive regulations on harmful emissions.

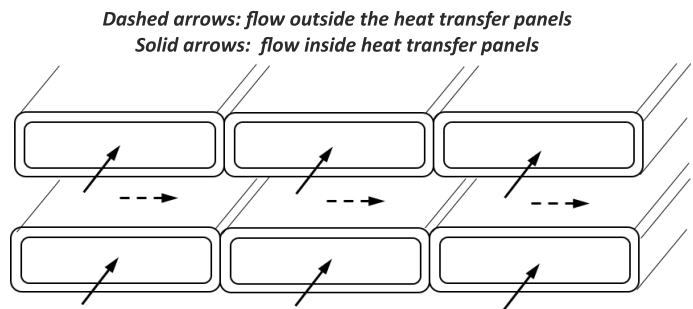
This widened application scope means that heat exchangers' operational conditions, such as operation differential pressure, temperature and fluid gas composition, have never been more varied.

This variety can easily be challenged with the V-FLEX heat exchanger, which allows flexibility in designing equipment, tailored to a specific application requirements. This is possible thanks to available choice of various heat transfer surface geometries (VORTI-FLEX Technology), process fluid channels sizes, construction materials and process fluids flow arrangements.

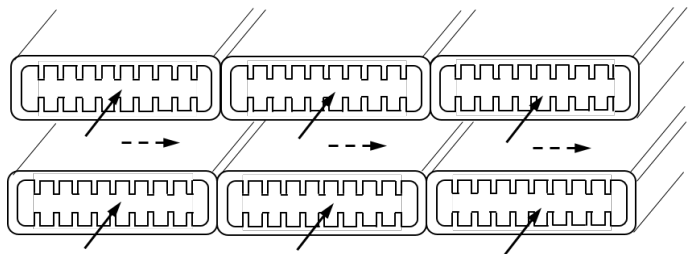
### VORTI-FLEX Technology

Thanks to their flat shape, the inner and outer surfaces of the V-FLEX heat exchanger's elements can be easily manipulated to increase turbulence of the fluid flow for maximum efficiency.

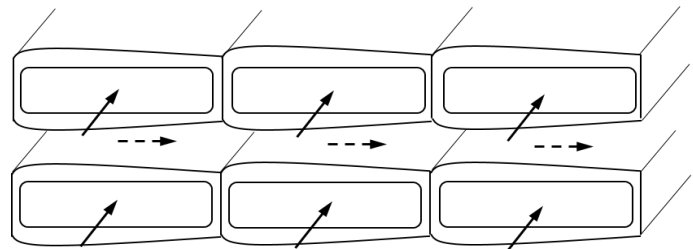
We offer three basic panel types: flat, finned and undulated, which can be further modified according to the application's requirements.



**Flat heat transfer panels:**  
*Similar heat transfer coefficient to flat plate-type heat exchangers.*



**Finned heat transfer panels:**  
*Higher heat transfer coefficient inside the panels; increased efficiency.*

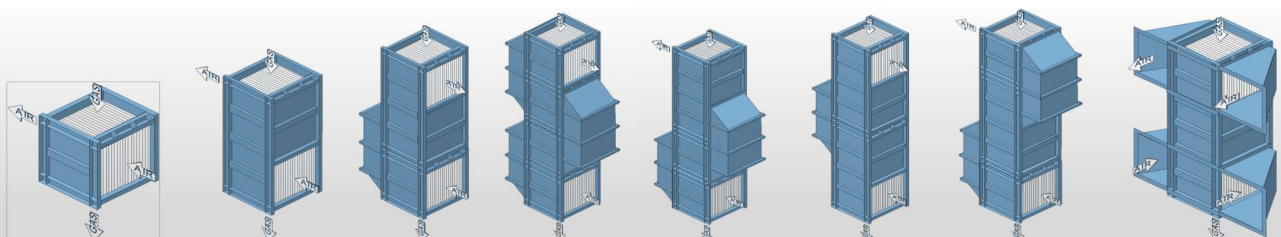


**Undulated heat transfer panels:**  
*Higher heat transfer coefficient outside the panels; increased efficiency.*

### Compatible with various flow arrangement

V-FLEX heat transfer panels can be arranged in cross-current, co-current or counter current flows.

The V-FLEX heat exchangers also benefit from our modular design, which allows flexible arrangement of the blocks for optimum size, while maintaining the performance.



**Modular design and flexible flow arrangement**

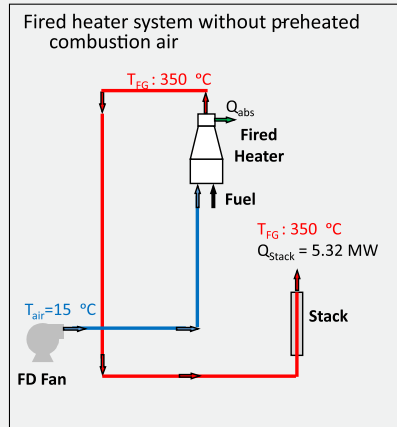
## Multiple Services

Due to their flexibility, the V-FLEX heat exchangers can be used in a wide range of applications and services, such as:

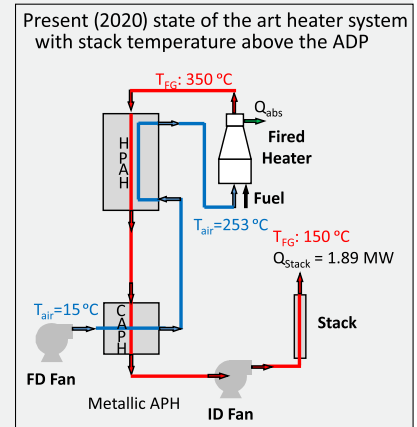
- Air preheaters;
- Economizers;
- Heat recovery;
- Water treatment;
- Desalination plants;
- Flue gas condensers;
- DeNOx and DeSOx units;
- Carbon capture and storage (CCS) or carbon capture, utilization and storage (CCUS);
- Replacement of shell and tube exchangers.

### Application: Steam Reformer Service: Air Preheater

Example: Required heat from fired heater  $Q_{abs} = 29.45$  MW



FG Flow rate: 50,194 kg/h  
Fuel Flow rate: 2,500 kg/h  
Heater Efficiency (LHV): 83.86 %  
CO<sub>2</sub> emissions: 6,860 kg/h



FG Flow rate: 45,199 kg/h  
Fuel Flow rate: 2,251 kg/h  
Heater Efficiency (LHV): 93.03 %  
CO<sub>2</sub> emissions: 6,176 kg/h

### Application: Flue Gas Scrubber Service: Gas/Gas Heater

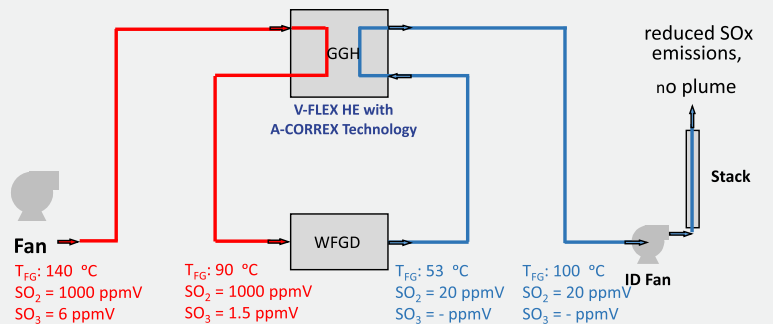
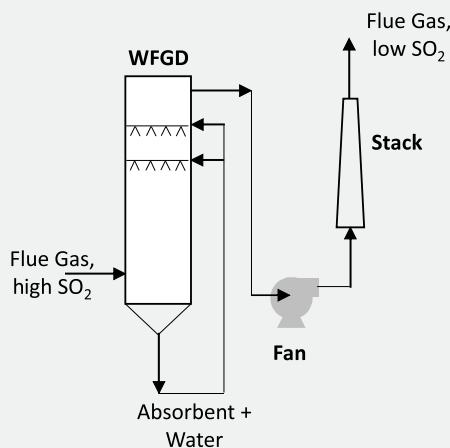
Wet Flue Gas Desulfurization units are known for their high SO<sub>2</sub> removal rates, which become more important in any sector with stringent regulations for a green environment.

Drawbacks of classical WFGD is the generation of a white plume as well as the corrosion of the downstream stack. Additionally, the requirement for cooling water is high due to the high inlet flue gas temperature, typically 180 °C.

APEX Group managed to overcome these issues by placing an intermediate Gas-Gas Heat Exchanger, which allows corrosion free operation below the acid dew point. This special unit is a V-FLEX Heat Exchanger with A-CORREX Technology, in which the untreated flue gas is cooled by the treated flue gas.

This results in a decreased flue gas temperature entering the WFGD, a significant reduction of needed water flow and less generation of aerosols. The flue gas temperature at the stack is increased above the ADP, the emissions to the atmosphere are reduced and the plume opacity disappears.

Read more about this in our *Acid-Resistant Heat Exchanger Brochure*.



#### High Efficiency WFGD process

Note: Part of the SO<sub>3</sub>, approx. 75% is retained in the GGH in the form of concentrated H<sub>2</sub>SO<sub>4</sub>, which is neutralized online.

— untreated flue gas  
— treated flue gas

## Characteristics of the V-FLEX heat exchanger:

- Increased differential pressure resistance;
- Excellent mechanical integrity at high operating temperatures (above 700 °C);
- Highly resistant to cyclic temperature loads;
- Increase of heat transfer coefficient both inside and outside of the heat transfer panels;
- Corrosion resistant when constructed from polymer composite;
- Maximum design temperature: 900 °C for metallic and 200 °C for polymer composite;
- Maximum differential pressure: up to 5 barg for metallic and up to 0.1 barg for polymer composite.

## Innovating, validating and improvement: A continuous process

APEX Group's innovation stems from its extensive experience in the heat transfer field, incorporated in its proprietary design software, to design and develop the V-Flex heat exchanger. V-FLEX product line has the advantage of incorporating the recently developed VORTI-FLEX Technology, which aims to use the vortical flow generation as an impulse to increase the heat transfer efficiency in our products.

APEX Group strives to validate its products and technology, therefore in order to do so, the group's R&D engineers did not only utilize its fluid laboratory but also constructed a hot wind tunnel testing facility in order to validate the data.

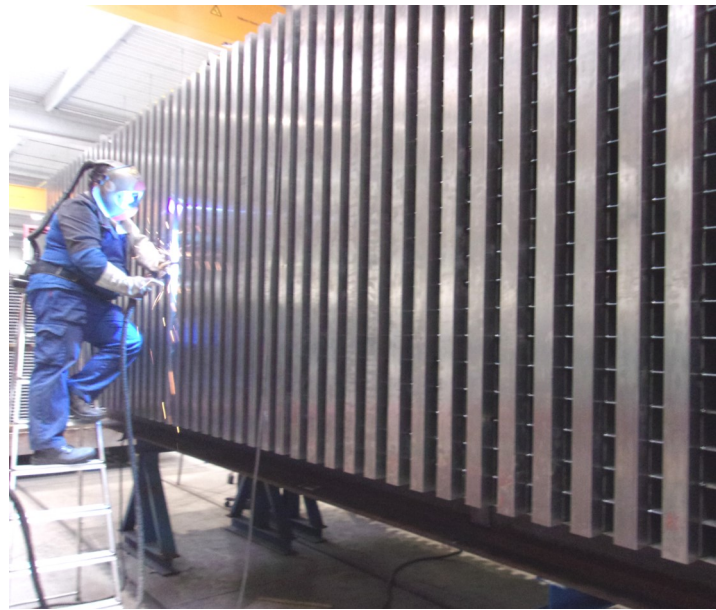
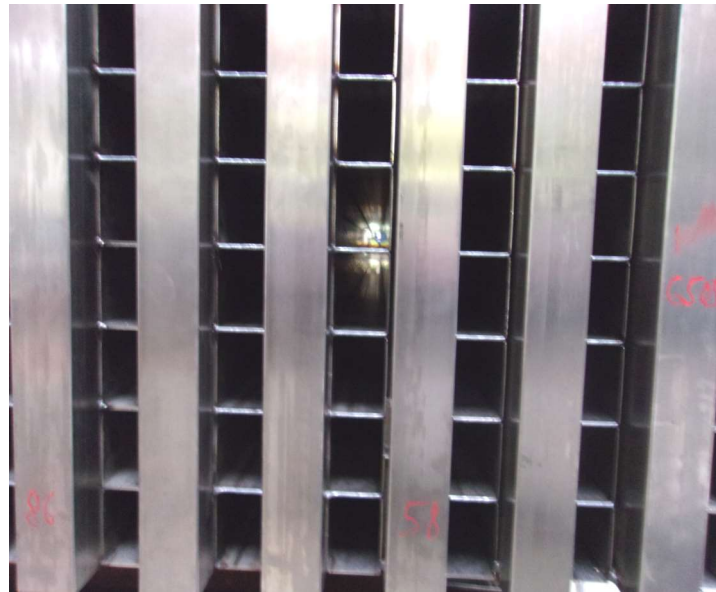
*"APEX Group is dedicated to offering engineering solutions, not just a commodity."*

**[Mircea Dinulescu, Founder of APEX Group]**

## Contact us today

As a family-owned company, we choose to build close long-term relationships with all our customers, collaborating to create personalized solutions. So, no matter where you are in the world, why not contact us today to see how we can support you?

+31 (0)70 300 42 42  
info@apexgroup.eu  
www.apexgroup.eu



V-FLEX Heat Exchangers



**“APEX Group is dedicated to offering engineering solutions, not just a commodity.”**

**Mircea Dinulescu, Founder of APEX Group**

**Company Profile**

**APEX Group** is specialized in designing and manufacturing high quality heat transfer equipment. Our 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 50+ 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*

**Quality and Innovation**

APEX Group’s strength consists of know-how, patented technology, professionalism and leading-edge engineering. Our Research and Development Department supports APEX Group’s activities by providing new solutions for continuously upgrading APEX Group’s products and guaranteeing optimal heat transfer, long lifetime, trouble-free and user friendly operation.

**Customers Worldwide**

We take pride in being a family-owned company, which allows us to build close connections with our customers and guarantees a personal approach to each project. We strive to support our customers by engaging in dialogue and developing long-term partnerships. Our company is renowned world-wide and naturally we deliver to every corner of the world.

**Broadening Horizons**

By encouraging feedback from customers, APEX Group develops solutions and products that anticipate market needs. To materialize our concepts we have expanded our Engineering, Research and Manufacturing facilities. Apex engineers are continuously keeping up to date with the newest industrial developments in order to provide optimum design for our customers.



+31 (0)70 300 42 42

info@apexgroup.eu www.apexgroup.eu

**Euro-Apex B.V.**  
**Technology Centre**  
 Westeinde 10  
 2275 AD Voorburg  
 The Netherlands  
 +31 70 300 42 42

**Apex-Research B.V.**  
**Research & Development**  
 Westeinde 10  
 2275 AD Voorburg  
 The Netherlands  
 +31 70 300 42 42

**America-Apex B.V.**  
**Contractor**  
 Westeinde 10  
 2275 AD Voorburg  
 The Netherlands  
 +31 70 300 42 42

**Benelux-Apex B.V.**  
**Contractor**  
 Westeinde 10  
 2275 AD Voorburg  
 The Netherlands  
 +31 70 300 42 42

**Czechia-Apex B.V.**  
**Contractor**  
 Westeinde 10  
 2275 AD Voorburg  
 The Netherlands  
 +31 70 300 42 42

**Silesia-Apex Sp. z o.o.**  
**Contractor**  
 ul. Bojkowska 47A  
 44-141 Gliwice  
 Poland  
 +48 32 381 50 50

**Apex-Supply s.r.o.**  
**Material Service Centre**  
 Videnska 1513  
 69123 Pohořelice  
 The Czech Republic  
 +42 51 677 72 30

**Moravia-Apex, spol. s r.o.**  
**Fabricator**  
 Videnska 1513  
 69123 Pohořelice  
 The Czech Republic  
 +42 54 142 48 83

**Valachia-Apex S.R.L.**  
**Fabricator**  
 Aleea Duvenbeck 3  
 507055 Cristian, Brasov  
 Romania  
 t+40 26 847 11 99



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