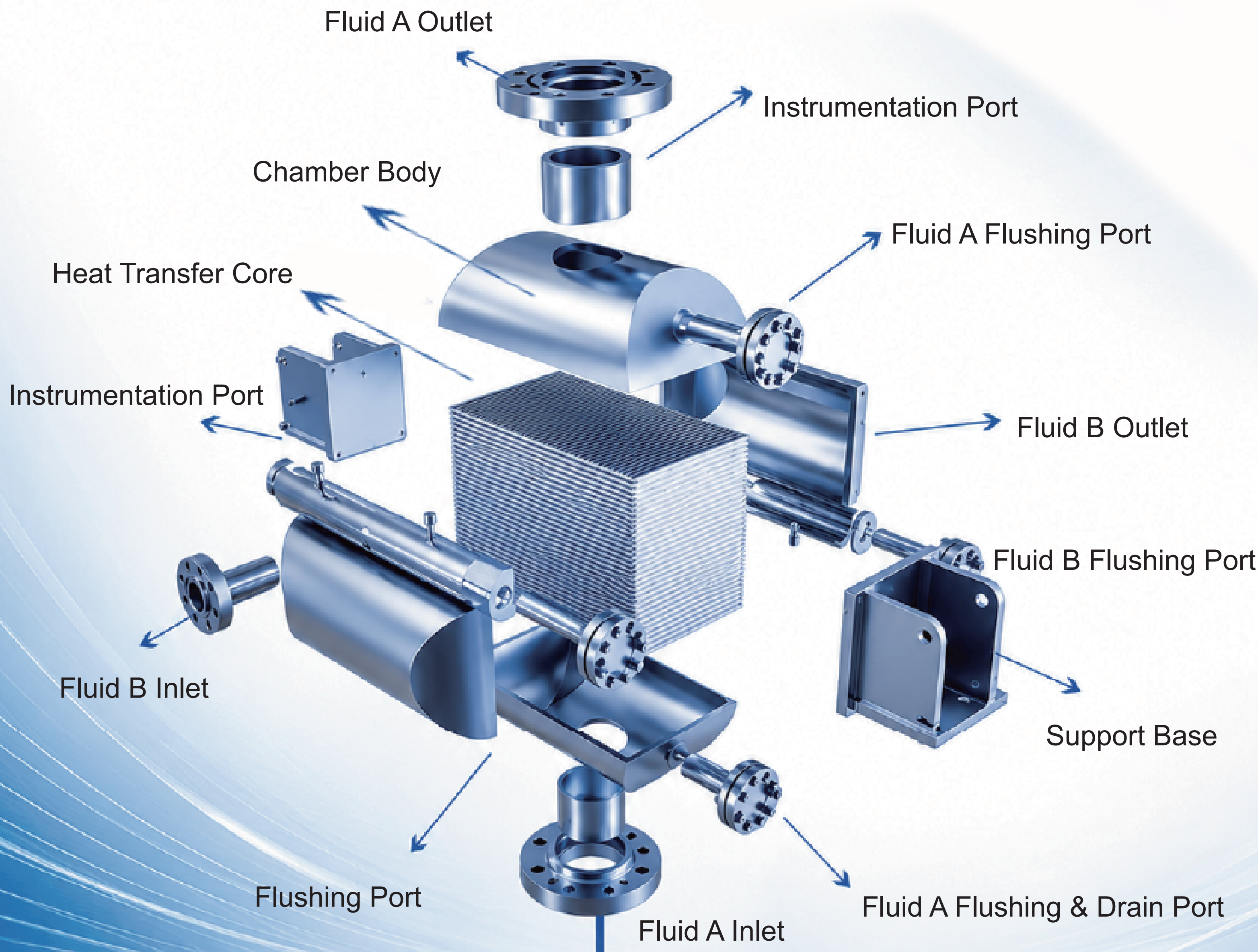
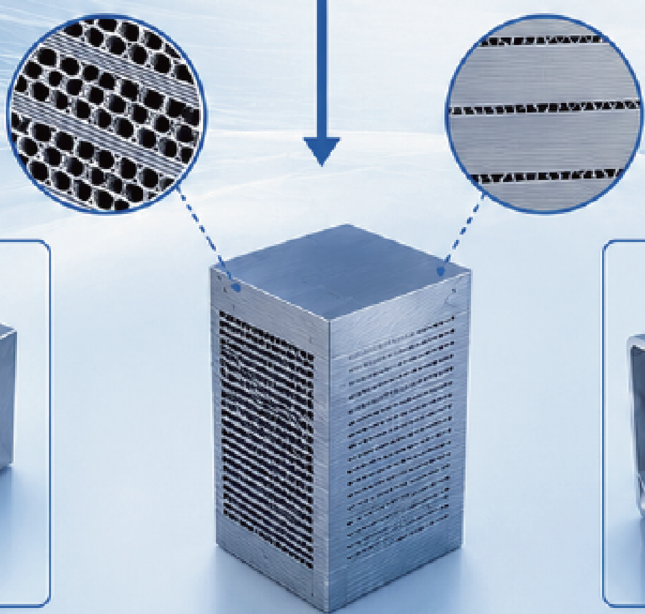
PCHE Technical Manual

Diffusion-Bonded Printed Circuit Heat Exchanger (PCHE)

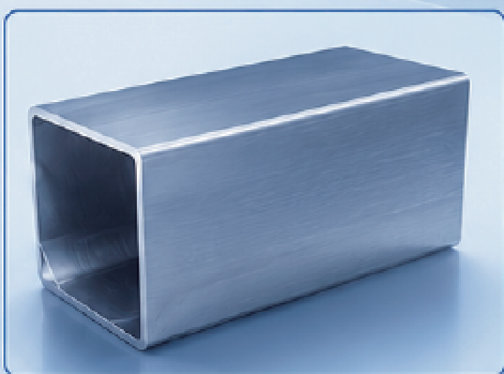
Product Exploded View



Crossflow Core



Asymmetric Core

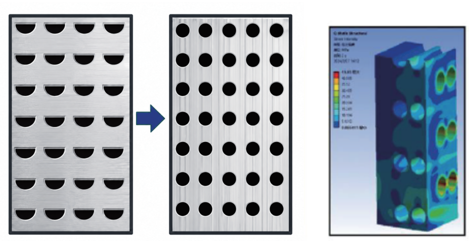


Counterflow Core

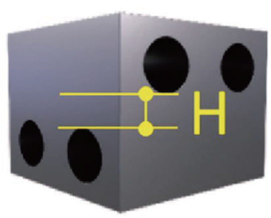
Product Features

1.The channel cross-section has been optimized from a semi-circular profile to a fully rounded design, significantly improving anti-clogging performance while eliminating stress concentration points. This enhances operational safety and extends service life.

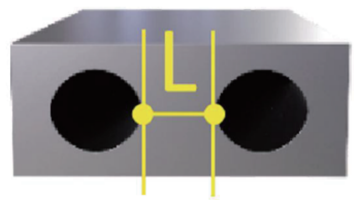
2.Through optimized manufacturing processes, the channel spacing is smaller than that of conventional etched-plate channels, delivering higher compactness and improved heat transfer efficiency.



Flow Channel Optimization & Stress Analysis Diagram



Vertical Channel Spacing (H)



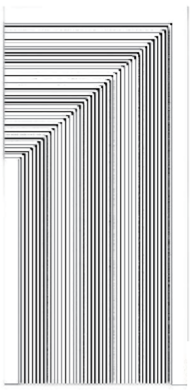
Horizontal Spacing (L) Schematic Diagram

Key Technologies

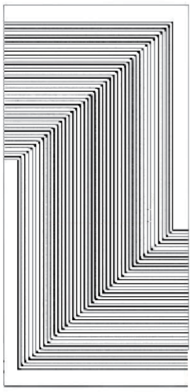
During the development of heat exchangers for supercritical CO_2 power generation systems, the company's R&D team has systematically mastered the core technologies across the entire microchannel heat exchanger development process.

Based on Printed Circuit Heat Exchanger (PCHE) technology, the team has implemented multiple innovative improvements in structural design, manufacturing processes, and heat transfer performance optimization.

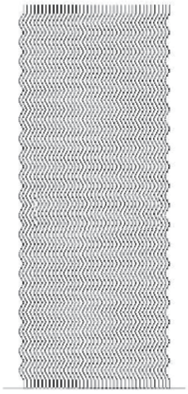
Design Configuration & Theoretical Optimization



L-Type Channel Configuration

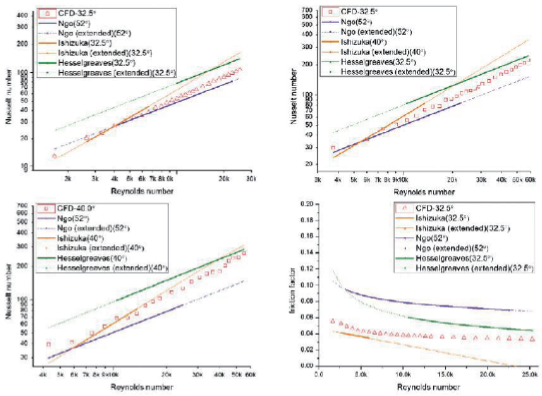


Z-Type Channel Configuration

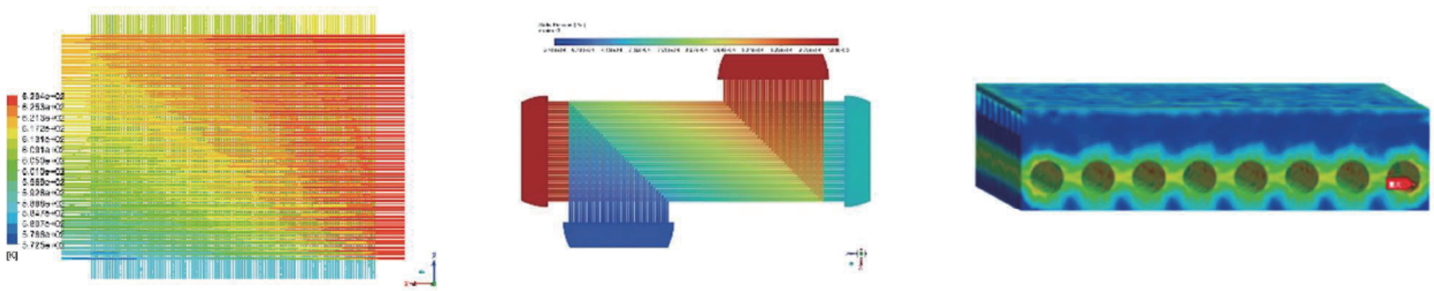


Wavy Channel Configuration

Common Channel Configurations

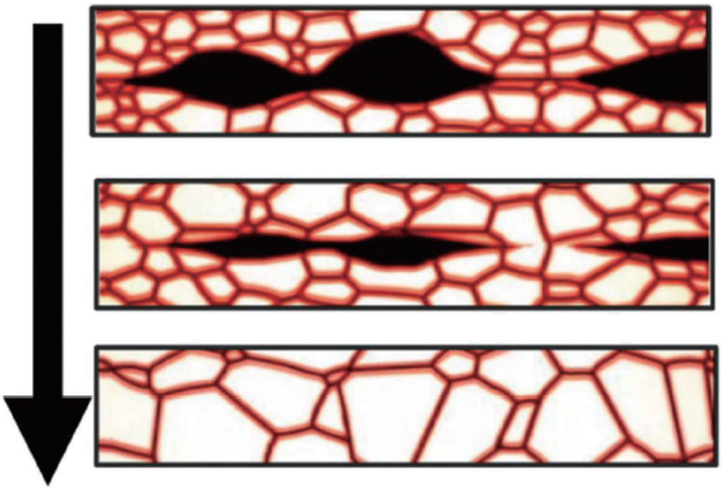


Comparison of Common Flow Resistance Correlations



Crossflow Heat Transfer Simulation Analysis

Solid-State Additive Manufacturing Technology



Upper and Lower Plates Closely Bonded

Vacuum Environment with Heating and Pressurization

Achieving Atomic-Level Bonding Between Plates

Product Performance

Heat Transfer Coefficient

The overall heat transfer coefficient can reach up to 8,183 W/(m²·K).

Test specimen: Crossflow capillary heat exchanger, dimensions 270 × 270 × 180 mm, with an equivalent channel diameter of 0.9 mm.

Test conditions: Hot-side inlet water temperature of 80°C, cold-side inlet water temperature of 35°C, with both sides operating at a flow rate of 13 kg/s.

检 验 报 告

Test Report

放热量	压力损失	热平衡误差	总传热系数
kW	kPa	%	w/(m²·K)
634.35	55.30	4.21	8183.59
635.35	55.40	3.27	8155.05
632.92	55.70	3.73	8128.48
633.43	55.90	1.66	8066.27
633.31	55.90	2.82	8081.30
632.38	55.90	1.78	8023.17
631.13	55.90	2.55	8040.24
628.30	55.90	3.42	8045.94

Product Advantages

Increase the heat exchange area

Under the same volume conditions, the heat transfer area is 7–10 times greater than that of conventional shell-and-tube heat exchangers, while offering lower weight and a significantly smaller footprint.

Short Production Cycle

Innovative manufacturing process optimization significantly shortens production lead times. Equipped with a complete production line, the company is capable of achieving large-scale manufacturing.

Low Maintenance Cost

The integrated core structure eliminates the need for gaskets and seals, significantly reducing leakage risks. In addition, the required fluid charge volume is reduced by more than 70%.

High Heat Transfer Efficiency

Compared with conventional heat exchangers, heat transfer efficiency is improved by 30–50%, with approach temperatures as low as 1°C and significantly higher heat transfer coefficients.

High Operational Safety

Utilizing diffusion bonding technology, the joint strength is equivalent to the parent material strength, providing excellent temperature and pressure resistance with a high safety factor.

Heat Exchanger Production Line Construction

Core Machining Center

The intelligent machining center completes the preliminary material processing, assembly, and stacking stages of the core manufacturing process.

Core Diffusion Bonding Process

The core undergoes seamless atomic-level bonding within the diffusion bonding equipment.

Intelligent Welding Center

Completes chamber welding, as well as the welding of the core to the chamber body and flanges.

Testing & Validation Center

Conducts comprehensive pre-delivery testing and inspection of heat exchangers to ensure product quality and operational safety.

Future Applications

Advanced applications across supercritical CO_2 power generation, hydrogen energy, LNG, oil & gas, chemical processing, and nuclear energy industries.

LNG Industry

Providing compact and high-efficiency heat exchange solutions for LNG liquefaction, refrigeration systems, boil-off gas handling, and cryogenic process cooling, particularly suitable for modular and offshore LNG applications.

Hydrogen Energy

Leveraging previous R&D and project experience in hydrogen compressor heat exchangers, hydrogen refueling stations, and hydrogen refrigeration systems, the company continues to expand its capabilities in high-pressure and cryogenic hydrogen applications.

Supercritical CO_2 Applications

Through strong collaboration with research institutes and universities, the company supports experimental platforms and industrial projects in the supercritical CO_2 field, including recuperators, precoolers, and high-efficiency compact heat exchange systems.

Chemical Industry

Providing microchannel heat exchanger and reactor solutions for highly integrated chemical processes, enabling enhanced thermal efficiency, compact system layouts, and improved process safety for demanding chemical applications.

Oil & Gas Industry

Designed for demanding oil & gas operating conditions, including high pressure, high temperature, corrosive media, and offshore environments, supporting applications such as gas processing, glycol systems, offshore platforms, and energy recovery systems.

Nuclear Energy

Participating in advanced nuclear energy projects through compact heat exchanger solutions for high-temperature and high-reliability operating conditions, including applications related to supercritical CO_2 Brayton cycle systems and next-generation nuclear energy technologies.

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