



PLATE CONCEPTS



PLATE & FRAME Heat Exchangers



PLATE CONCEPTS, inc.
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TABLE OF CONTENTS

<i>Section</i>	<i>Page</i>
Plate Concepts: Who We Are	2
Range of Products	3
Plate & Frame versus Shell & Tube Heat Exchanger	4
Plate Concepts Installation Gallery	5
Brazed Plate Heat Exchangers	9
Plate & Frame Heat Exchangers	10
MODU-FLEX™ Heat Transfer Plates	12
Gaskets	14
Fouling	15
Inquiry Form	17

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PLATE CONCEPTS: WHO WE ARE

A TRADITION OF EXCELLENCE

Plate Concepts (PCI) specializes in the design of Plate & Frame Heat Exchangers. The foundation of our company relies on the expertise of our engineers who have over 100 years of experience in heat transfer and plate heat exchanger technology. Over the last two decades, we have been a leading supplier with a proven record of providing economic solutions, quality equipment, and reliable service to a broad range of industries and commercial HVAC applications. Our success is premised on a commitment to excellence in design, workmanship, and service.

Based on our *MODU-FLEX™* series of plates, we offer a comprehensive range of Plate & Frame Heat Exchangers that can be used for a variety of applications.

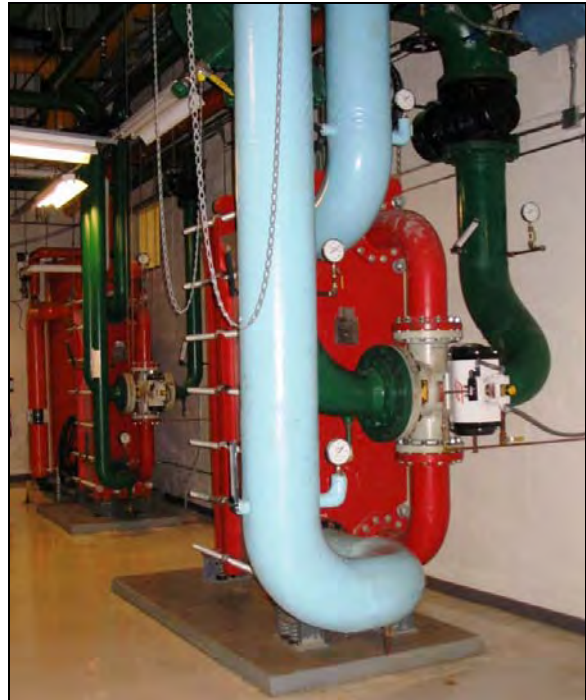


THE PLATE & FRAME HEAT EXCHANGER

The Plate & Frame Heat Exchanger (PFHX) is widely considered the most efficient type of heat transfer equipment available today. PFHX are often the lowest cost solution to heat transfer problems in the industrial and commercial HVAC markets.

PFHX ADVANTAGES

- High Thermal Efficiency
- Compact Size
- Easy Maintenance
- Ideal for Heat Recovery
- Low Overall Cost
- Low Fouling
- Small Footprint
- Flexible Design / Expandable
- Close Approach Temperatures
- On-line Reliability



EXPERTISE

Since our beginning, PCI has been committed to be the leader in providing quality heat transfer solutions using Plate & Frame Heat Exchangers. Our manufacturing organization and technical marketing staff have in-depth knowledge, application expertise and extensive experience in assisting our valued customers in all aspects of our business including:



- Sizing & Design
- Rating
- Optimization
- Engineering
- Purchasing
- Construction
- Spare Parts
- Manufacturing
- Field Service



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COMPLETE RANGE

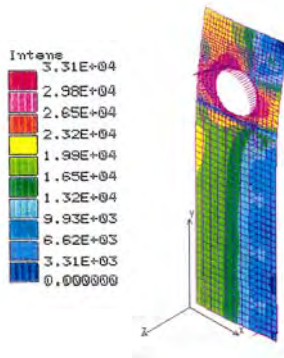
Plate Concepts offers an extensive range of PFHX innovations and design capabilities to meet your heat transfer needs.

- A complete line of *MODU-FLEX™* plates with port diameter sizes from 1" to 20" (5 - 15,000 GPM).
- Plate materials of construction in stainless steel (304 SS, 316 SS), Titanium, 254 SMO, or Hastelloy™.
- Frame designs that can accommodate up to 15,000 sq. ft. of heat transfer surface in a single frame.
- Design Pressures ranging from 150 to 400 PSIG.
- PFHX strictly designed & constructed in accordance with the latest ASME Code Section VIII, Div.1 requirements.
- ASME Code stamped (UM or U) units registered with the National Board
- Gaskets materials in Nitrile (NBR), EPDM or Viton
- Additional innovations such as Free-Flow (Wide-Gap), Welded Cassette & Double Wall plate designs.
- Copper or Nickel brazed stainless steel units



Partial List of Industries Served by PCI

- Power Generation
- Commercial HVAC
- Pulp & Paper
- Steel
- Metals & Mining
- Chemicals
- Oil & Gas Refining
- Pharmaceuticals
- Surface Finishing



ADVANCED TECHNOLOGY

Plate Concepts complements its craftsmanship with the latest advances in technology. Computerized systems for thermal rating & mechanical design, finite element analysis and new fabrication techniques ensure the highest quality Plate & Frame Heat Exchangers at the most economical price.



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BENEFITS COMPARISON: Plate & Frame vs. Shell & Tube Heat Exchangers

HIGHER EFFICIENCIES

- 1/3 - 1/2 the surface area required by S&T
- 2 °F approach temperatures
- 90% heat recovery
- Suitable for temperature crosses

LOWER FOULING

- High turbulence & shear reduce fouling
- No dead spots
- 1/10 S&T design fouling factors
- Above results verified by HTRI & HTFS

EASIER MAINTENANCE

- Easily opened for inspection & cleaning
- Both fluid streams equally accessible

LESS SPACE, WEIGHT & VOLUME

- 1/10 liquid hold-up
- 1/3 to 1/2 shipping weight
- 1/6 operating weight
- 1/4 to 1/2 overall length

MODULAR CONSTRUCTION

- All bolted construction
- Expandable for capacity increases & upgrades
- Easily modified for another service
- On-site field assembly (even in skyscrapers)

ADVANTAGES

- Low first cost
- Easy maintenance
- Small foot-print
- Flexible capacity



**FROM THE BIGGEST
TO THE SMALLEST**

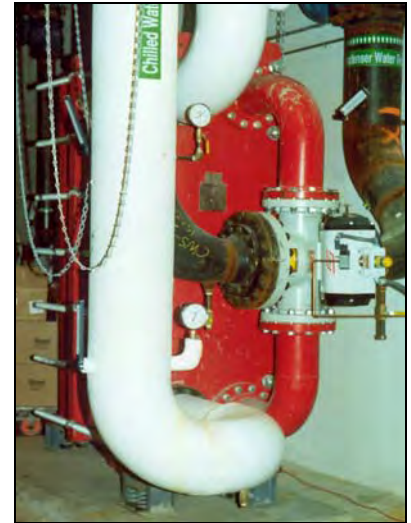
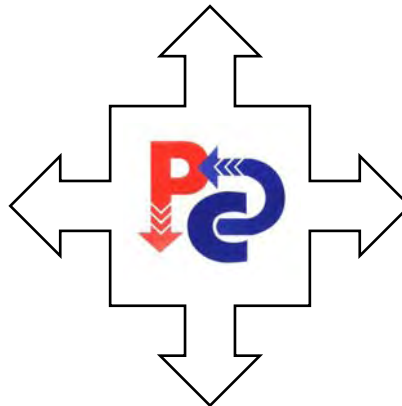
Our innovative MODU-FLEX™ series of plates provides the broadest range of sizes and outstanding quality with the latest advances in enhanced surface plate heat transfer technology.



Mid-Atlantic Power Plant
Auxiliary Cooling Water Heat Exchanger
MODU-FLEX™ Model MFK200 - 20" ports
Design Pressure: 150 PSIG
Heat Transfer Area: ~ 13,000 ft²

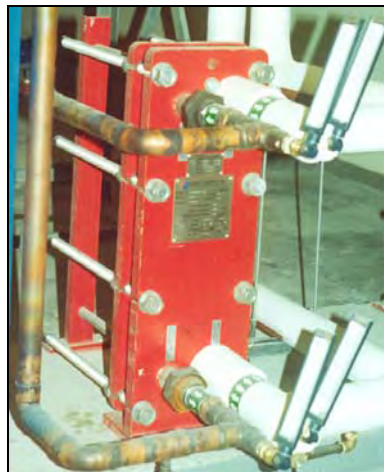


New York Business Center
Chiller By-Pass
MODU-FLEX™ Model MFK084 - 8" ports
One of Three Units
Design Pressure: 300 PSIG
Heat Transfer Area: 4000+ ft²



Modern NYC High-Rise
Free Cooling Exchanger
MODU-FLEX™ Model MFK063 - 6" ports
With 6" Diverter Valves & Controls
Design Pressure: 300 PSIG
Heat Transfer Area: ~ 1500 ft²

New York Business Center
Kitchen Water Heater
MODU-FLEX™ Model MFK022 - 2" ports
Design Pressure: 300 PSIG
Heat Transfer Area: ~ 75 ft²



 *For additional information,
contact Plate Concepts.*

**HIGH EFFICIENCY
AT ITS BEST**

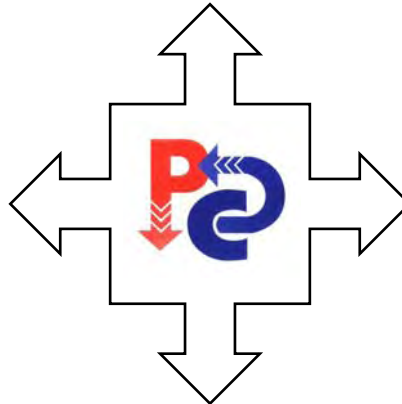
Close temperature approaches can be achieved economically for maximum energy conservation.



NYC Mid-Town Hotel
Free Cooling Exchangers
MODU-FLEX™ Model MFK063 - 6" ports
Three in Parallel
Design Pressure: 300 PSIG
Heat Transfer Area: ~ 2,200 ft²



Major US City Business Center
Cooling Tower Isolation
MODU-FLEX™ Model MFK063 - 6" ports
With Diverter Valves & Controls
Design Pressure: 300 PSIG
Heat Transfer Area: ~ 1,800 ft²



Modern Hotel
Chilled Water Exchanger
MODU-FLEX™ Model MFK082 - 8" ports
Design Pressure: 300 PSIG
Heat Transfer Area: ~ 5,200 ft²

Power Generation Plant
Auxiliary Cool Water Exchanger
MODU-FLEX™ Model MFK201 - 20" ports
Design Pressure: 150 PSIG
Heat Transfer Area: ~ 12,000 ft²



*For additional information,
contact Plate Concepts.*

**COMPACT DESIGN
IDEAL FOR
TIGHT SPACES**

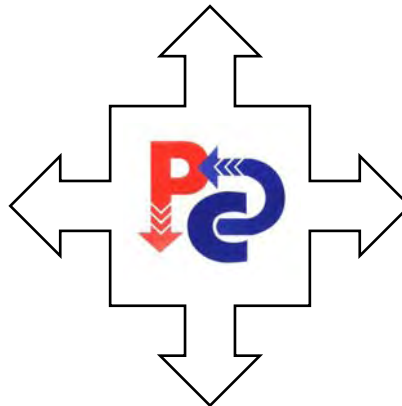
Minimal footprint enables installation at locations where available space is at a premium.



Food Processing Plant
Enzyme Temperature Control
MODU-FLEX™ Model MFL041 - 4" ports
Design Pressure: 150 PSIG
Heat Transfer Area: ~ 300 ft²




Major US City Business Center
Condenser Water Cooler
MODU-FLEX™ Model MFK081 - 8" ports
With Diverter Valve & Control
Design Pressure: 300 PSIG
Heat Transfer Area: ~ 3,000 ft²



Times Square High-Rise
Three Parallel Chilled Water Economizers
MODU-FLEX™ Model MFK101 - 10" ports
With Diverter Valves & Controls
Design Pressure: 150 PSIG
Heat Transfer Area: ~ 10,000 ft²

Computer Chip Manufacturer
Batch H Cooler
MODU-FLEX™ Model MFK021 - 2" ports
Design Pressure: 150 PSIG
Heat Transfer Area: ~ 25 ft²



 For additional information,
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**APPLICATION
VERSATILITY**

- Power Generation
- Chemicals
- Food & Beverage
- Pulp & Paper
- Lube Oils
- Steel

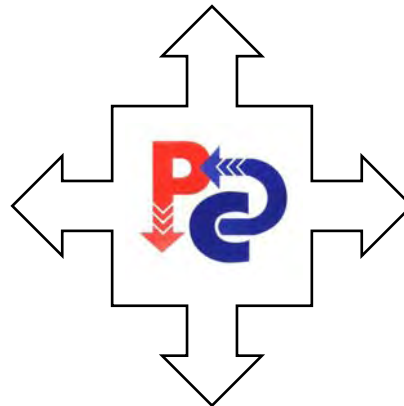
and many more...



Southern Power Plant
Closed Water Exchanger
MODU-FLEX™ Model MFK201 - 20" ports
Design Pressure: 150 PSIG
Heat Transfer Area: ~ 8,000 ft²



Adhesive Manufacturer
Formaldehyde Cooler
MODU-FLEX™ Model MFK022 - 2" ports
Design Pressure: 150 PSIG
Heat Transfer Area: ~ 200 ft²



Specialty Oil Processor
Batch Cooler & Heater
MODU-FLEX™ Model MFK043 - 4" ports
Design Pressure: 150 PSIG
Heat Transfer Area: ~ 350 ft²

Chocolate Processor
Process Water Cooler
MODU-FLEX™ Model MFK042 - 4" ports
Design Pressure: 150 PSIG
Heat Transfer Area: ~ 125 ft²




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BRAZED PLATE HEAT EXCHANGERS

Plate Concepts Brazed Plate Heat Exchangers are custom designed to meet the specific needs of our clients. The type of brazed heat exchanger and the required number of plates are determined by duty requirements, fluid media, temperature profile, flow range and hydraulic conditions.



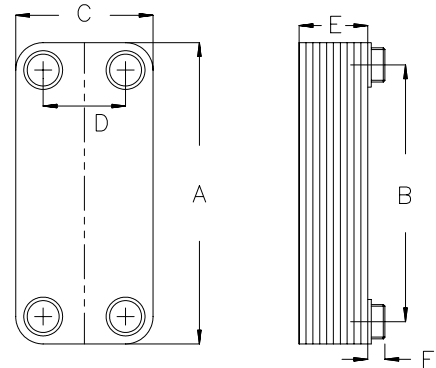
CONSTRUCTION DATA:	
Maximum Working Pressure	362 psig
Test Pressure	471 psig
Maximum Working Temperature	365 °F
Minimum Working Temperature	-300 °F

Materials of Construction:

Plates & Connections: AISI 316 SS brazed with copper

Construction: Pressed metal plates assembled in plate packs with the chevron pattern reversed in every other plate. The ridges of the pattern intersect on adjacent plates - forming a lattice of contact points. Each adjacent pair of plates forms a channel. The stainless steel plates are then brazed with copper in a high temperature vacuum furnace.

Operation: The hot and cold media are in counter-current flow to each other in alternate channels. The plate pattern induces intense turbulence in the hot & cold channels - resulting in a high heat transfer coefficient and maximum heat transfer.



Model	A	B	C	D	E	F	Conn Size NPT*	Weight LBS	Area/Plate FT ²	Vol/Channel Gallons
MBC25	12-1/4"	11"	3"	1-5/8"	(N x 0.078)+0.2	1"	1/2" & 3/4"	(N x 0.20)+2.2	0.250	0.083
MBC36	12"	9-7/8"	4-3/16"	2"	(N x 0.085)+0.3	1"	3/4" & 1"	(N x 0.28)+2.7	0.362	0.014
MBC37	11-1/2"	9-1/2"	4-3/16"	2-1/2"	(N x 0.08)+0.3	1"	3/4" & 1"	(N x 0.28)+2.7	0.372	0.117
MBC75	19-5/8"	17-1/2"	4-3/16"	2-1/2"	(N x 0.09)+0.4	1"	1-1/2"	(N x 0.47)+3.3	0.753	0.267
MBC150	23-7/8"	20-1/2"	9-3/8"	5-7/8"	(N x 0.1)+0.4	1-5/8"	2-1/2"	(N x 1.11)+4.9	1.506	0.700
MBC350	46-1/2"	33-11/16"	15"	9-3/8"	(N x 0.108)	Flanged	4"	(N x 2.826)+110.7	3.580	2.670

N = Number of plates

*Other sizes available

Solder Connections available



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PLATE & FRAME HEAT EXCHANGERS

Design:

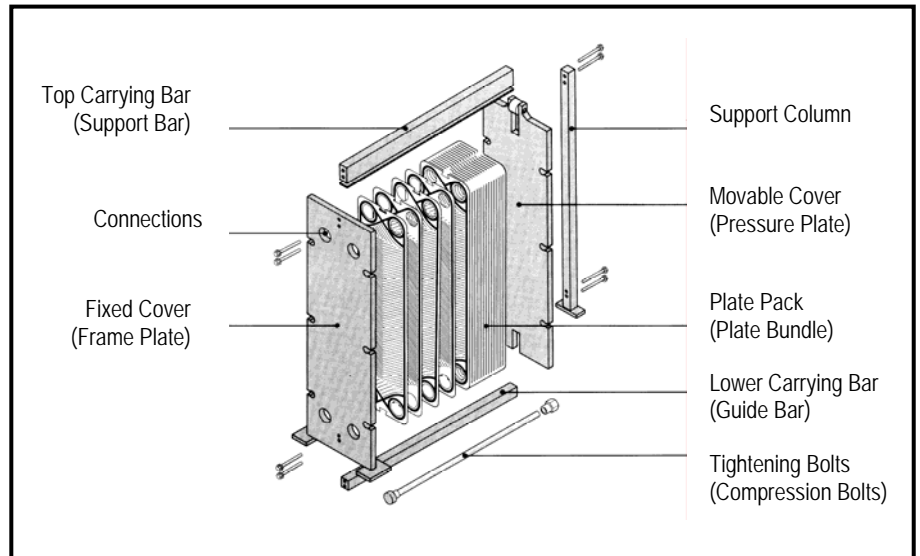
Plate Concepts *MODU-FLEX™* series Plate & Frame Heat Exchangers (PFHX) are designed to meet the heating and cooling duties specified by customers in a broad range of industries and services.

Advanced sizing programs calculate the required heat transfer area based on the stated duty, fluids, temperature program, flow rates and hydraulic conditions for both the hot & cold circuits. The PFHX model and number of plates are determined from this data.

Construction:

The PFHX is an assembly of metal plates pressed with a chevron pattern equipped with elastomer gaskets. The plates are assembled within a structural frame consisting of the following components:

- Fixed Cover & Movable Cover
- Top & Bottom Carrying Bars
- Tightening Bolts & Support Column



Materials of Construction:	
Frame	Carbon Steel, epoxy painted
Connections	Stainless Steel, Titanium, Hastelloy™, or Rubber-lined
Plates	304 SS, 316 SS, Titanium, 254 SMO, Hastelloy™
Gaskets	NBR, EPDM, Viton, Hi-temp NBR & EPDM
Frame Design Pressures	Up to 400 psig ASME



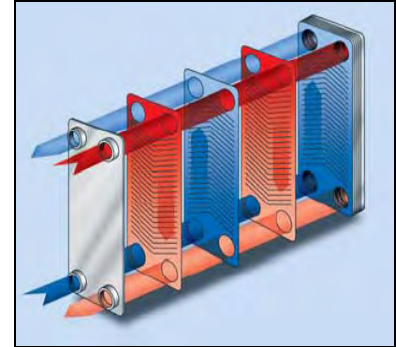
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Flow Principle of the PFHX:

- When fluid enters the PFHX, the gaskets on each plate direct and contain the hot and cold fluids in alternating plate channels.
- The hot and cold circuits flow in opposite or counter-current directions.
- Heat transfers from the hot circuit to the cold circuit through the plates.



PFHX Nomenclature:

TERM	DEFINITION
FIXED COVER or FRAME PLATE	The fixed cover of the PFHX is where all of the connections are usually located. This allows the PFHX to be opened without removing any piping connections.
FRAME	The frame provides structural support and pressure containment for the plate pack.
GASKETS	Elastomer gaskets on each plate direct and contain the hot and cold media through the proper channels.
LOWER CARRYING BAR or GUIDE BAR	The lower carrying bar guides and helps align the plates. It is bolted horizontally to the fixed cover and the support column.
MOVABLE COVER or PRESSURE PLATE	The movable cover of the PFHX permits access to the unit for inspection and / or cleaning. It is supported and guided by the carrying bars.
PLATES	Metal plates pressed with a herringbone pattern and equipped with portholes and gaskets Plate pattern induces a high degree of turbulence in the channels & optimizes heat transfer efficiency
PLATE PACK or PLATE BUNDLE	The plate pack is the assembly of gasketed metal plates between the fixed and movable covers. Heat transfer takes place through alternating hot and cold channels in the plate pack.
PROTECTIVE SHROUD	A metal shield placed over the plate pack to provide personnel protection against fluid leakage.
SUPPORT COLUMN or END SUPPORT	This column supports the carrying bars and extends to the foundation to make the PFHX totally rigid.
SUPPORT PAD	The pad attached to the fixed cover for front support of the PFHX.
TIGHTENING BOLTS or COMPRESSION BOLTS	These bolts are used to compress the plate pack together between the fixed and movable cover.
TIGHTEN DIMENSION (TD)	The distance between the inside of the fixed and movable covers when the plate pack is compressed.
TOP CARRYING BAR or SUPPORT BAR	The top carrying bar is joined horizontally to the fixed cover and the support column.



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ABOUT MODU-FLEX™ HEAT TRANSFER PLATES



Plate Concepts *MODU-FLEX*™ Plates are designed to obtain the maximum heat transfer coefficient. Our plates are corrugated with a herringbone pattern and arranged into a pack with the chevron angles pointing alternately up and down on adjacent plates.

This configuration provides the following advantages:

- Rigidity and strength due to numerous support points between the plates
- PFHX design pressures up to 400 psig
- High turbulence resulting in higher heat transfer coefficients
- Reduction in fouling of the heat transfer surfaces due to intense shear

Each plate contains:

- Flow directors at the top and bottom of the heat transfer surface
- Porthole area patterns designed to evenly distribute the fluids across the plate

Two different plate styles with different chevron angles allow for three different channel designs to be used inside one plate pack.

Pure High, Pure Low or Mixed Theta channels can be combined to optimize performance by reducing the required heat transfer area while utilizing the available pressure drop in full.

To optimize PFHX performance, two styles of plates are used in combination within a plate pack:

Style 1: High Theta Plates

- Corrugated with obtuse chevron angles
- Generate very high turbulence
- Extremely high heat transfer rates
- High pressure loss



Style 2: Low Theta Plates

- Corrugated with acute chevron angles
- Generate lower turbulence
- Lower heat transfer rates
- Less pressure loss





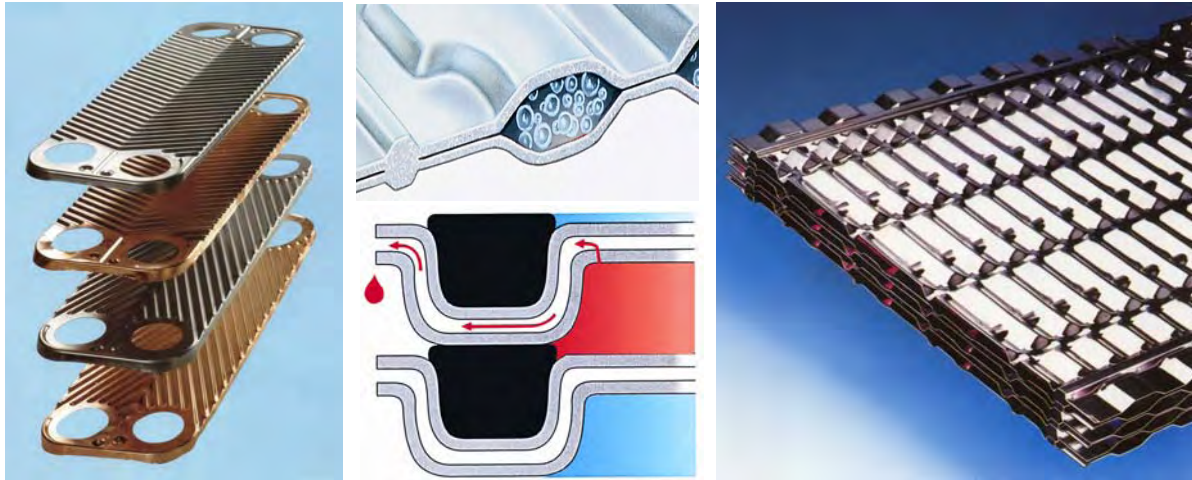
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Additional Plate Innovations

- | | |
|---------------------|---|
| Brazed Plates: | Stainless steel brazed in Copper or Nicked |
| Double Wall Plates: | Provide double wall protection from contamination |
| Free-Flow Plates: | Pressed with a wide channel gap for fibrous or slurry media |
| Welded Cassette: | Laser-welded seal for a channel set formed by two plates |



MODU-FLEX™ Plate Specifications

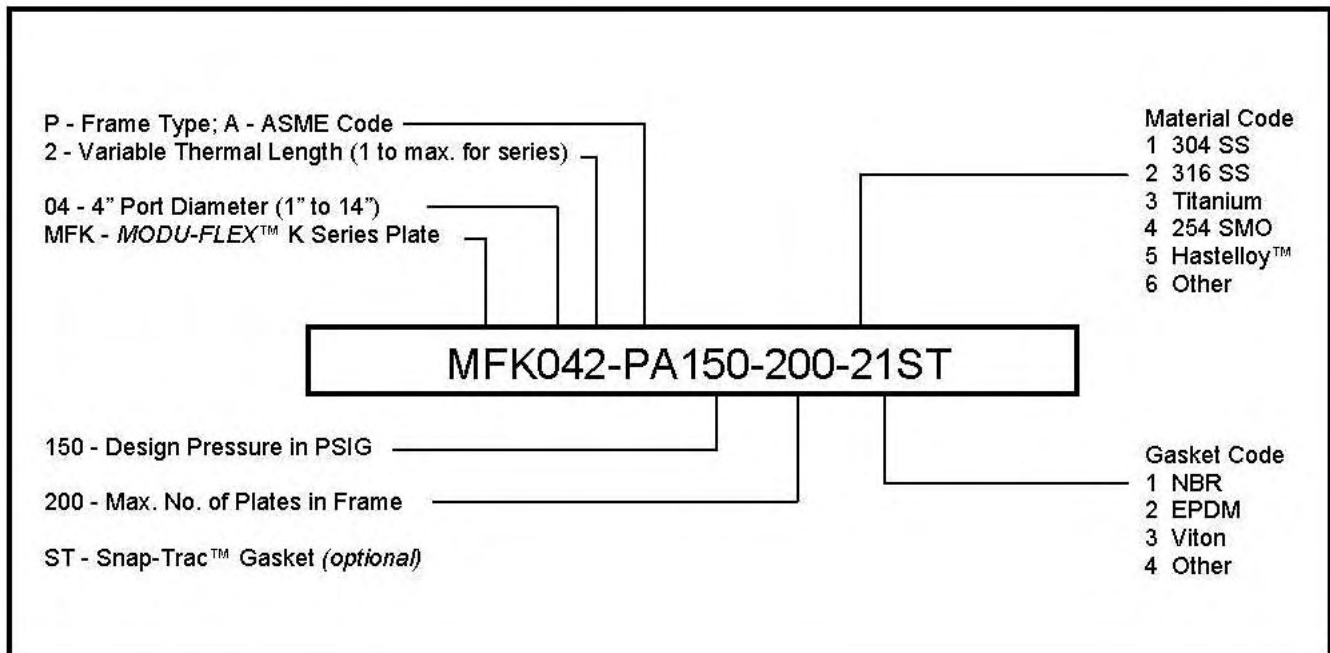




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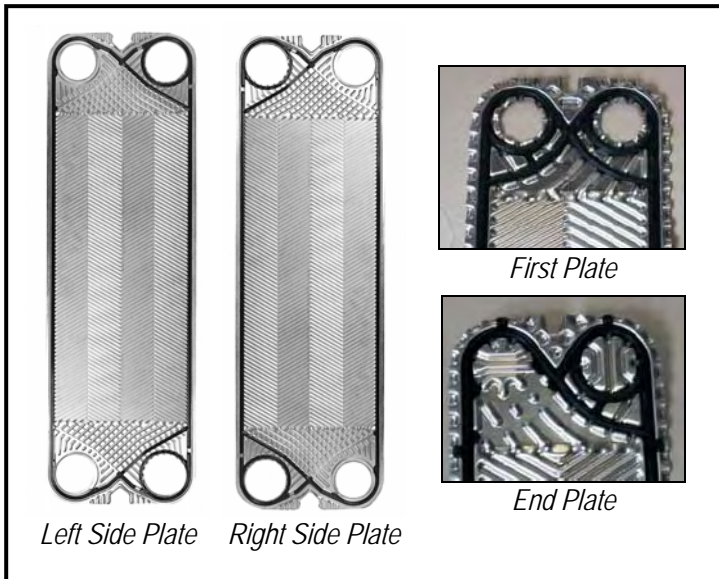
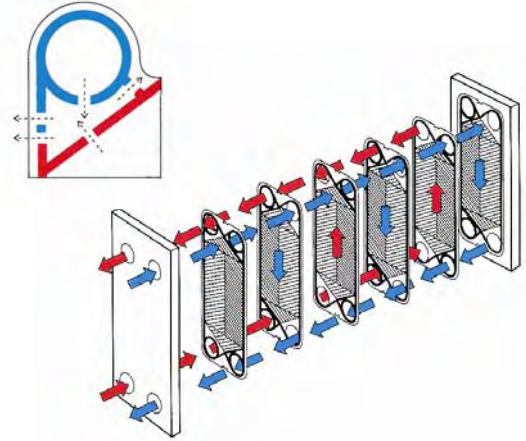
THE GASKETS

Basic Functions of the Gasket:

- To keep the fluid contained within the plates
- Direct the flow of the hot and cold circuits

Double Gasket Design:

- Dual safety protection
- Prevents media intermixing
- Vents provide a path to the atmosphere for media leakage



The **Left and Right Side Plates** have gaskets arranged so that the fluids will flow in alternate channels in a same side flow pattern, either from top to bottom right or from top to bottom left.

The **First Plate** does not act as a heat transfer plate because it has four O-ring gaskets that prevent fluid from flowing between it and the fixed cover.

The **End Plate** does not have any portholes and prevents fluid contact with the movable cover.

Optional Sealing Systems:

- **Glued Gaskets:** Gasket is retained in its groove by an adhesive compatible with both process fluids and materials of construction.
- **Snap-Trac™ Gaskets:** Glue-free gaskets are “snapped” into place along a specially designed sealing groove that facilitates servicing.





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FOULING

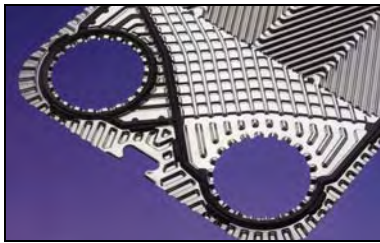
Fouling in the Plate & Frame Heat Exchanger is a complex subject that can manifest itself in several different ways.

The following types of fouling generally occur in the PFHX:

- Sedimentation (solids in suspension)
- Biological (marine or organic)
- Scaling or Deposition (calcium carbonate)
- Corrosion

Maximum Particle Size

Suspended particles and granular solids > 1/8" (3mm) diameter typically get trapped in the inlet portal and do not flow into the plate channels. Particles < 1/8" (3mm) diameter can generally flow through the PFHX channels without risk of build-up.



Inlet Port Area

Plate & Frame Heat Exchanger Accessories

Strainers for the inlet port or the inspection port in the movable cover are available to protect the plate pack from large particulates clogging the channels.

Clean-in-Place (CIP) systems are another option for cleansing the PFHX. CIP systems circulate a pre-heated detergent through the PFHX at a suitable flow rate to dissolve deposits.

Back-Flushing in reverse flow with a Diverter Valve is also an effective method for cleaning the port area without opening the PFHX.

Note: Fibers can pose a problem for standard PFHX designs because they tend to nestle and get hung-up on the contact points in the plate channels. Wide-Gap or Free-Flow plate designs should be considered for such services.

View inside plate pack portal



Advantages to Plate Concepts PFHX Design:

- Turbulence & high shear rates induced by *MODU-FLEX™* Plates enables small particles to flow through the PFHX
- No stagnant areas where solids can build-up
- Easy accessibility for mechanical cleaning
- High Turbulence + Reduced Fouling = Low Maintenance

Prevention Methods

Sedimentation:	<ul style="list-style-type: none"> • Strainers (in-line filters or screens) • Back-Flush with diverter valves • CIP (Clean-in-Place) systems
Biological:	<ul style="list-style-type: none"> • Chlorination (NaOCl) with strainers • Back-Flush
Scaling:	<ul style="list-style-type: none"> • Inhibitors to retard scale formation • PFHX design factors such as velocity (increased turbulence; high shear rates) • No dead spots (good flow distribution) • Surface finish and materials • CIP system
Corrosion:	<ul style="list-style-type: none"> • Plate material in Stainless Steel, Titanium, Hastelloy™, Nickel

Note: Keep in mind that PFHX can easily be opened so that all heat transfer surfaces are exposed and thus easily accessible for mechanical cleaning and / or pressure washing.



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Fouling Factors

Fouling factors that are used today by most engineers were developed by TEMA (Tubular Exchangers Manufacturers Association) for Shell & Tube Heat Exchangers. Over the last 20 years, these factors have been deemed to be not applicable in many industries (e.g. by API – American Petroleum Institute) for Plate & Frame Heat Exchangers for the following reasons:

- Velocities in PFHX are normally between 1 to 2.5 ft/sec but the herringbone plate pattern and the small plate gap produce high shear rates thus decreasing the tendency of the plates to foul.
- Specifying too large a fouling factor results in high excess area margins in PFHX to the extent that fouling rates may actually increase. By adding plates in parallel to obtain a desired fouling factor, the flow velocities inside each parallel channel are reduced, thus increasing fouling risks.
- Using advanced thermal length plates can allow for higher safety margin without adding plates in parallel.

- In designing PFHX for a specific duty, performance reliability is enhanced by allowing sufficient pressure drop through the channels on each side such that high shear due to increased velocities can be realized to minimize fouling rates.
- Independent tests have shown that the incidence of fouling is approximately 1/10th that of Shell & Tube Exchangers.

Although fouling factors are an important consideration for heat exchanger design, instead of using Shell & Tube fouling factors, a specified excess area percent margin is best suited for PFHX. This is a measure of excess area included in the design defined as a percentage safety margin to allow for fouling over clean conditions.

The typical excess area margin for most applications is 10% (the percentage commonly used today by most PFHX manufacturers). Sea water applications may require a higher margin (e.g. 15%) if biological fouling is a likely scenario.





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PFHX FAX FORM

For best estimate, fill out the items in blue.

Customer:	Phone:	Ext.:
Address:	Fax:	
City, State, Zip Code:	Project/RFQ#:	
Contact:	Number of Units:	
Email:	ASME Code Stamp:	<input type="checkbox"/> Yes <input type="checkbox"/> No

▶▶ Design Conditions			
Thermal Performance	Units**	Hot Side	Cold Side
Fluid Name			
Flow Rate	GPM (or lb/hr)		
Temperature In	°F		
Temperature Out	°F		
Allowable Pressure Drop	PSI		
Operating Pressure	PSIG		
Heat Load	Btu/hr		
Fluid Condensed or Vaporized	lb/hr		
▶▶ Fluid Properties			
Concentration	%		
Density (Spec. Gravity)	lb/ft ³		
Specific Heat	Btu/lb-°F		
Thermal Conductivity	Btu/hr-ft-°F		
Viscosity	cP		
Latent Heat	Btu/lb		

Construction

Plates

- 304 SS
- 316 SS
- Titanium
- Hastelloy™
- 254 SMO
- Other: _____

Gaskets

- NBR
- EPDM
- VITON
- Other: _____

▶▶ Connections		
Design Pressure	PSIG	
Design Temperature	°F	

For a quotation, please complete and fax this form to Plate Concepts at 908-236-9575 or email to info@plateconcepts.com.

**Units can also be in metric or SI units