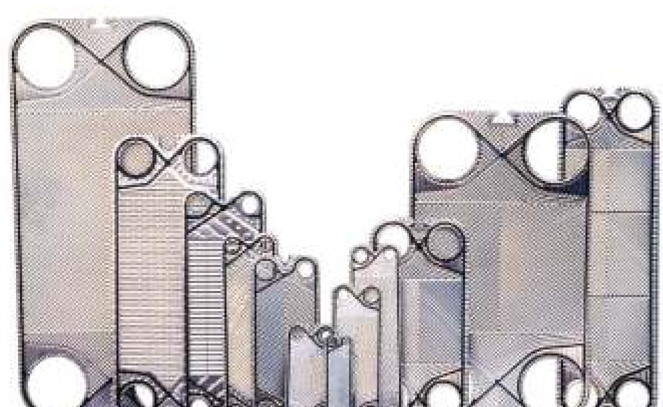
SEC Heat Exchangers

PLATE HEAT EXCHANGER
Operating Manual

Customer Name:
Serial Number:
Purchase order number:
Project Name:



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NAME PLATE:

To assist us to reply to questions please quote your serial number:

PROCESS SIDE		SERVICE SIDE	
DATE BUILT		UNIT TYPE	
SERIAL NO.		SURFACE AREA	
DESIGN PRESS.		DESIGN TEMP.	
TEST PRESS.		EMPTY WEIGHT	
PLATE MAT'L.		GASKET MAT'L	

CHANNEL ARRANGEMENT X PASS NO.

ORIGINAL TIGHTENING DISTANCE

WORK COVER APPROVAL No.

SEC Heat Exchangers

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Basic Unit Information

UNIT TYPE:	SERIAL NUMBER:	HOT SIDE	COLD SIDE
		FLUID: IN: OUT: FLOW:	FLUID: IN: OUT: FLOW:

1.0 PRINCIPLE OF THE PLATE HEAT EXCHANGER (PHE)

1.1 PRINCIPLE

The PHE is composed of corrugated thin alloy plates, which are hung between top and bottom guide bars.

The plates are compressed by bolts between fixed and movable frames, until metal to metal contact is reached and a channel is formed. The manner in which the gaskets are fitted enables alternative flow channels to be created and heat transfer to pass from one side of the plate to the other.

The alternative channels maximises the heat transfer surface in a compact manner. Therefore, it can produce the most effective performance from the compact size.

1.2 FEATURES OF PHE

- **High performance** : The total heat transfer co-efficient of the PHE is 2,000-6,00O Kcal/m2/hrC. The value is 3 to 10 times higher than the traditional shell and tube heat exchanger.

- **High economic tendency**: The PHE can maximise energy transfer efficiently from the unique combination of high turbulence and thin plate technology for any given unit size.

- Maintenance costs are also reduced due to it’s compact size.

- **Variety of Options**: The PHE has been developed to allow many types of plates and gaskets for a large number of applications.

  Changing the number of plates or configuration of the plate pack allows for a change in duty requirements in the shortest possible time. Maintenance is also greatly simplified, should Re-gasketing or the cleaning of the plate surfaces be required.

2.0 FLUSHING

Before first running a unit, the pipes should be flushed out and all foreign material removed e.g. (sand, welding slag etc).

Failure to do so may void the warranty and affect heat transfer rates.

3.0 GENERAL OPERATING INSTRUCTIONS

- Check the sealing of the plates.

- Check the outlet valve is opened.

- Open the inlet valve of the PHE.

- Run the pump.

- Open the pump outlet valve slowly, watching the PHE's inlet pressure meter, if fitted.

- Control the amount of liquid according to the temperature gradient.

- Start the cold side of the unit first and then the hot side.

- In the case of steam, pass the medium liquid first, then steam slowly.

4.0 Long Term Storage

When the PHE has not been in operation for an extensive period of time, make the following arrangements.

- Disassemble and clean the plates, and loosen the bolts (100 plates / 50Omm)

- If the PHE is not easily disassembled, clean the PHE with water or chemical solvent and loosen the bolts to release the liquid.

- Do not keep any unit in an unclean condition for an excessive period of time, as corrosion of the plate surface may occur.

5.0. CONSTRUCTION OF THE PLATE HEAT EXCHANGER

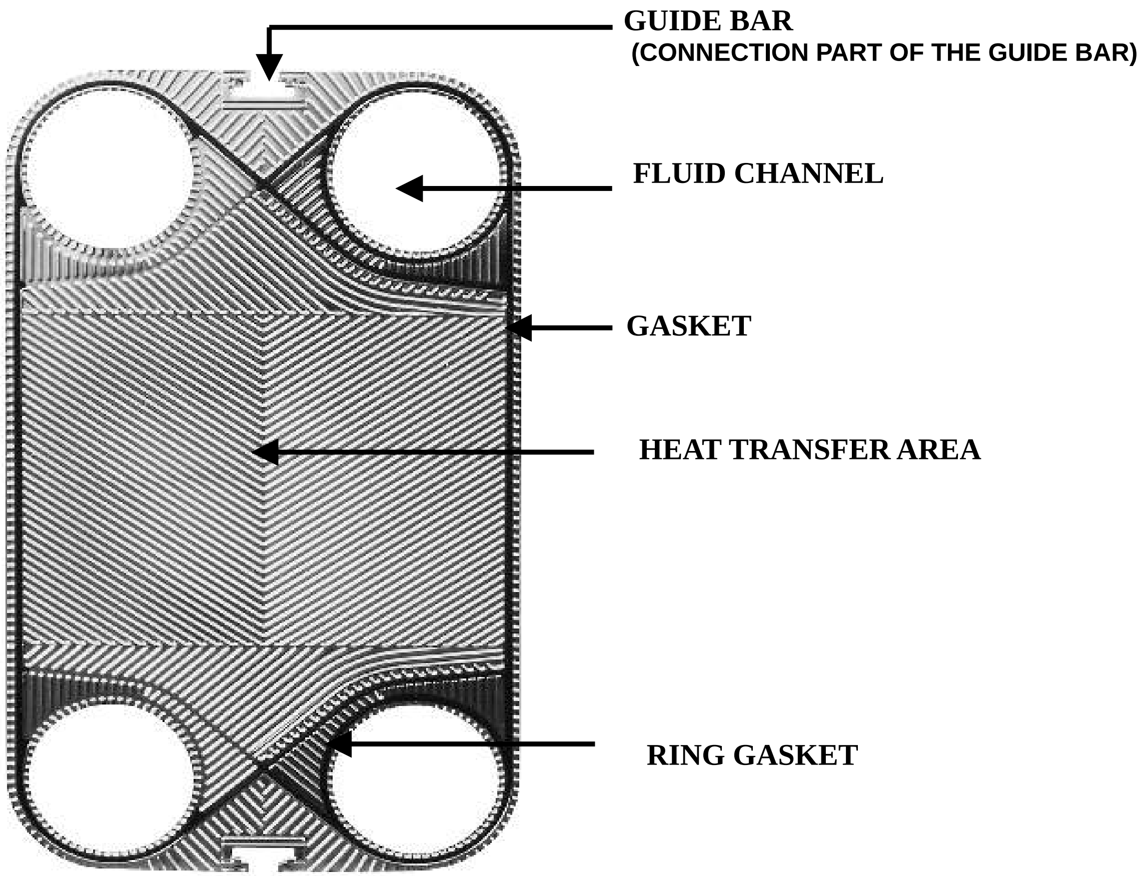
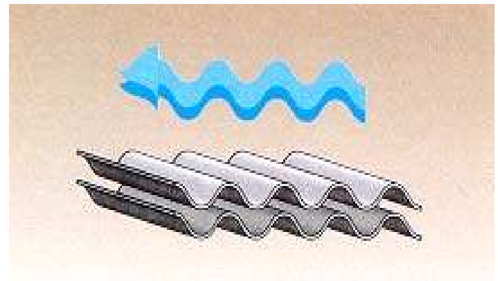


Fig. 1 PLATE
(MAIN FEATURES OF A HEAT TRANSFER PLATE)

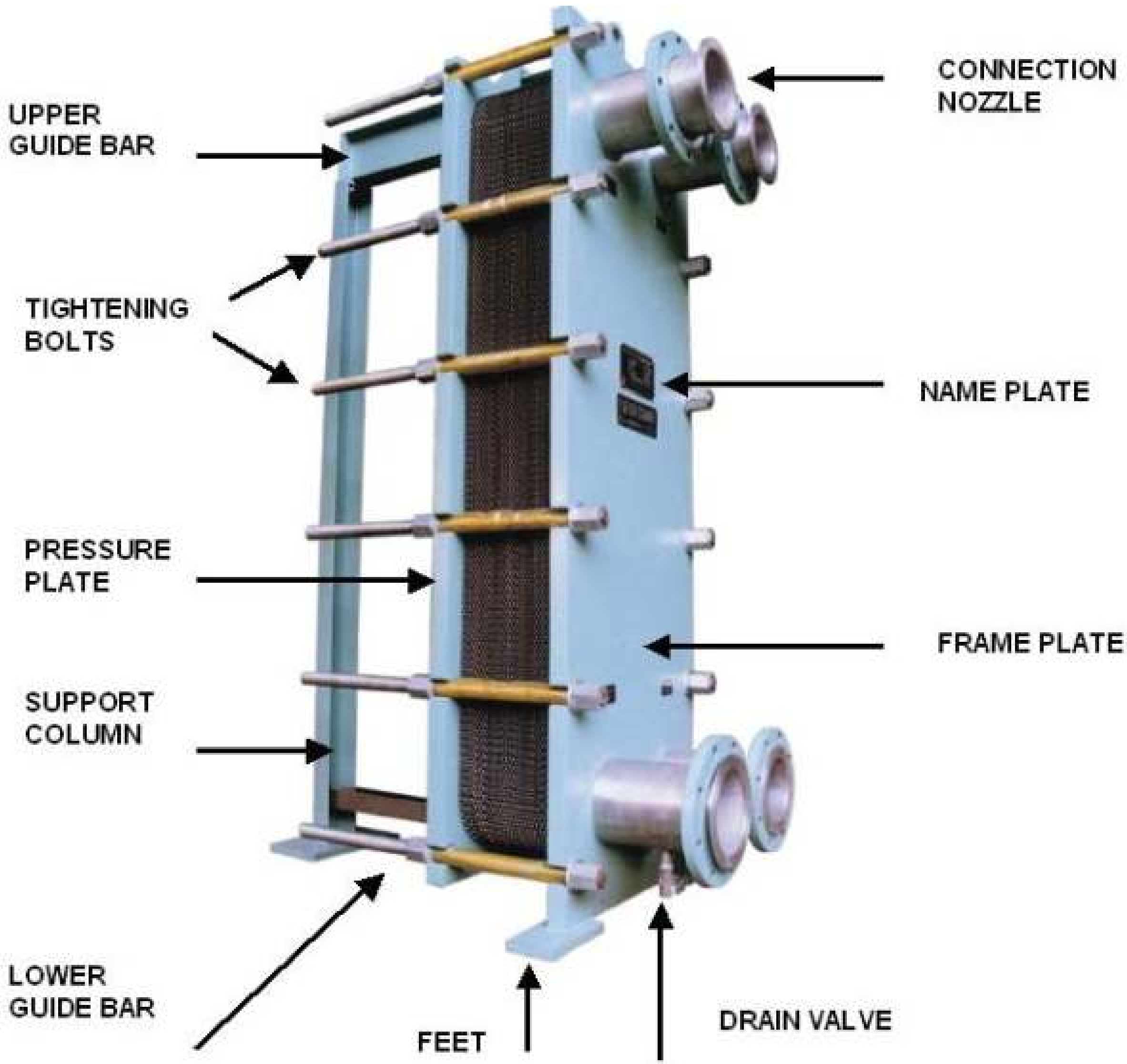


5.1 PLATE CHARACTERISTICS

Plate thickness is normally in the range 0.6-1.0mm. Stainless steel, Titanium, Hastelloy, Copper-Nickel and Al-brass are available.
The plates are pressed to form corrugations which increase the surface area and strength of the plates.
The plate has up to four connection holes for fluid transfer, with gaskets fitted to confine the liquids.
Gaskets are made from composed rubber and are chosen in accordance with the types of fluids to be used in the PHE. The corrugated shape on the plates maximises the heat transfer efficiency by creating high turbulence in the channels.
Centrally located cut outs on the top and bottom ends of each plate is designed to make the plate hang correctly either side to the top and bottom guide bars.

HERRINGBONE TYPE

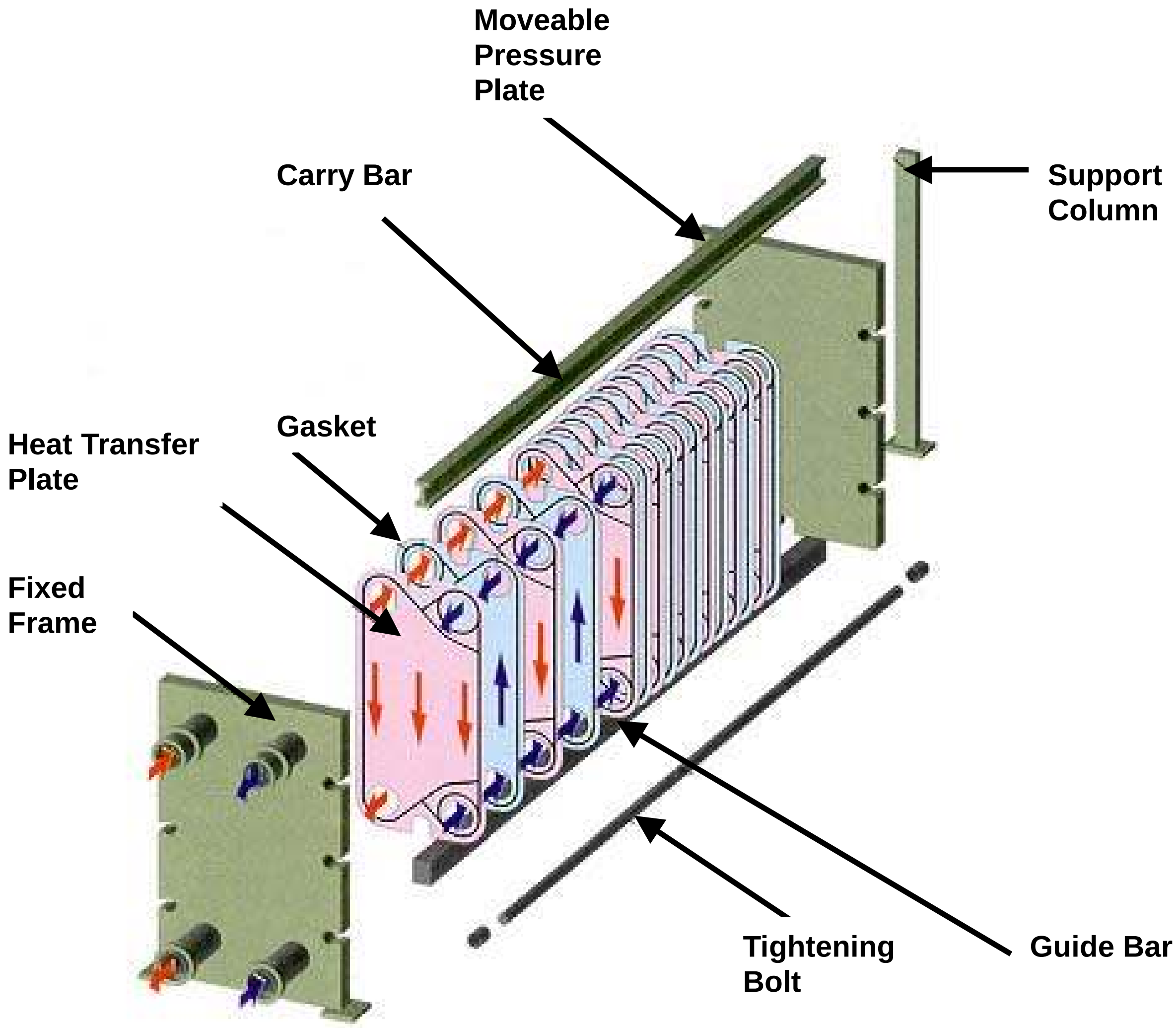
5.2 FRAME COMPONENTS



PART	QTY	DESCRIPTION		PART	QTY	DESCRIPTION
FRAME PLATE	1	CARBON OR STAINLESS		HEAT TRANSFER PLATE	*	ALLOY
PRESSURE PLATE	1	CARBON OR STAINLESS		TIGHTENING BOLT	*	HIGH TENSILE
SUPPORT COLUMN	1	CARBON OR STAINLESS		NAME PLATE	1	STAINLESS
UPPER GUIDE BAR	1	CARBON OR STAINLESS		CONNECTION NOZZLE	*	STAINLESS
LOWER GUIDE BAR	1	CARBON OR STAINLESS		DRAIN VALVE	*	STAINLESS

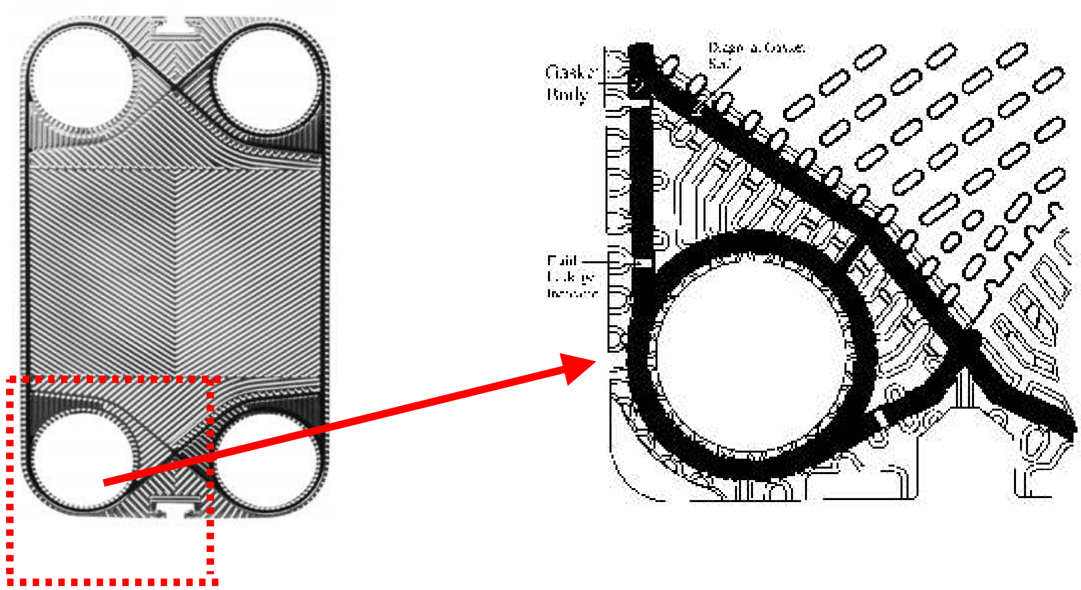
DETERMINED BY UNIT TYPE AND DESIGN

5.3 TYPICAL FLUID FLOW



5.4 CONSTRUCTION OF THE GASKET

The gaskets are designed as a duplicate structure to prevent mixing the fluids.
Should the ring gasket fail the liquid vents to the atmosphere (‘B’ part), and is prevented from mixing with the opposing liquid by the diagonal gasket.
In a similar manner if the diagonal gasket fails the ring gaskets acts as a secondary seal.



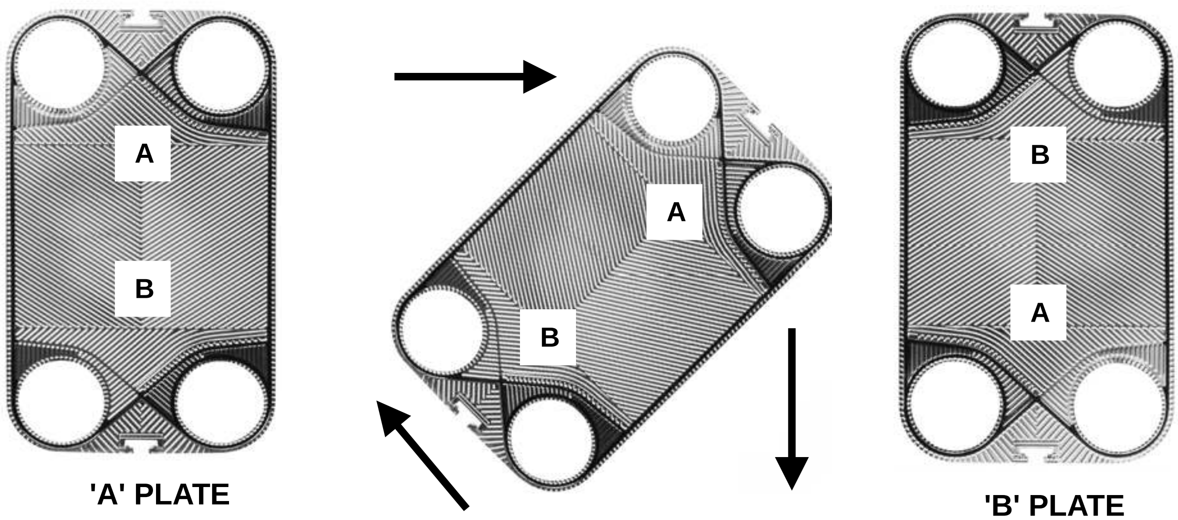
5.5 CONSTRUCTION AND APPLICATION OF THE FRAME

The construction of the frames is dependent on the application, pressure requirements and the type of the plates held in the frame.
The frames are protected from the liquids due to the welding or pressing of liners into the appropriate connection.
In general terms the construction and operation of the frames is the same for all PHE’S

5.6 FLUID FLOW ARRANGEMENT “A” to “B” CONFIGURATION

Forming of the plate pack channels is accomplished by hanging the plates (gasketed plates should be faced to the frame) in alternative “A” then “B” fashion.

As can be seen in Fig.6, the plate which has the ring and diagonal gasket on the right hand side and chevron pattern pointing down, the plate is called the 'A' plate and when rotated becomes the 'B' plate. One fluid flows on the surface of each of the 'A' plates, while the alternative fluid flows over the 'B' plate.



to each other. The hot fluid flows with two parallel lines, top to bottom and bottom to top, and the cold fluid with 4 parallel lines flows bottom to top.

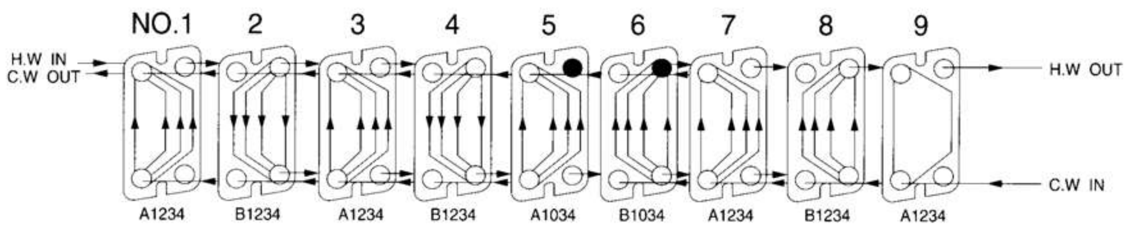
The plate arrangement can be written as $\frac{2 \times 2}{4 \times 1} + 1$

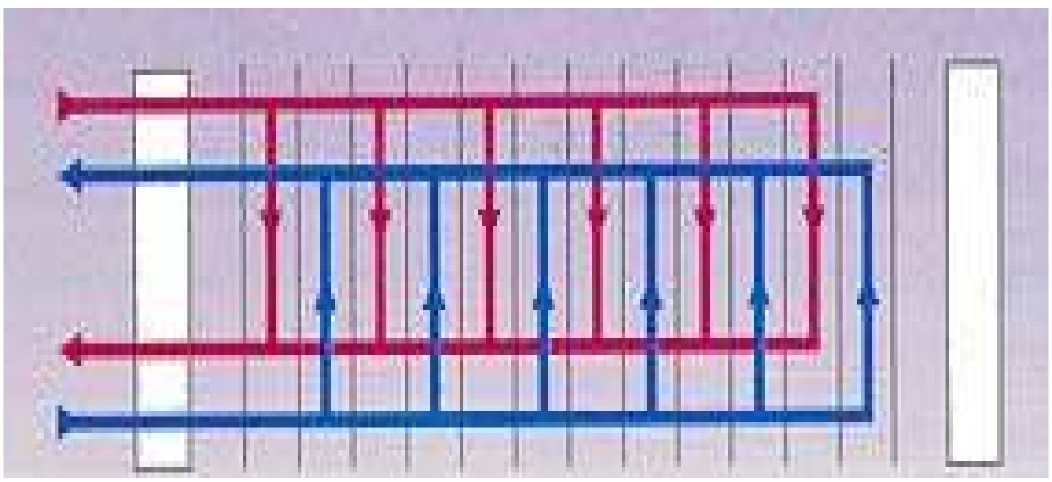
where + 1 represents the end plate which does not perform any heat transfer.

The four holes in the plate are distinguished as 1, 2, 3, and 4 from their positions, and '0' means no hole.
There are 16 hole combinations possible depending on the application and temperature approach.

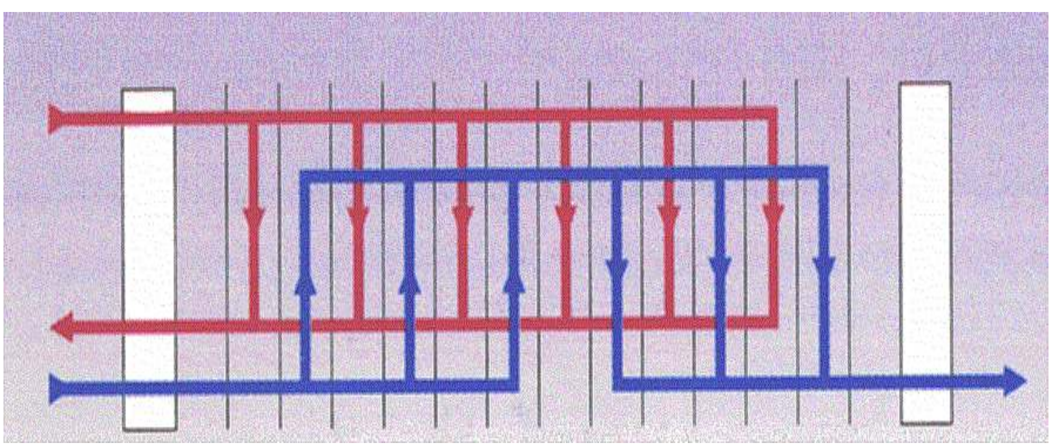
5.7 TYPICAL PLATE ARRANGEMENTS

EXAMPLE OF PLATE ARRANGEMENT AND FLOW



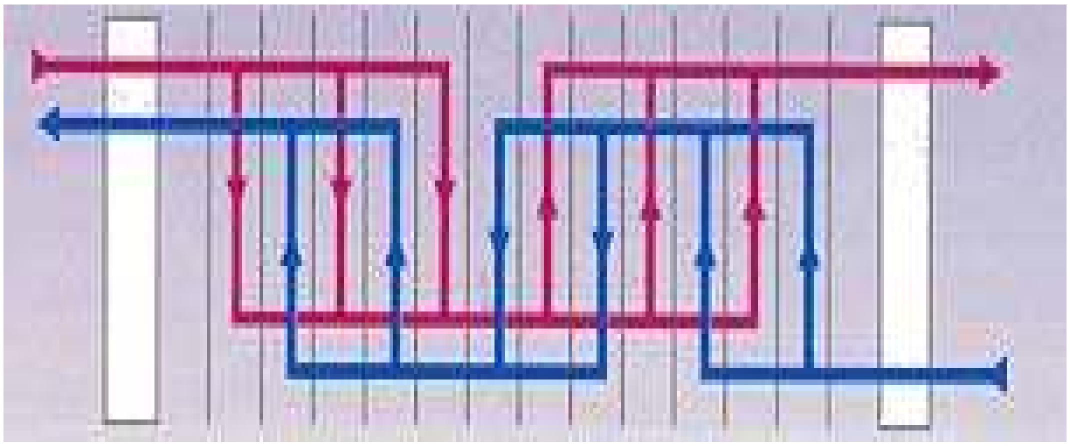


SINGLE PASS ARRANGEMENT

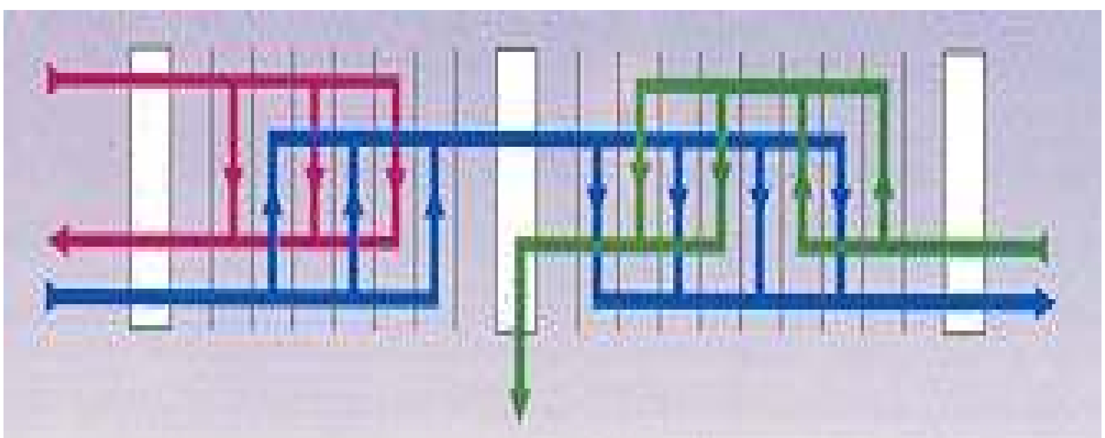


SINGLE AND MULTI PASS ARRANGEMENT

5.7.1 ADDITIONAL PLATE ARRANGEMENTS



MULTI PASS ARRANGEMENT



SINGLE & MULTI- MULTI PASS ARRANGEMENT

6.0 TROUBLE SHOOTING

6.1 EXCESSIVE TEMPERATURES

The normal maximum operating temperature for a plate heat exchanger is approximately 120 degrees Celsius.

Higher temperatures may be reached with special gasket and adhesive materials.

Operating any plate heat exchanger at temperatures above the design temperature of the gasket material will result in gasket and adhesive failure.

An excessive temperature gasket failure is indicated by a hard, shiny-surfaced gasket face. Quite often, these gaskets are so brittle they can be crumbled with the fingers.

Points to look for are:

a. Excessive hot-side fluid or steam temperatures.

b. Unit being operated under conditions for which it was not designed.

c. Superheated steam.

d. Cold fluid stoppage on units operating at upper gasket temperature limits.

Corrective measures should include checking for excessive operating temperatures and lowering where needed or replacing with higher temperature gaskets.

If the unit is being used for services other than those for which it was designed, the necessary adjustments or gasket replacement should be done to ensure gasket compatibility with the operating temperature.

6.2 STEAM

Quite often high pressure steam is put through a reducing station without going through a desuperheater.

The steam is now at a lower pressure while still retaining much of its previous high pressure temperature.

This, of course, has a very detrimental effect upon gaskets and greatly reduces the overall performance of the heat exchanger because of the decreased availability of latent heat while steam is in the superheated state.

Plates and gaskets will generally be at a temperature between the hot and cold fluids. Intermittent cold flow conditions can cause problems in units operating at borderline temperature conditions.

As the cold flow is interrupted, the unit will begin to come up to the temperature of the hot fluid and damage gaskets if upper temperatures are exceeded.

This can be alleviated by ensuring a constant cold-side flow or by throttling down the hot side during flow interruption.

6.3 EXCESSIVE PRESSURE AND SPIKES

The normal maximum operating pressure for a plate heat exchanger is generally 16 bar for ASME-code units. ASME units require ASME relief devices per UG-125 of ASME Code, Section VIII, Div. 1, Preventing Excessive Pressure.

However, plate heat exchangers which can operate at pressures up to 25 bar are available.

6.4 DESIGN PRESSURE

Operating a plate heat exchanger above its design pressure will result in gasket sealing problems.

These problems vary depending on the type of plate being used but are most often indicated by protruding gaskets which will extrude between plates and be visible on the perimeter of the plate pack.

Leakage may or may not be present; but in either case, steps must be taken to correct the situation.

Excessive pressure must be reduced to limits within the design pressure of the unit.
All regulating and throttling valves are to be placed on the inlet sides of the exchanger.

Excessive lengths of piping being stopped by valves on nozzle outlets can cause tremendous pressure on gaskets, and this is to be avoided at all times.

6.5 PRESSURE SPIKES

Pressure spikes can also cause extremely high pressures.

Some of the causes are totally closed systems without allowances for expansion, booster-pump start-up, and rapid-acting control valves.

When these conditions exist, they should be handled with vented closed systems, slow acting control valves, and accumulators whenever possible.

Negative pressure (vacuum) on a standard-design plate heat exchanger may also result in gasket leakage problems.

A plate heat exchanger must never be subjected to vacuum (unless designed for vacuum application) during normal operations or during start-up and shut-down procedures.

6.6 FLUID INCOMPATIBILITY

This is evidenced by swelling of gaskets upon unit opening, tacky or liquid surface to gaskets, and gaskets failing off plates.

Advice should be obtained from factory personnel whenever these conditions are encountered.

Quite often, minute quantities of tramp contaminants in the fluid can have a large effect upon some elastomers.

Fluid sample testing and gasket coupon testing of various elastomers in the customer's process fluid can determine the proper compound to use.

In extremely difficult case s, a dual gasketing system using two different gasket materials on the fluids may solve the problem.

6.7 LEAK DETECTIO N AND ELIMINATION

Because of vented areas between portholes and plate faces, barring corrosion completely through plates, fluids cannot cross within the unit.

If any leakage does occur, it will be to the outside of the unit and observed as a slow leak.

If a unit starts leaking, check operating temperatures, pressures, and the "Q" dimension.

When pressures and/or temperatures are in excess of design conditions, take measures to correct them and restart the unit.

If the above are within design conditions, allow the unit to cool to ambient temperature and relieve the pressure on all fluid circuits within the unit.

At this time, begin tightening the compression bolts in the prescribed manner but do not go below the "Q" dimension by more than 1%.

If the unit still continues to leak, it may contain damaged or worn-out gaskets. Open the unit and individually examine gaskets for particulates,glue failure, or damage and wear.
Remove those gaskets which appear to be have reached their life span and replace with new gaskets.

If there appears to be a problem with fluid crossing, that is, internal leakage-this indicates a condition that has been favorable for corrosion, causing pinholes through the plates.

The damaged plate or plates may be located by two methods for single-pass units:

Shut the unit down and relieve all pressure within the unit.

The piping on one side of the unit is now removed to allow viewing of the portholes for the length of the plate pack.

At this time, pressure is again turned on to the piped side, and leakage may be observed by shining a flashlight into the porthole to view and locate the leak.

With multiple-pass units, the above procedure will only allow partial viewing of the plate pack because of the non punched portholes in some locations.

In this case, the unit is opened and all plates are either wiped dry or allowed to air dry.

The compression bolts are then replaced, and the unit is re-tightened to the "Q" minimum dimension.

One side only is now pressurized for approximately 15 minutes.

Pressure is then relieved and the unit is now reopened. Carefully separate the plates one at a time, going from movable frame to fixed frame.

It will be noticed that every other flow channel is wet with a dry channel in between.

When you find two adjacent wet channels, you have located the affected plate. It will be one of the two plates in the centre.

Once the suspected leaking plate is lo cated, you may confirm with visual inspection or dye penetrant techniques.

If the plate at fault is punched 1-2-3-4, the unit may be rapidly put back on line by removing an adjacent plate with the same punching.

Heat transfer will be reduced only to a minor extent.

If this punching arrangement is other than above, you will have to remove and replace the faulty plate(s) before restart.

Always reduce the "Q" dimension when removing plates by the thickness of the gasketed plates.
The amount of reduction in the "Q" dimension necessary for each plate removed may be obtained by using the multiplier shown on the data plate.

7.0 OPERATING HISTORY LOG

OPERATED BY	COMMENTS OF	DATE STARTUP	DATE OF SHUTDOWN

SEC Heat Exchangers
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SERVICES AVAILABLE:

HEAT EXCHANGERS

- New Unit Supply
- Heat Transfer Design
- Plate & Gasket Supply
- Retrofit Units (replace existing unit without pipe changes)

ENGINEERING SERVICES

- Program Maintenance
- Waste Water Solutions
- Project planning