



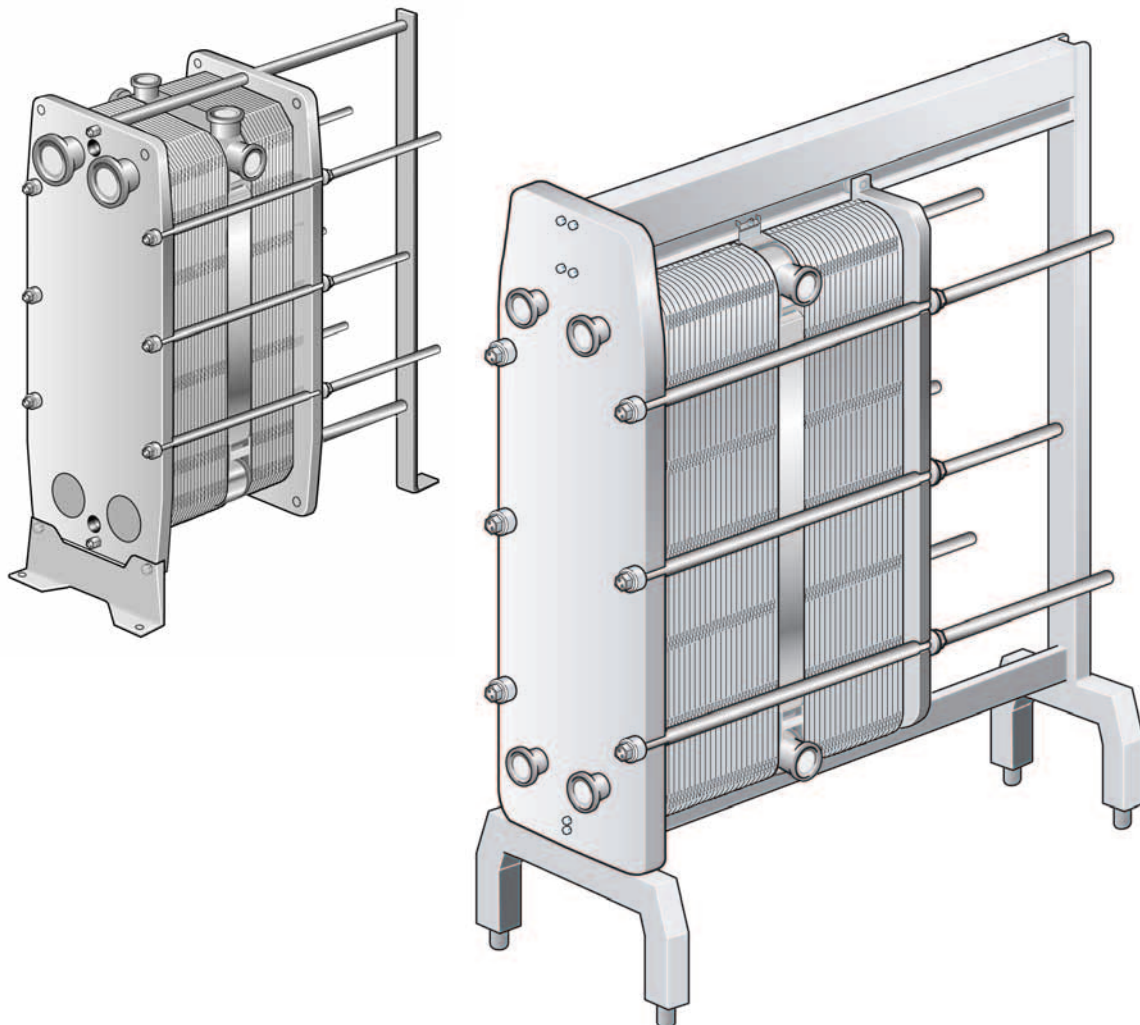
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Instruction Manual Plate Heat Exchangers

FRONTLINE[®] BASELINE[™] M-line
CLIPLINE[™] TS6-MFMC



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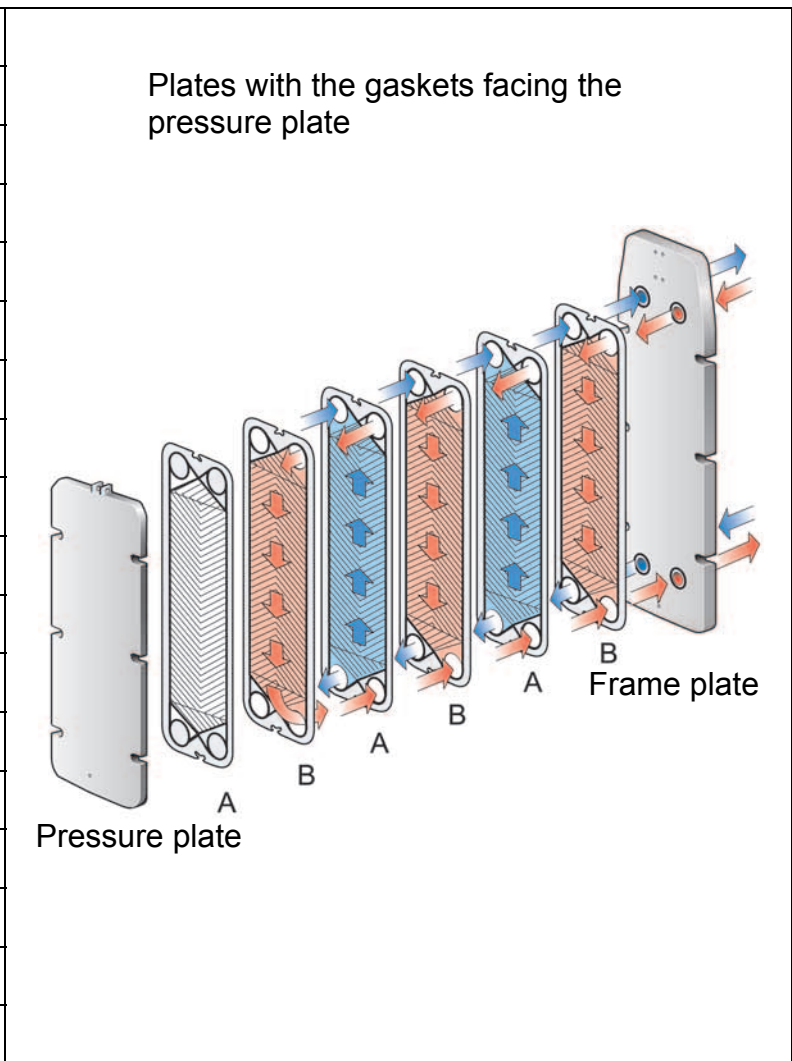
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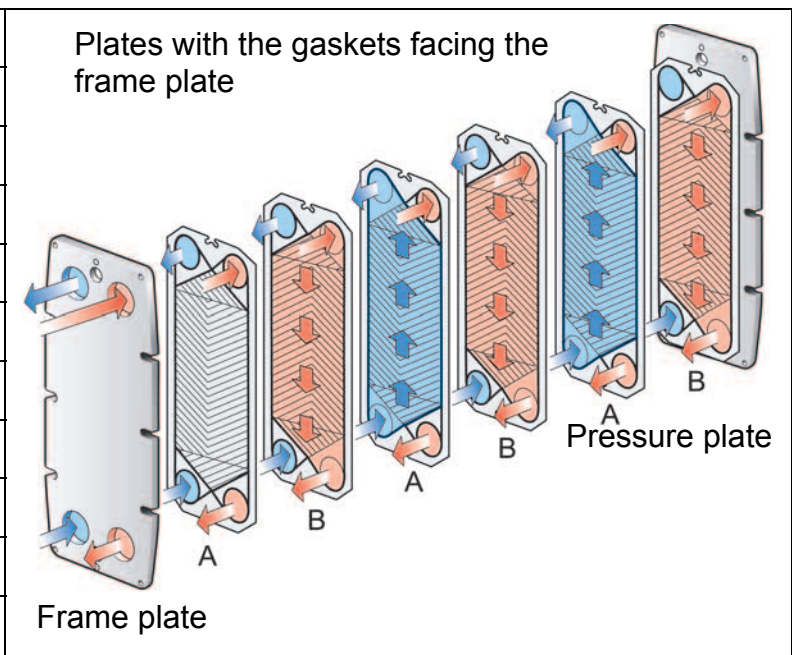
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Front6-FRM
Front6-FRH
Front6-FRD
Front8-RM/RMS
Front8-RH/RHS
Front8-RD
Front10-RM
Front10-RH
Front10-RD
Front15-FRH
Front6-WSFRM
Front8-WSRM
Front6-GFRM
Front8-GRM
Front10-GRM
Clip3-RM



M6-MFHC, M6-FHC
M6-MDFHC, M6-MGFHC
M10-MFHC, M10-BFHC, M10-BDFHC
M15-MFMC, M15-BFMC, M15-BGFMC
M15-MFHC, M15-BFHC
M3-Base, M3-GBase
M6-MBase, M6-Base
M6-MDBase, M6-MGBase
M10-MBase, M10-BBase, M10-BDBase
TL10-BBase
TS6-MFMC



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Except for this Instruction Manual, the following documents are also included in this shipment:

- Plate Heat Exchanger (PHE) drawing
- Plate hanging list
- Parts list with exploded view drawing.

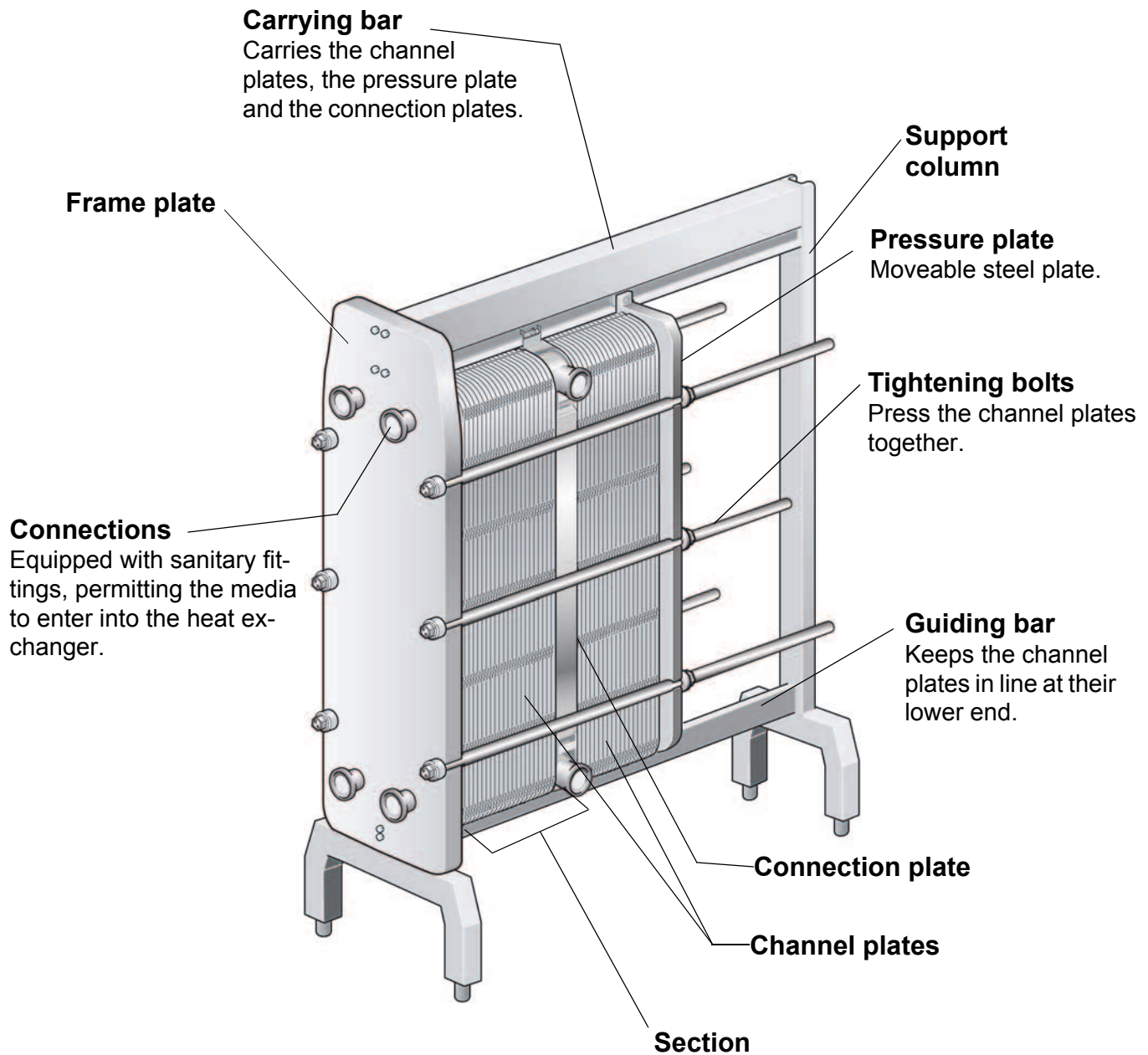
Description

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Definitions

Plate heat exchanger	Assembly of one or more plate packs and its supporting frame. If there is more than one plate pack, connection plates are used to separate them. Figure 1 shows typical components of a plate heat exchanger.
Plate	A sheet of material pressed into a corrugated pattern carrying an elastomer gasket surrounding its periphery and two of the ports.
Plate pack	An assembly of plates clamped together to entity having internal channels in which two or more fluids can be handled.
Port	Inlet or outlet opening in the channel plate, most plates have four ports.
Heat transfer area	The area of the plate, which is in contact with both fluids.
Total heat transfer area	The total surface area of all the plates, which is in contact with both fluids.
Frame	An assembly that provides the structural support and the pressure containment of a plate heat exchanger.
Connection plate	Plate used to separate two or more services in one plate heat exchanger. The plate pack performing such a service is called a section.
Protection sheet	Removable covering for the top and sides of the plate heat exchanger, which provides protection in the event of spray leak.
Section	See "Connection plate" above.

Main components



Name plate

On the name plate the type of unit, manufacturing number and manufacturing year can be found. Pressure vessel details in accordance with the applicable pressure vessel code are also given. The name plate is fixed to the frame plate, most common, or the pressure plate.

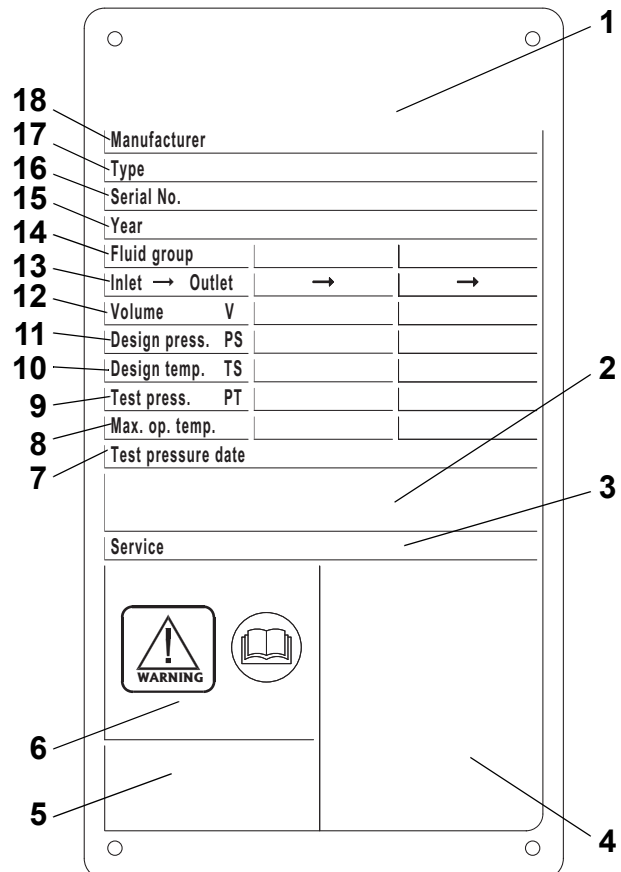


Warning!

For each unit, the mechanical design pressures and temperatures are marked on the name plate. These must not be exceeded.

The mechanical design pressure and the design temperature as given on the name plate are the values to which the plate heat exchanger is approved to the pressure vessel code in question. The mechanical design temperature may exceed the operating temperature for which the gasket has been selected to reach a decent lifetime. If the operating temperatures as specified on the assembly drawing are to be exceeded the supplier should be consulted.

1. Space for logotype.
2. Open space.
3. Web site for service.
4. Possible locations of connections.
For 3A units location of 3A tag.
5. Space for mark of approval.
6. Warning, read manual.
7. Date of pressure test.
8. Maximum operating temperatures.
9. Test pressure.
10. Max permissible operating temperatures.
11. Max permissible operating pressures.
12. Decisive volume or volume for each fluid.
13. Locations of connections for each fluid.
14. Decisive fluid group.
15. Year of manufacture.
16. Serial number.
17. Type.
18. Manufacturer's name.



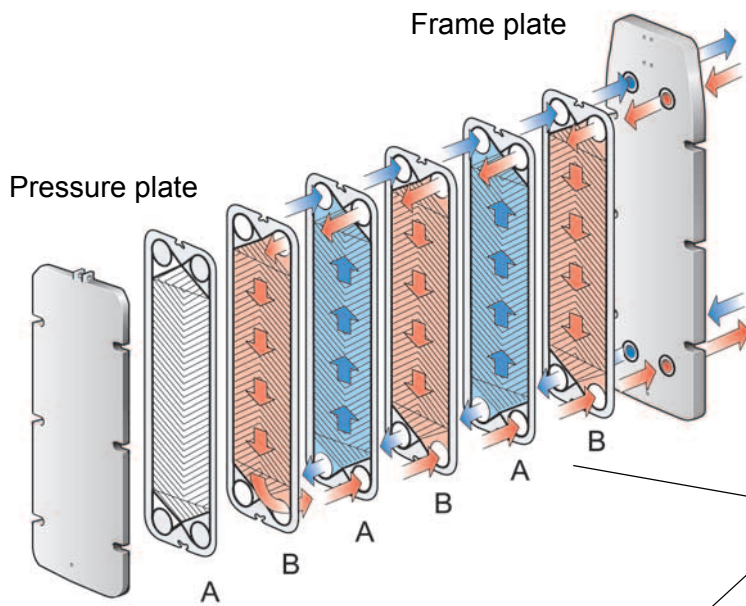
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Function

The plate heat exchanger consists of a pack of corrugated metal plates with port for the passage of the two fluids between which heat transfer will take place. The plates are fitted with a gasket, which seals the channel and directs the fluids into alternate channels.

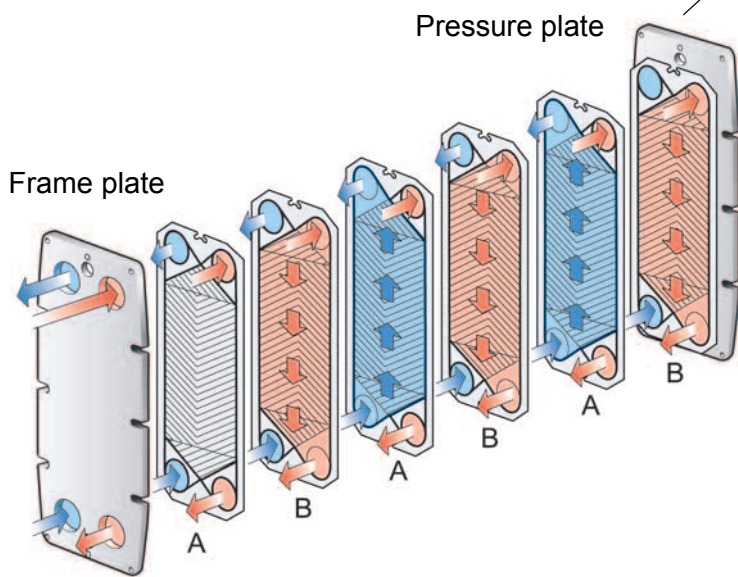
The plate pack is assembled between a frame plate and a pressure plate and compressed by tightening bolts. Channels are formed between the

plates and the corner ports are arranged so that the two media flow through alternate channels. The heat is transferred through the plate between the channels, and complete counter-current flow is created for highest possible efficiency. The plate corrugation provides the passage between the plates, supports each plate against the adjacent one and enhances the turbulence.



Depending on type plate heat exchanger the plates may be mounted:

- a) with the gaskets facing the pressure plate.
- b) with the gaskets facing the frame plate.



The front cover (page 2) specifies per type whether the plate pack is to be mounted with the gaskets facing the pressure plate or the frame plate.

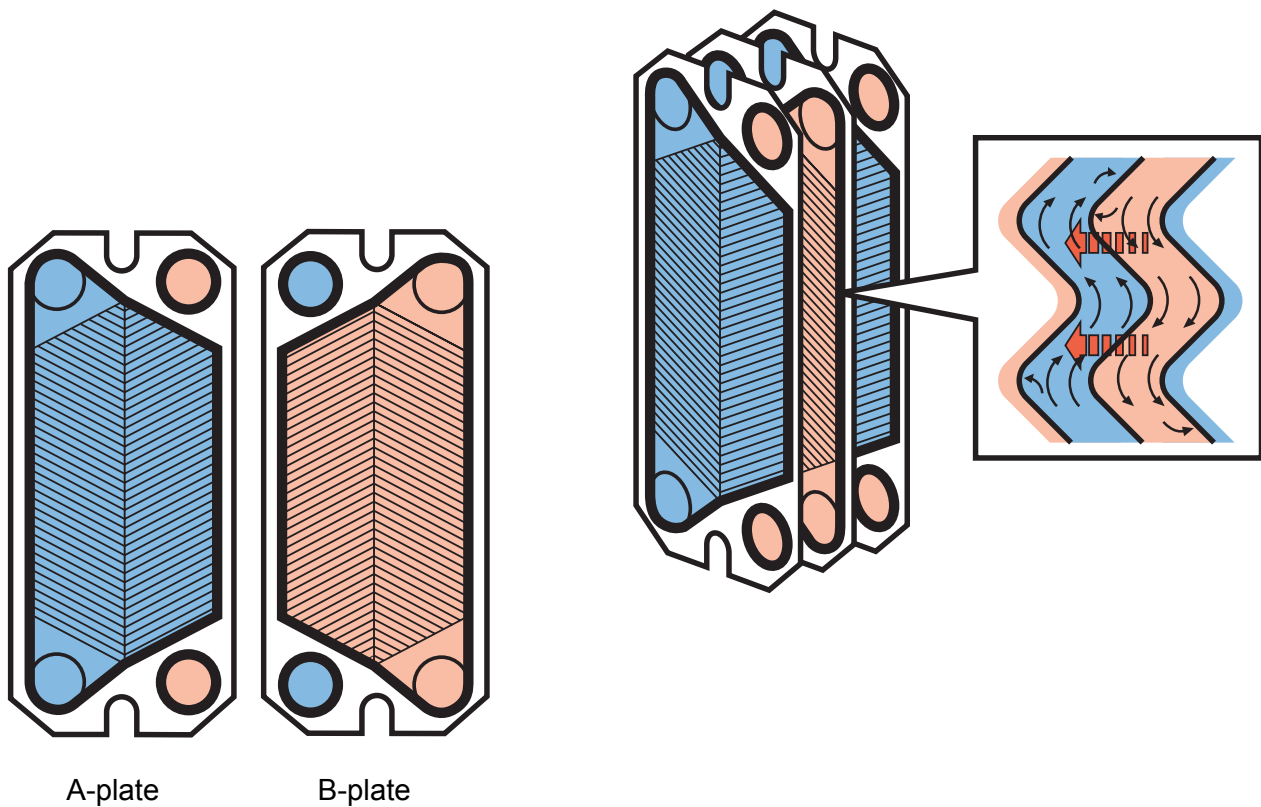
The plate heat exchanger is typically used for heating or cooling food or other products with low to medium viscosity. A specific plate heat exchanger is dimensioned for a specific duty, set out in the product documentation, and should not be used in any other way without consulting the supplier.

Plates

There are four different types of plates:

- **Standard plates**, the most common type plate
- **Wide stream plates**, with enlarged passage for products containing fibres and particles
- **Gemini double wall plates**, for increased process safety. The plates may be separated for inspection of the inter-plate space
- **Double wall plates**, not possible to separate for inspection

The plates are identified by one or more markings punched into the plate.



Installation

Requirements

Pipes

Fit the pipes so that no tension is transferred to the heat exchanger

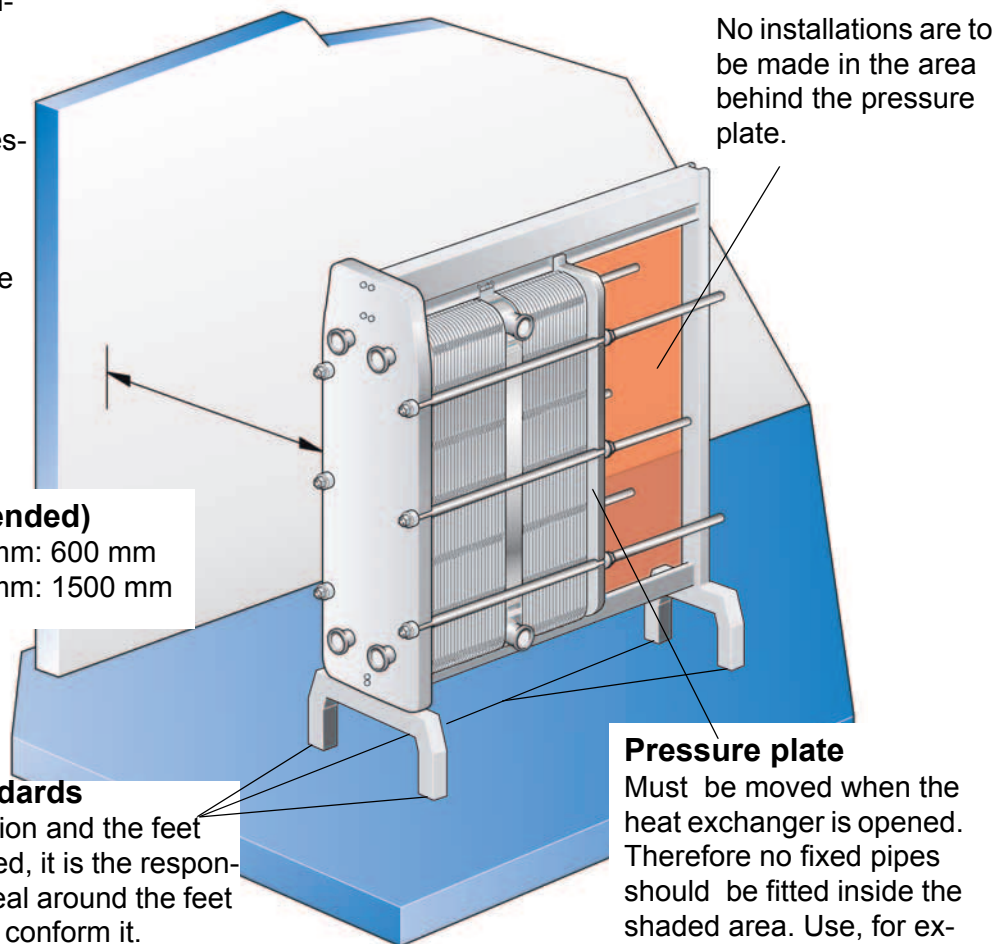
Pipes connected to the pressure plate and to the connection plates must allow $\pm 1\%$ of the distance from the connection to the frame plate (see assembly drawing).

Space (recommended)

Plate length ≤ 750 mm: 600 mm
Plate length ≥ 750 mm: 1500 mm

Applicable for 3A Standards

Once the unit is in its location and the feet have been properly adjusted, it is the responsibility of the end user to seal around the feet with silicone or caulking to conform it.



Pressure plate

Must be moved when the heat exchanger is opened. Therefore no fixed pipes should be fitted inside the shaded area. Use, for example, a short bend directed sideways.

Note!

- Before connecting any piping, make sure all foreign objects have been flushed out of the system.
- When connecting the pipe system make sure the pipes do not subject the plate heat exchanger to stress or strain.
- To avoid water hammer, do not use fast-closing valves.

It is recommended that protective sheets are used to cover the PHE.

In automated installations, the stopping and starting of pumps and actuation of valves should be programmed so that the resulting amplitude and frequency of the pressure variation will be as low as possible. If a homogeniser is connected to the plate heat exchanger, install efficient dampers at the inlet and outlet of the homogeniser.



Warning!

Safety valves should be installed according to pressure vessel regulations.

Venting of liquid circuits must be considered. Pumps must not draw air into the heat exchanger. When the velocity is low, by e.g. for viscous products, venting possibilities at the upper most points of the circuit may be necessary. It should be possible to vent a tubular holder.

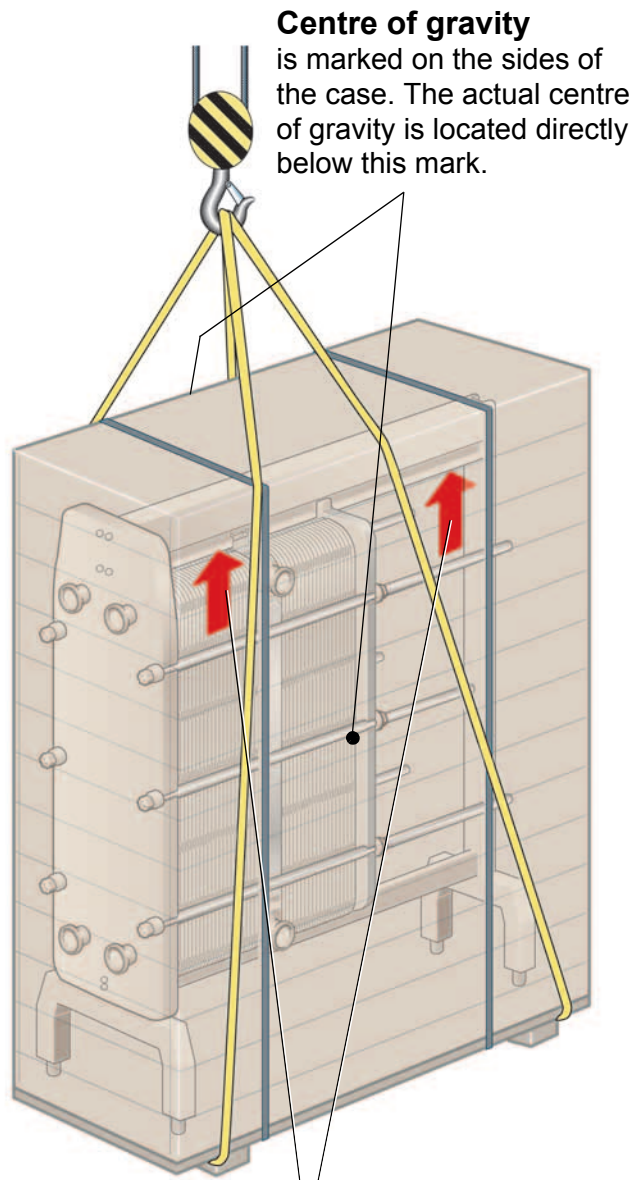
Lifting

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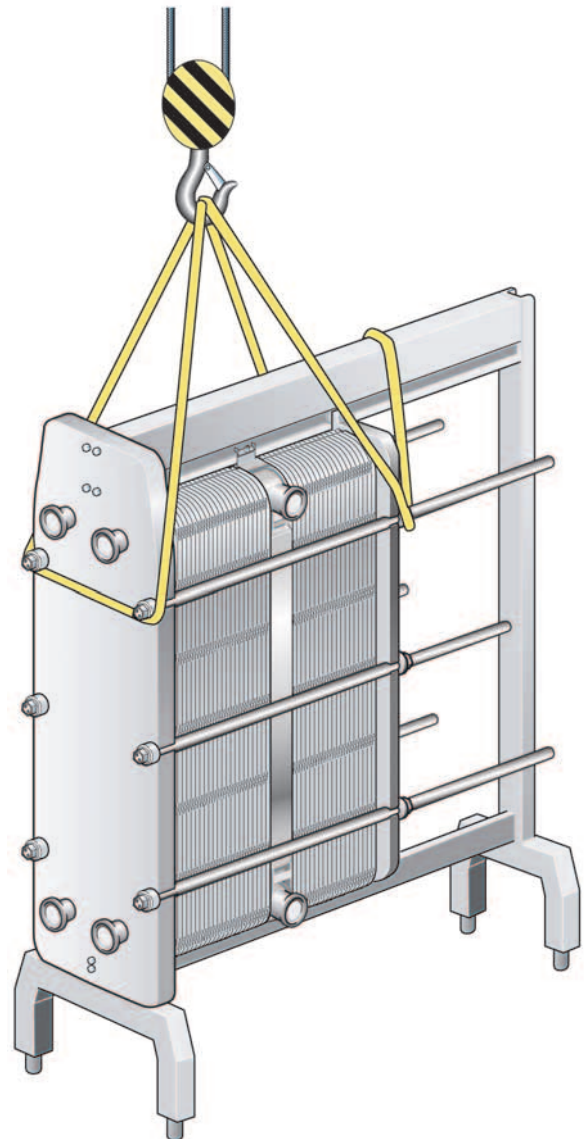
Warning!

Never lift by the connections or the studs around them. Straps should be used when lifting. Place straps according to picture.



Centre of gravity

is marked on the sides of the case. The actual centre of gravity is located directly below this mark.



Lifting hooks

Observe the markings on the case indicating where to place lifting hook.

Operation

Start-up

Note!

If several pumps are included in the system, make sure you know which one should be activated first.

Centrifugal pumps must be started against closed valves and valves must be operated as smoothly as possible.

Do not run pumps temporarily empty on the suction side.

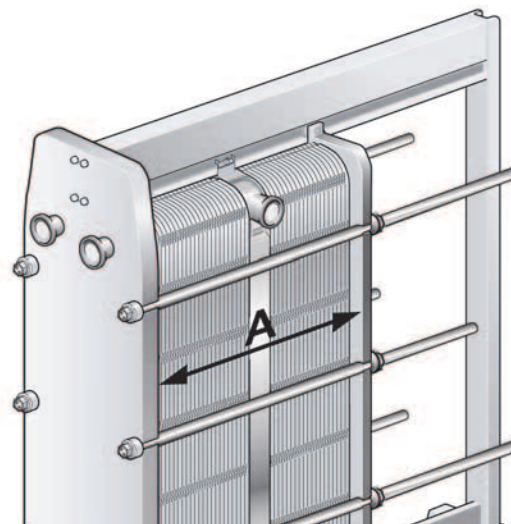
Note!

Adjustments of flow rates should be made slowly in order to avoid the risk of **water hammer**.

Water hammer is a shortlasting pressure peak that can appear during start-up or shut-down of a system, causing liquids to travel along a pipe as a wave at the speed of sound. This can cause considerable damage to the equipment.

1

Check that measurement A is correct, see the assembly drawing.



2

Check that all valves are in correct position.

3

If a vent is installed, open it and start the pump.

4

Increase the flow rate slowly.

5

When all air is out, close the vent.

6





Repeat steps 1–5 for the other medium/media.

Unit in operation

Note!

Adjustments of flow rates should be made slowly in order to protect the system against sudden and extreme variations of temperature and pressure.

During operation, check that

-  media temperatures and pressures are within the limits stated on the assembly drawing
-  no leakages appear due to faulty tightening of the plate pack or to defective or damaged gaskets
-  carrying bar and guiding bar are kept clean and greased
-  the bolts are kept clean and greased.

Always consult your local supplier for advice on

- new plate pack dimensions if you intend to change number of plates
- selection of gasket material if operating temperatures and pressures are permanently changed, or if another medium is to be processed in the PHE.

Shut-down

Note!

If several pumps are included in the system, make sure you know which one should be stopped first.

- 1** Slowly reduce the flow rate in order to avoid water hammer.
- 2** Repeat steps 1–2 for the other medium/media.
- 3** If the heat exchanger is shut down for a longer period, it should be drained. Draining should also be done if the process is shut down and the ambient temperature is below freezing temperature of the media. Depending on the media processed, it is also recommended to rinse and dry the heat exchanger plates and connections.

Maintenance

Cleaning and sterilisation – Product side

General

Immediately after a production cycle, the product side is normally cleaned by circulation of acid and/or lye, Cleaning-In-Place (CIP).

Sterilisation is performed immediately before starting the next production cycle.

Cleaning

The CIP flow rate should always be at least the same as the production flow rate. Increased flow rate may be required in some cases as e.g. milk sterilisation and processing of viscous liquids or liquids containing particles.

Generic cleaning agents	Instructions
Lye solution	1 % by weight sodium hydroxide (NaOH) at max. 80 °C. Dissolve 1 kg of NaOH in 100 litres of water or mix 2.2 litres of 33 % NaOH solution in 100 litres of water.
Acid solution	0.5 % by weight nitric acid (HNO ₃) at max. 70 °C. Mix 0.7 litres of 53 % (36Be) HNO ₃ in 100 litres of water.

Detergents containing wetting and complexed agents may also be used in addition to the caustic soda or nitric acid.

The maximum NaOH and HNO₃ concentrations by weight must be respected.

Water of more than 300 ppm Cl ions may not be used for preparation of cleaning solutions



Warning!

Sodium hydroxide and nitric acid can cause serious injuries to skin and mucous membranes. Handle with great care! Always use protective goggles and protect your hands with rubber gloves.

Note!

After the first test run with product, the plate heat exchanger should be cleaned following a cleaning program applicable to the product in question, see chapter Cleaning below. The plate heat exchanger should then be opened, see section "Opening" on page 14, and the plate surfaces carefully inspected. The cleaning result should be checked at regular intervals.

Sterilisation

Method	Instructions
By heat	Circulate water of 90 °C until all parts of the system have been kept at the required temperature for at least ten minutes.
Chemically by hypochlorite	Before introducing the hypochlorite solution, make sure that the equipment is clean, has cooled down and is free from deposits and that no acid residues are left. Gradually dose 100 cm ³ of hypochlorite solution, containing max. 150 g/l active chlorine to 100 l of circulation water at a max. temperature of 20 °C. Treat for five minutes, up to maximum 15 minutes. Rinse well after sterilisation.

Typical cleaning programs

Consult your supplier of cleaning chemicals for advice on suitable cleaning programmes.

Products rich in protein			Products poor in protein			
Coolers		Pasteurizers and other heaters	High content of insoluble components, e.g. nectar and tomato juice	Low content of insoluble components, e.g. beer and wine		
Daily	Weekly	Daily	Daily	Weekly	Daily**	Weekly
– Rinsing 5 min.	– Rinsing 5 min.	– Rinsing 5 min.	– Rinsing 10 min.	– Rinsing 10 min.	– Rinsing 5 min	– Rinsing 5 min.
– Lye 20 min.	– Acid 15 min	– Acid 15 min	– Lye 30 min.	– Lye 30 min.	– Lye 15 min.	– Lye 15 min.
– Rinsing 10 min.	– Rinsing 5 min	– Rinsing 5 min	– Rinsing 10 min.	– Rinsing 5 min*	– Rinsing 10 min.	– Rinsing 5 min*
– Stop	– Lye 20 min.	– Lye 20 min.	– Stop	– Acid 15 min*	– Stop	– Acid 15 min*
– Sterilisation 10 min.	– Rinsing 10 min.	– Rinsing 5 min*	– Sterilisation 10 min.	– Rinsing 10 min	– Sterilisation 10 min	– Rinsing 10 min
	– Stop	– Acid 15 min*		– Stop		– Stop
	– Sterilisation	– Rinsing 10 min		– Sterilisation 10 min		– Sterilisation 10 min
		– Stop				

* The need for an additional acid cycle in order to remove calcium carbonate scaling depends on the product. In many cases it is possible to carry out cleaning at considerably longer intervals. Sometimes it is possible to eliminate acid cleaning altogether.

** In some cases, where the risk for growth of micro-organisms is low, it is possible to eliminate daily cleaning and replace it by the following procedure: Rinsing 20 min – Stop – Sterilisation 20 min.

Applicable for 3A Standards

When used in a processing system to be sterilized, the system shall be provided with an automatic shut down if the product pressure becomes less than that of the atmosphere and not be restarted without re-sterilization (see paragraph D10.3). Information plate will then state that the PHE “is” designed for steam sterilization.

Cleaning – Non-product side

Cleaning of deposits from cooling medium or heating medium

Solid deposits can be removed by opening the heat exchanger and cleaning the plates with a soft brush and 10 % nitric acid.

Note!

Rinse well!

Note!

Under no circumstances should Hydrochloric acid be used with

- stainless steel plates
- titanium plates.

Water of more than 300 ppm Cl ions may not be used for preparation of cleaning solutions.

Hydrofluoric acid should never be used with titanium plates.

Chlorine as a growth inhibitor

Chlorine, commonly used as growth inhibitor in cooling water systems, reduces the corrosion resistance of stainless steels (including high alloys like 20/18/6).

Chlorine weakens the protection layer of these steels making them more susceptible to corrosion attacks than they otherwise should be. It is a matter of time of exposure and concentration.

In every case where chlorination of non-titanium equipment cannot be avoided, your local representative must be consulted.

Note!

Titanium is not affected by chlorine.

General guidelines regarding maintenance

Plate Sheet material

Even stainless steel can corrode. Chlorine ions are hazardous.

Avoid cooling brines containing chlorine salts as NaCl and most harmful CaCl₂.

Inspect the plates regularly, for possible corrosion attacks, especially on a new installation and after changing the running conditions.

Gasket rubber

The storeroom for spare gaskets should be cool and dark. Gaskets must not be stored hanging or twisted or subject to great load.

Stainless steel surfaces

The stainless steel surfaces of the frame plate, the pressure plate and connection plates are glass blasted.

Clean with cloth wetted by paraffin oil. Do not degrease the surface!

Lubrication

Lubricate the bolt threads of the tightening bolts with an EP (extreme pressure) grease. for example Gleitmo 800 or equivalent.

Grease the suspension wheels on the pressure plate and the connection plates.

Connection plates – Dismantling

Most connection plates have corners, which easily can be exchanged or relocated. At normal service and maintenance the connection plates need not to be touched only if the plate heat exchanger is rearranged for new duties. In such cases contact your supplier for advice on how to rebuild your plate heat exchanger.

Pressure plate – Dismounting

At rebuilding it may be necessary to remove the pressure plate. In such cases contact your supplier for advice on how to rebuild your plate heat exchanger.

Pressure test after maintenance

Before start up of production, whenever plates or gaskets have been removed, inserted or exchanged, it is strongly recommended to perform a pressure test to confirm the internal and external tightness of the PHE. At this test, one media side at the time must be tested with the other media side open to the atmosphere. This also applies for the upside and the downside of a regenerative section.

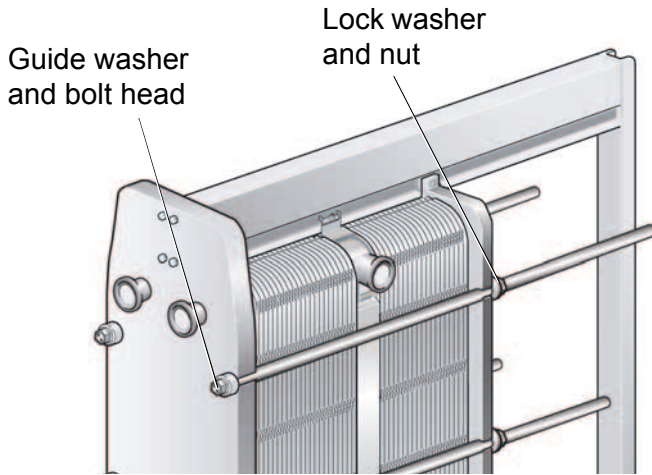
The pressure testing shall be performed at a pressure equal to the operating pressure of the actual unit but never above the design pressure as stated on the name plate.

Please consult the local office/representative of the supplier for advice on pressure testing procedure.

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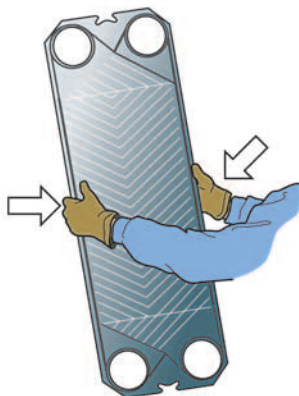
Opening and closing

The tightening bolts have one lock washer and one guide washer each. The lock washer is placed under the nut and locks the nut. The guide washer is under the bolt head. With the nut locked it is possible to operate the bolts from the frame plate side with either pneumatic or manual spanners. Larger plate heat exchangers have a bearing box instead of a guide washer to facilitate opening and closing of the unit.



If needed the washers can be reversed with the lock washer under the bolt head and the guide washer under the nut, but then the plate heat exchanger need to be opened with a manual spanner from pressure plate side.

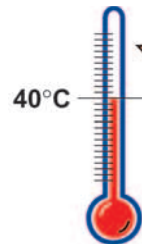
Warning! To avoid hand injuries owing to sharp edges, protective gloves should always be worn when handling plates and protective sheets.



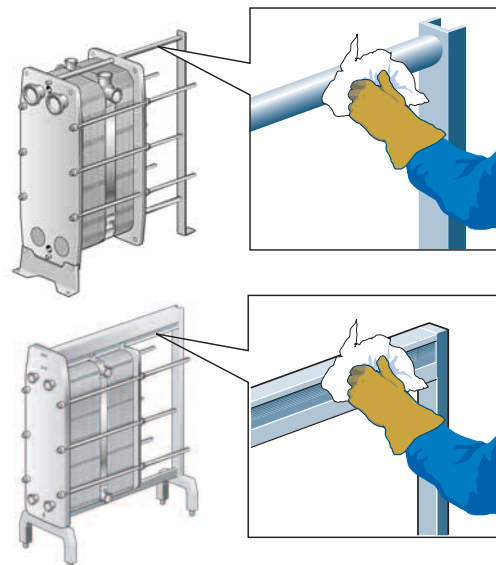
Opening

- 1 Shut down the heat exchanger.
- 2 Close the valves and isolate the heat exchanger from the rest of the system

Warning! If the heat exchanger is hot, wait until it has cooled down to about 40 °C (100 °F).

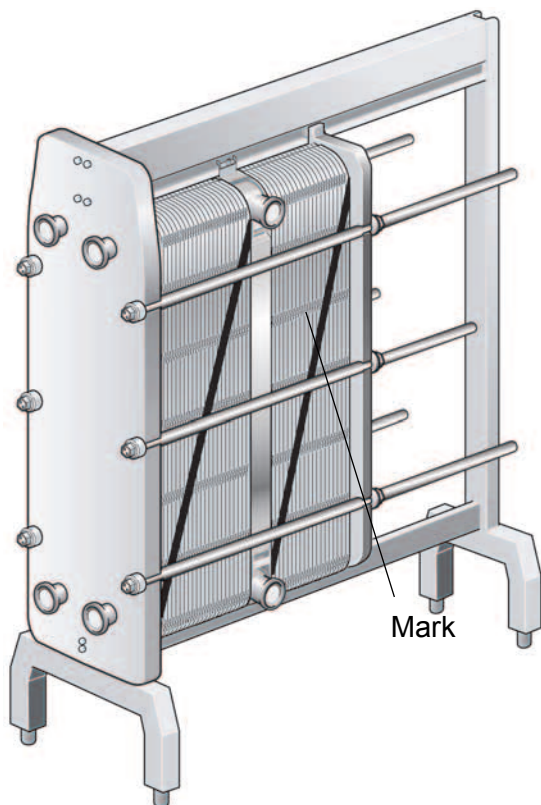


- 3 Drain the plate heat exchanger.
- 4 Remove the protective sheets, if any.
- 5 Dismantle pipes from the pressure plate and the connections plate(s) so that the pressure plate and the connection plate(s) are free to move along the carrying bar.
- 6 Inspect the sliding surfaces of the carrying bar and wipe clean.



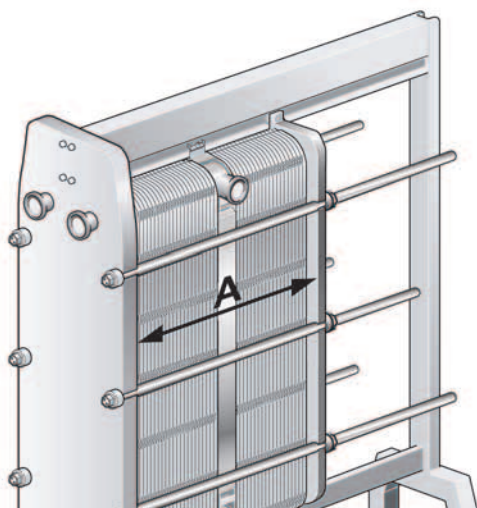
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Mark the plate assembly on the outside by a diagonal line.



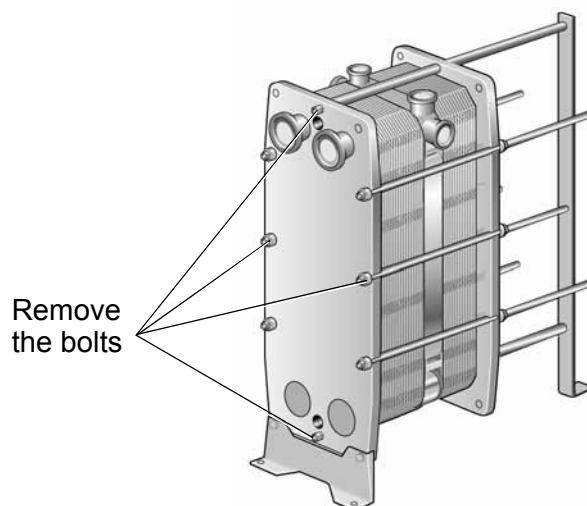
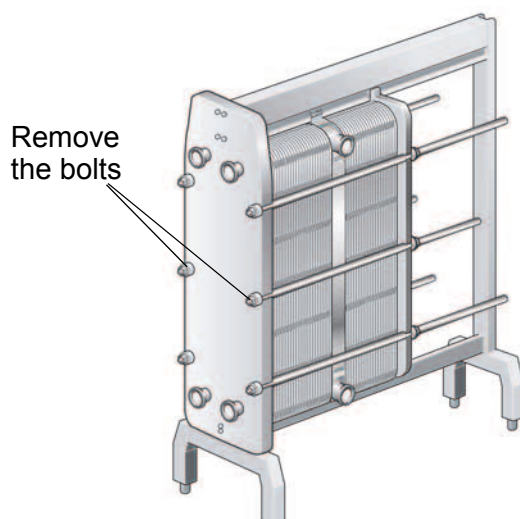
8

Measure and note down the dimension A.



9

Loosen and remove the bolts as shown in the figures below.



10

Use the remaining four bolts to open the heat exchanger. On the larger heat exchangers these bolts are equipped with bearing boxes.

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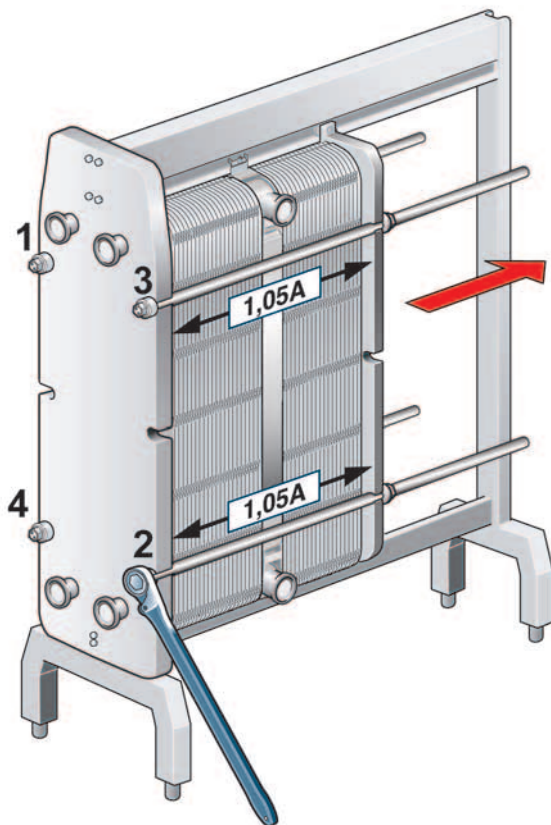
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11 Pairs of bolts are opened alternately and diagonally in two steps, see figures below.

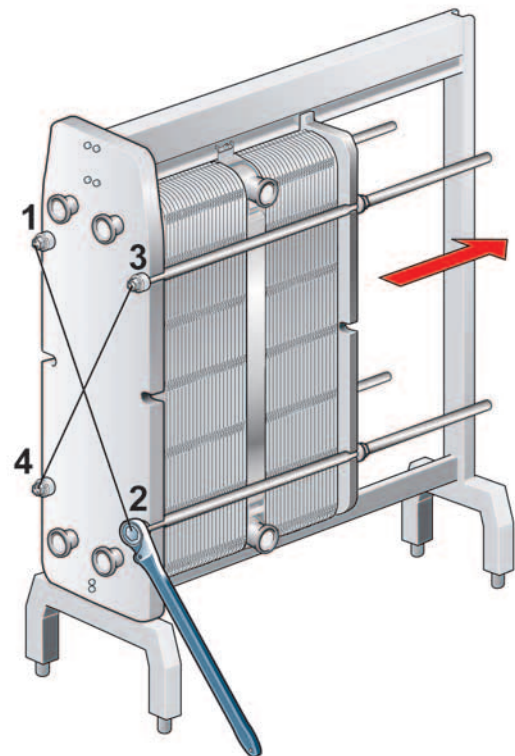
Step	Bolt No.	To dimension
1	1-2-3-4	1,05A
2	1-2 or 3-4	Opening

Be careful so that the frame plate and pressure plate are always in parallel. Skewing of the pressure plate during opening must not exceed 10 mm (**2 turns per bolt**) across the width and 25 mm (**5 turns per bolt**) vertically.

Step 1: Loosen the four bolts alternately and diagonally until the plate package measures 1,05A.



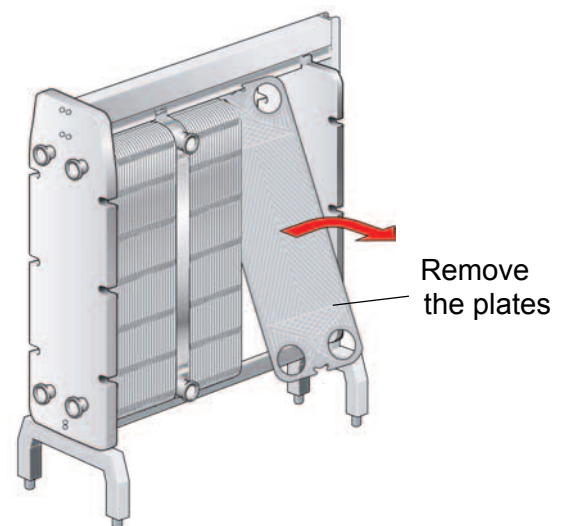
Step 2: Two diagonal bolts are loosened alternately, as shown in the figure below.



12 Open the plate pack by letting the pressure plate glide on the carrying bar.

If plates are to be numbered, do this before removing the plates.

Plates need not be removed if cleaning is done using only water, i.e. without cleaning agent.



Closing

If the plates have been taken out, insert A- and B-plates alternately, and with the gaskets turned towards the pressure plate or the frame plate depending on type of plate heat exchanger, see the second page of the front cover. Also, refer to the Plate Hanging List.

On opening the PHE. Check that all gaskets are clean in good condition and correctly positioned in the grooves of plates and connections.

- 1 Check that all gaskets are correctly positioned in the grooves and that the sealing surfaces are clean. Even slight product remains or foreign particles may cause leakage. If a PHE is opened without previously having been efficiently cleaned by circulation, it is necessary to brush the plates manually and to rinse them with a water-hose.
- 2 Brush the threads of the bolts clean, using a steel wire brush. Lubricate the threads with a thin layer of grease, e.g. Gleitmo 800 or equivalent.
- 3 Check that all gaskets are properly attached to the plates.

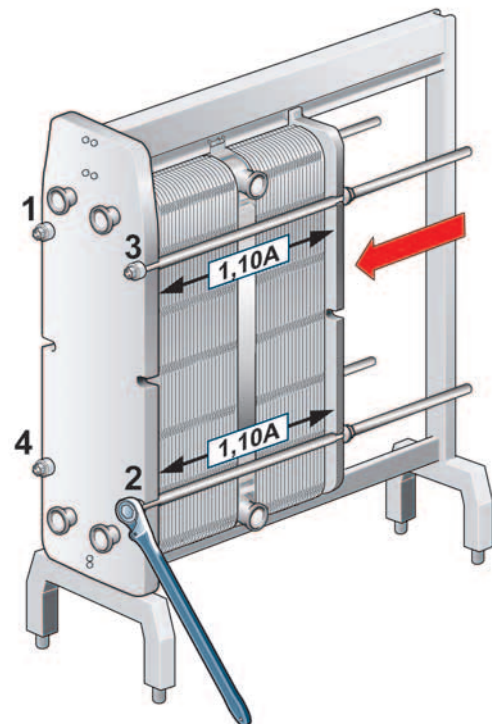
Note!

If the gasket is wrongly positioned, it will show by the fact that it rises out of the gasket groove or that it is positioned outside the groove.

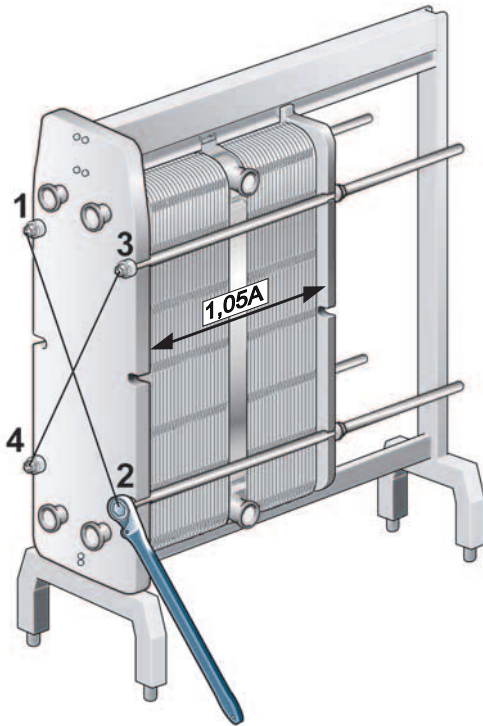
- 4 Press the plate assembly together. Tightening is done in two steps, see figures below. Be careful so that the frame plate and the pressure plate are always in parallel.

Step	Bolt No.	To dimension
1	1-2 or 3-4	1,10A
2	1 - 2 - 3 - 4	A

Step 1: Tighten the two diagonal bolts alternately until the plate package measures 1,10A.



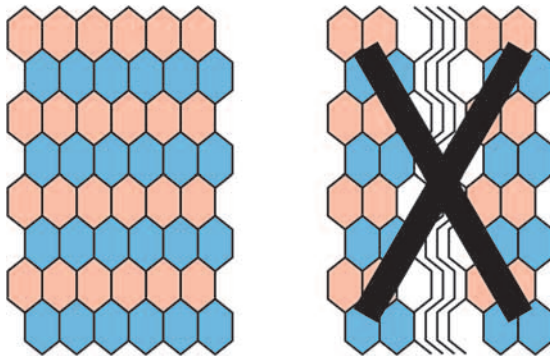
Step 2: After that bolts are tightened alternately and diagonally, as shown in the figure below. Check the dimension A during tightening at the positions of the bolts that are being used.



5

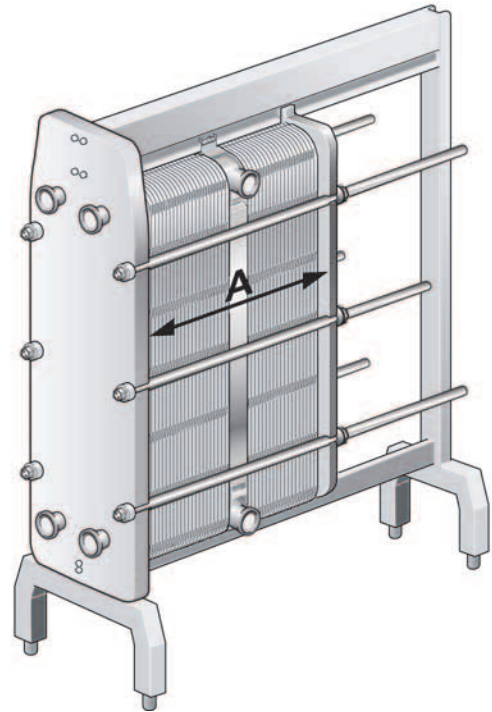
If the plate pack has been marked on the outside, check this (see step 3 in section "Opening").

If the plates are correctly assembled (A/B/A/B etc.), the edges form a "honeycomb" pattern, see picture below.



6

Mount remaining bolts and check measurement A on both sides, at top and bottom.



7

Mount protection sheets (if provided).

8

Connect pipes.

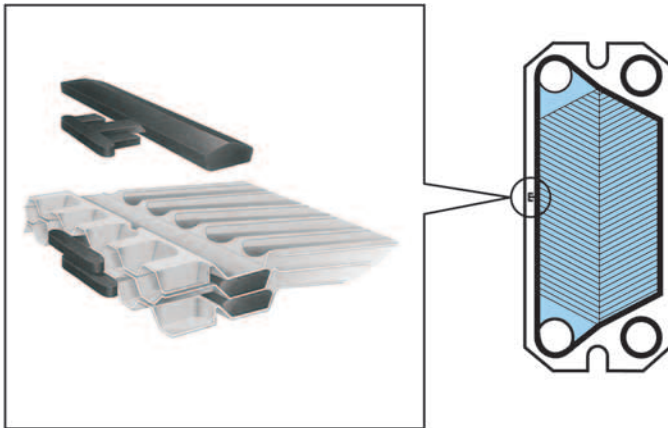
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If the PHE does not seal when the measure A has been reached, it can be tightened further to A minus 0.5 %.

Regasketing

Clip-on gaskets

- 1 Open the plate heat exchanger according to page 14.
- 2 Remove the old gasket with the plate still hanging in the frame.
- 3 Attach the clip-on gasket to the plate. Slip the gasket prongs under the edge of the plate.
- 7 Perform a pressure test, see section “General guidelines”.



Note!

Make sure the two gasket prongs are in correct position.

- 4 Proceed with the next plate to be regasketed until all plates in need of regasketing are done with.
- 5 Check that the plates hang according to the Plate Hanging List. Read the platage table in the Plate Hanging List from the top and down.
- 6 Close the plate heat exchanger according to page 17.

Fault detection

Fault	Correction
Performance of the PHE with regard to heat transfer and/or pressure drop is abnormal	Check the platage. A consequence of wrongly located plates can be that some channels are by-passed, creating dead area. Stagnation will follow making circulation cleaning impossible and creating immediate risk of corrosion and/or product contamination.
Leakage to the outside	Check A-measure. If the leakage continues, mark the leaking plates, open and replace the gaskets in question.
Liquids mixing, inside leakage	Apply water pressure on one side of all the sections in the unit. Fill the other side with water and then open all connections on that side. If a plate is perforated, water will pour out of one side of the corresponding open connections. The plates of the faulty section are then examined by means of current crevice-detection liquids. A large plate section may be divided and the pressure test repeated in order to reduce the number of plates on which the crevice-detector has to be applied.