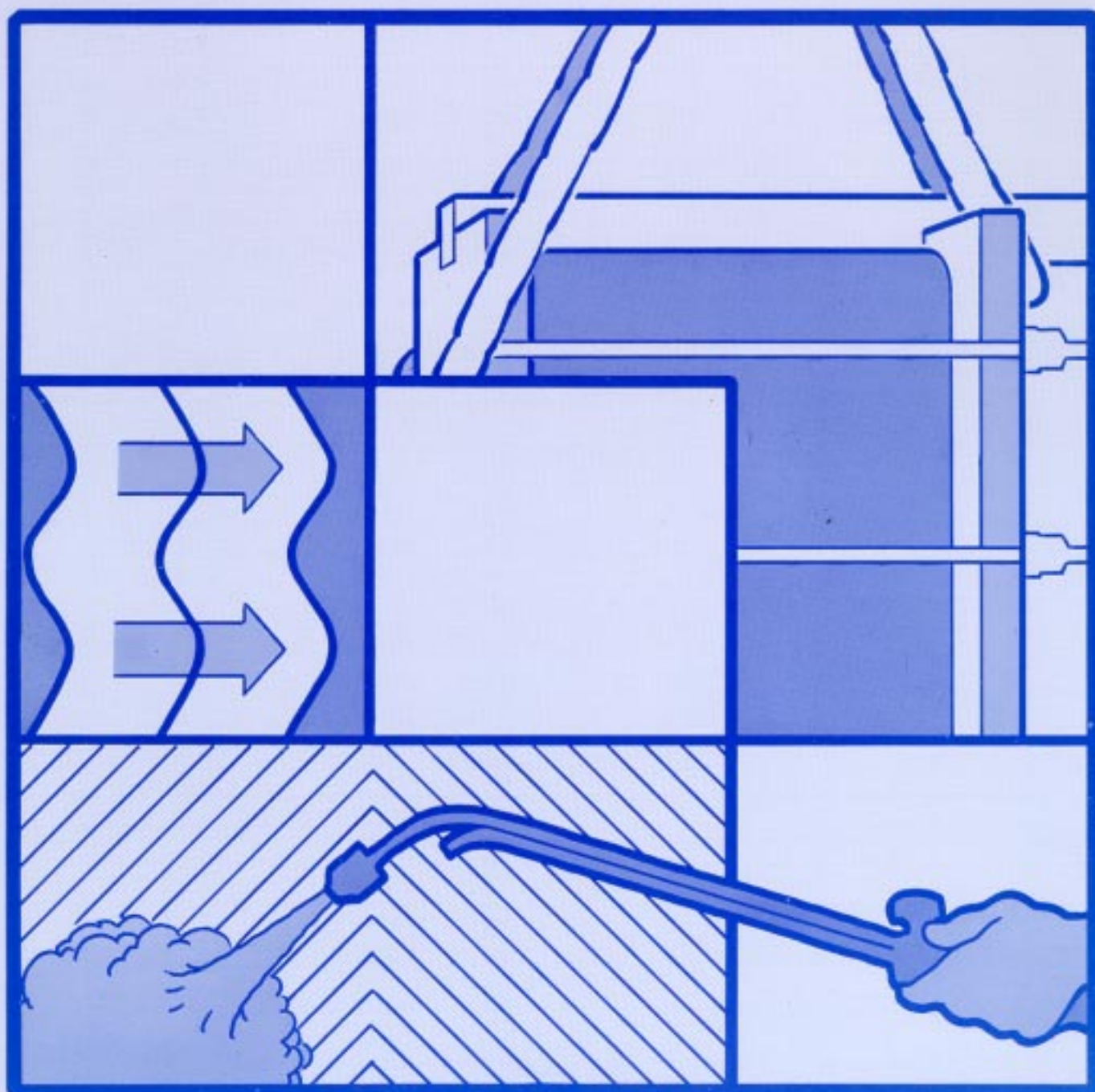


# INSTRUCTION MANUAL

Plate Heat Exchanger

Type

Manufacturing No.



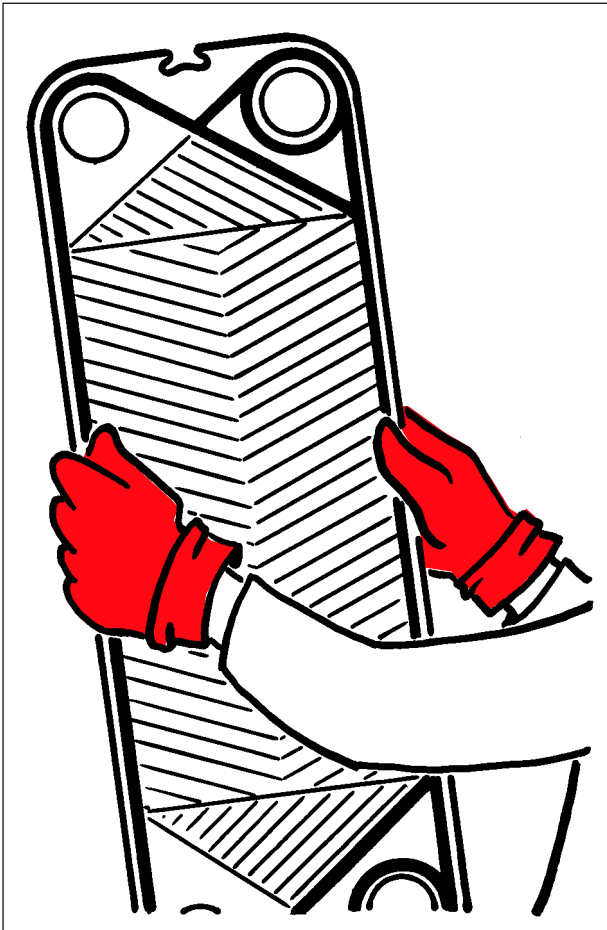
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## **Warning!**

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### **CAUTION!**

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

## **PROTECTIVE SHEETS Ref: chapter 9**

To avoid injuries and damages, follow the instructions in this manual. Also comply with applicable local safety regulations.

To prevent from injuries or damages in case of leakage and spouting liquid or steam, when necessary we can supply protective sheet for all plate heat exchangers.

---

## **Dear owner,**

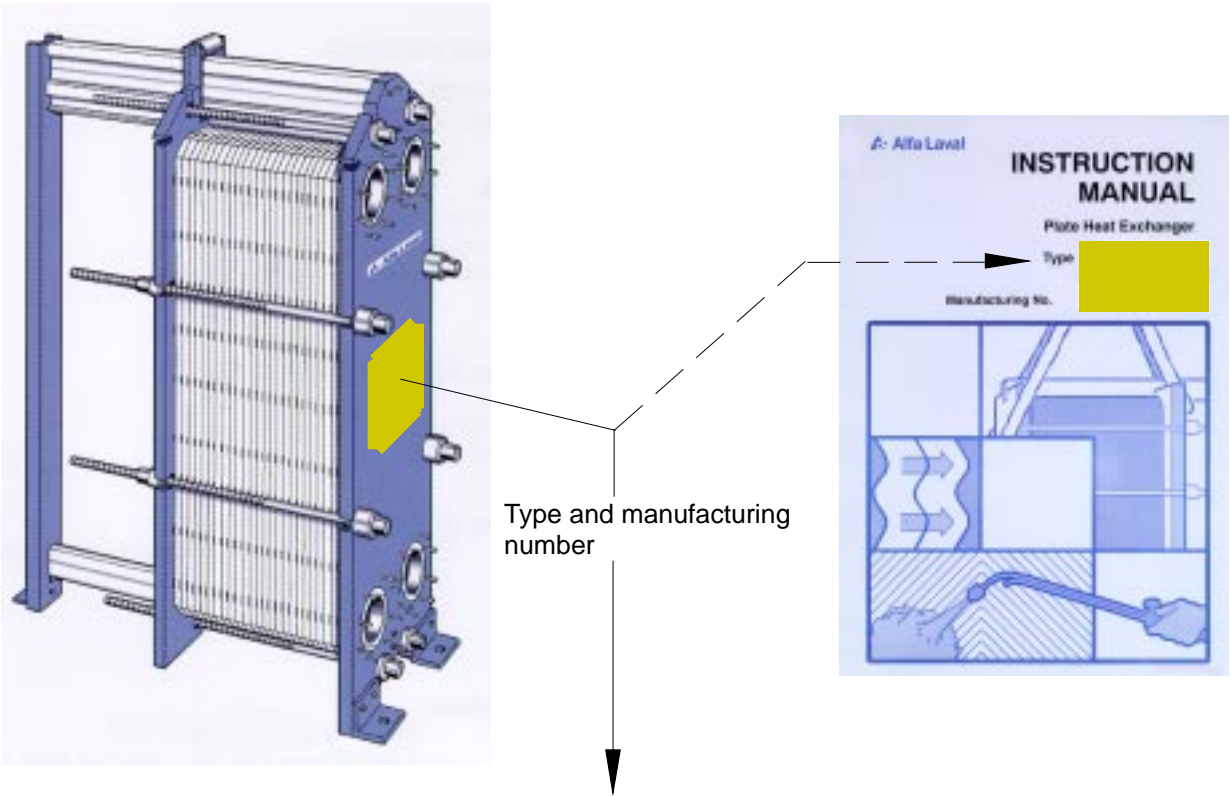
This Instruction Manual is your instant guide, when dealing with your Alfa Laval Plate Heat Exchanger in various situations. Alfa Laval advises you to study it carefully, and – above all – to ensure its availability to those who install, maintain and operate the apparatus on a daily basis. This manual will be of no value to you if it is not available at a time when your personnel needs it.

Alfa Laval will not be responsible for any breakdown of the equipment caused by the

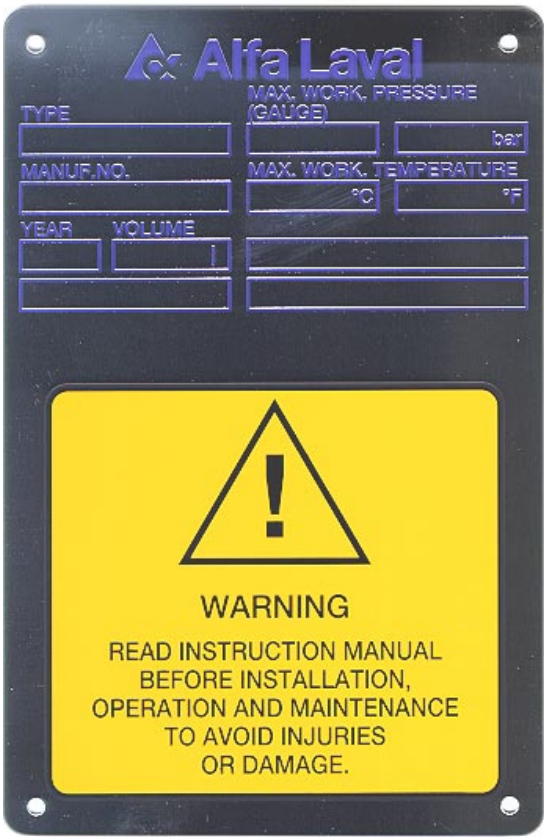
owner's failure to follow the instructions of this manual.

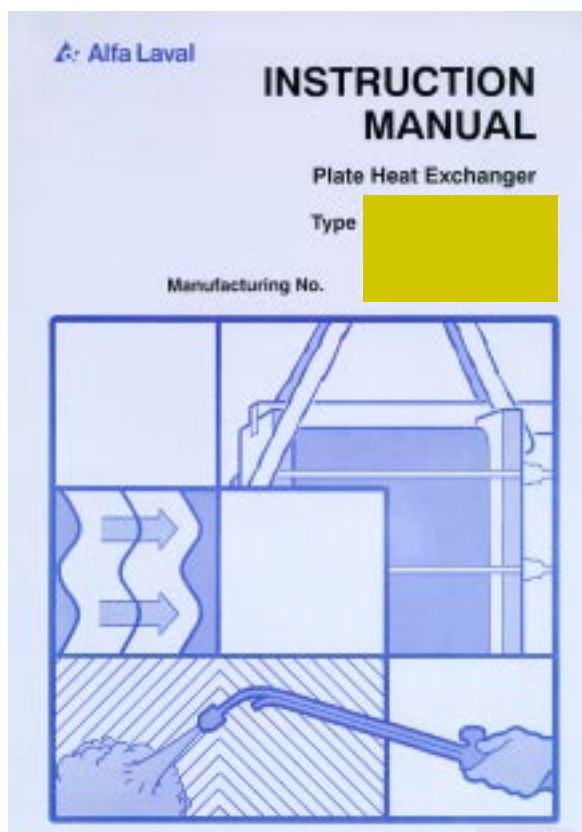
If you nevertheless should have a problem with your Alfa Laval Plate Heat Exchanger which is beyond the scope of this manual, do not hesitate to turn to your Alfa Laval representative. We can help you, wherever you are in the world.

# The data plate – and the identification of the apparatus 2



A data plate is fixed to the apparatus and gives the following information





This instruction manual has been issued for one particular apparatus and carries the manufacturing number of that apparatus on the upper line on the front cover.

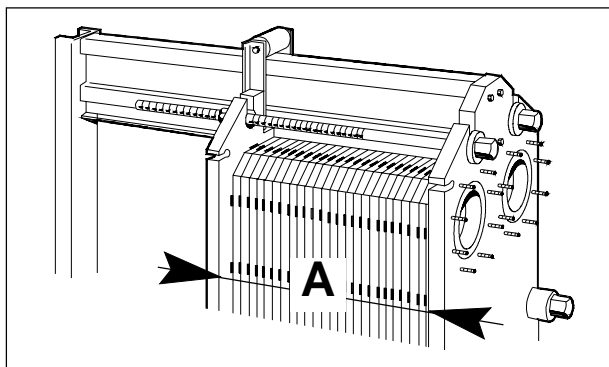
A design drawing of the apparatus is located in the inside pocket of the back cover of this manual.

- Whenever using the manual, check first that the manufacturing number on the front cover is identical to that on the data plate of the apparatus.
- In all correspondence with Alfa Laval, please refer to the manufacturing number, for true identification of the apparatus.
- All parts of the plate heat exchanger are identified by a part number. Whenever contacting Alfa Laval about a part, be sure to state its identification number (from parts list in this manual).



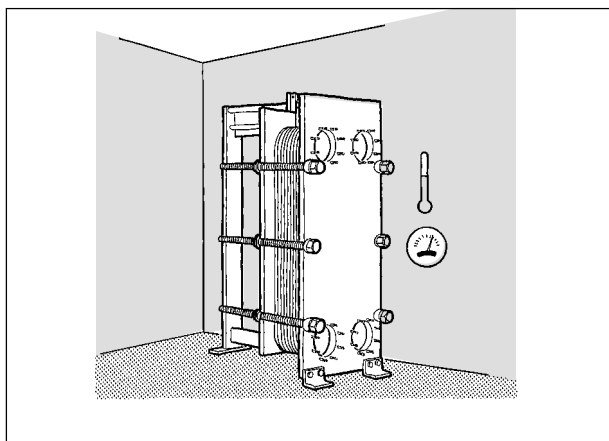
## Storage

In this section, names of heat exchanger parts are mentioned for the first time. For your information, see the first paragraph of Section 4.



- 1 Unless otherwise agreed, Alfa Laval delivers the plate heat exchanger ready to be put in service upon arrival. This means that the plate package is tightened to its correct measurement A.

Should it be necessary, however, to store the apparatus for a longer period (1 month or more) before, certain precautions should be made in order to prevent unnecessary damages of the equipment:



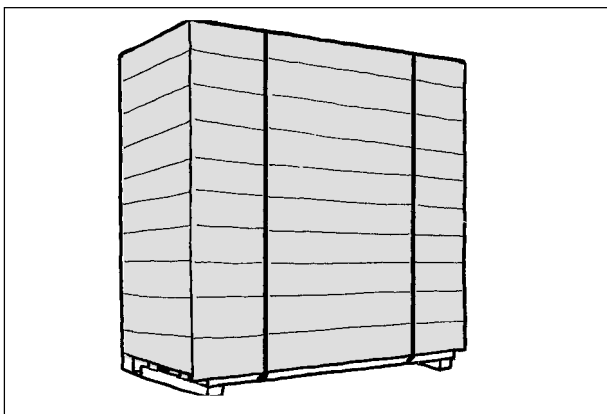
- 2 Preferably, the heat exchanger should be stored inside, in a room with temperature around 15 to 20 degrees Celsius (60 to 70 Fahrenheit) and humidity around 70%.

### NOTE!

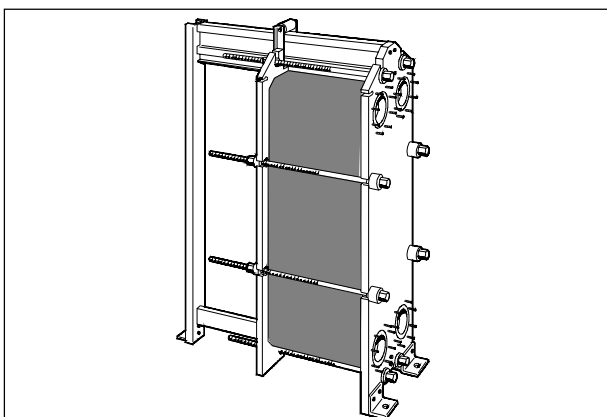
There should **absolutely not** be any **ozone-producing** equipment in the room, like electric motors or arc-welding equipment, since ozone destroys many rubber materials (cracking).

Do not store organic solvents or acids in the room and avoid heat- or ultraviolet radiation. These may destroy the rubber materials.

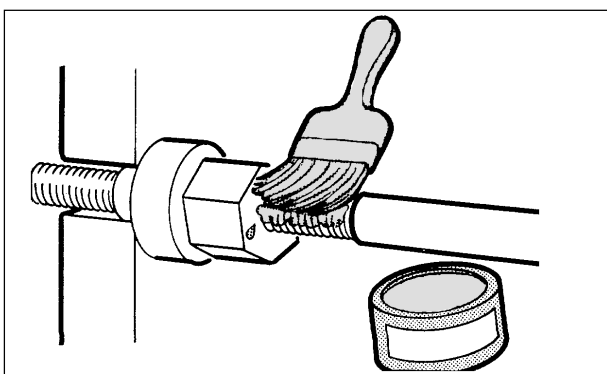




- 3** The best solution is often to leave the heat exchanger in the packing case until it is time for installation. In this case Alfa Laval should be informed, in order that proper preparation can be done prior to packing.

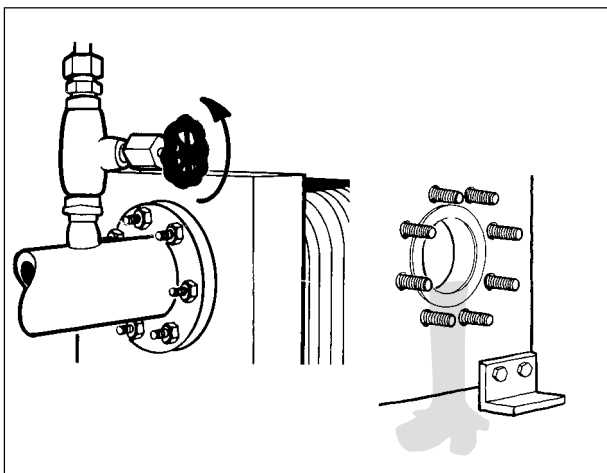


- 4** To wrap the plate package with a non-transparent plastic film is a good precaution.



- 5** The tightening bolts should be well covered with a good rust preventing coating, like Esso Rustban 326 or similar, and if not connected to the pipe system, the connections should be covered.

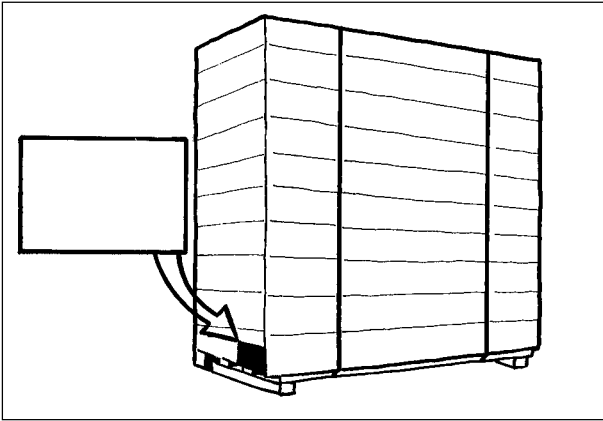
If the heat exchanger must be stored outdoors, the precautions mentioned above should be taken as far as practical. The need for protection against the climate etc. is of course even more important in this case.



- 6** Also, if for any reason the heat exchanger is closed down and taken out of service for a long period, it is recommended to follow the advice above, even if the apparatus is not moved from the location. The heat exchanger should be **drained** and depending on the media processed, it is recommended to **rinse and dry** it, before it is left for storage.

## Packing list, unpacking and lifting

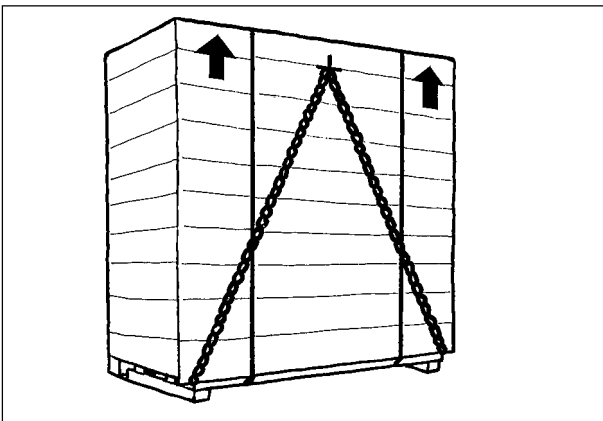
### Packing list and unpacking



- 1** The packing list is attached to the goods.

For safe transport it is necessary to deliver instruments, valves etc. unmounted. Please check all parts against packing list, handle fragile parts with care.

### Lifting



- 2** When lifting the unopened packing case (or skid) please observe the markings on the case indicating where to place lifting hooks.

The centre of gravity of the load is important and is marked on the topside of the case; the actual centre of gravity is located on a vertical line directly below this mark.

Alfa Laval generally advises customers in advance on how the heat exchanger has been placed inside the crate.

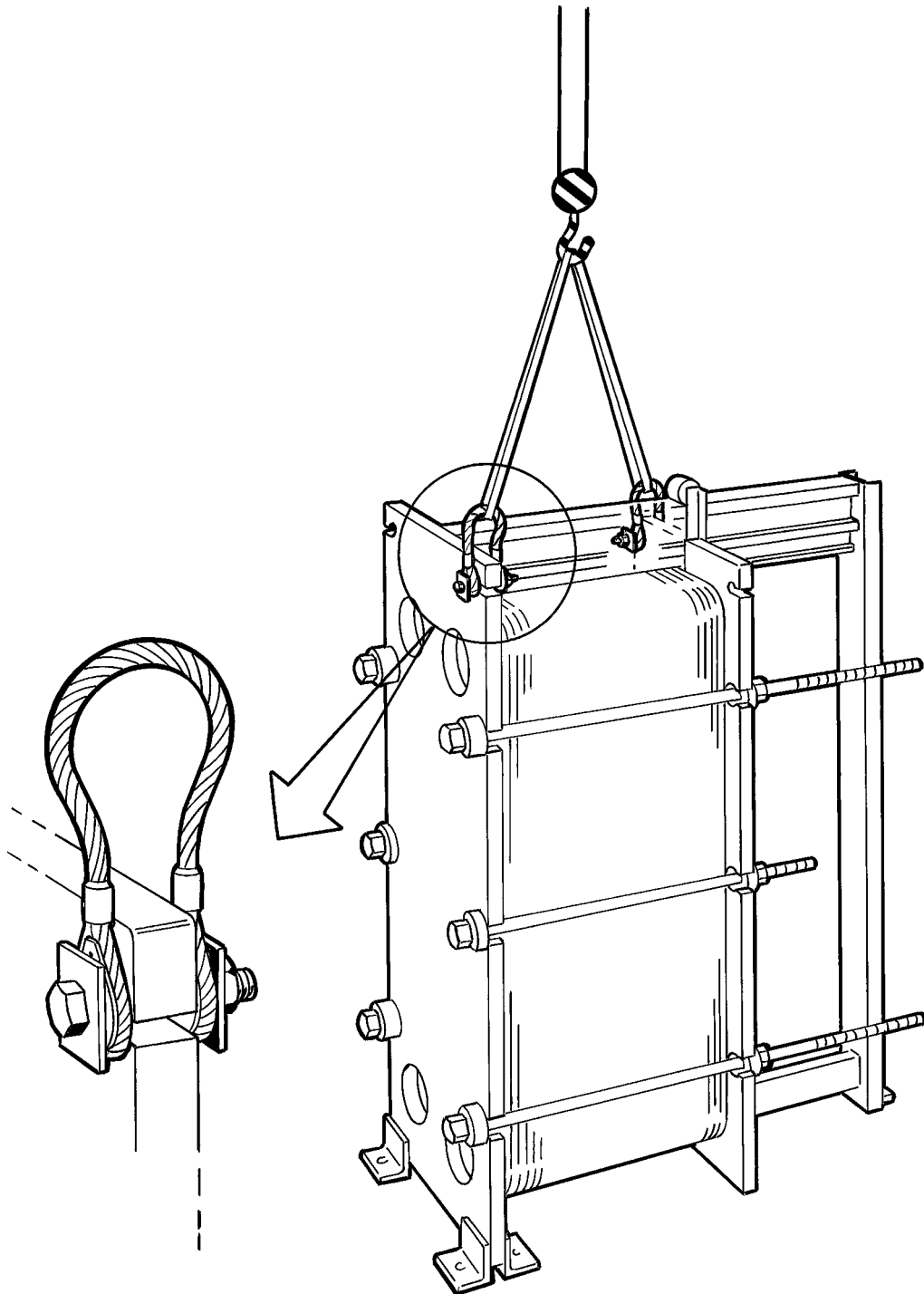
## Lifting

PHE–Types M3, M6, M10, M15, A15, AK20, AM20, M20 and A20

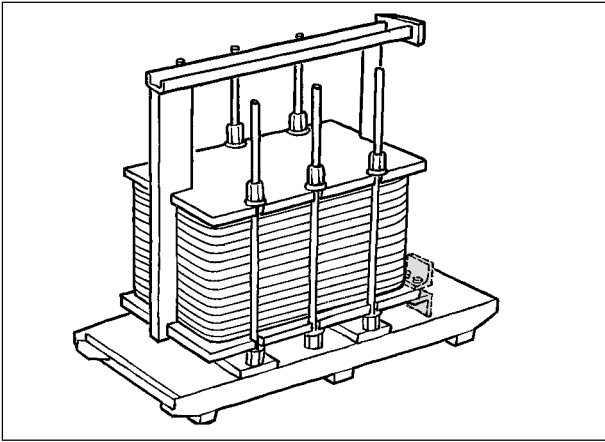
If you are to lift the heat exchanger itself, straps should be used. They should be placed as shown on the picture.

**WARNING!**

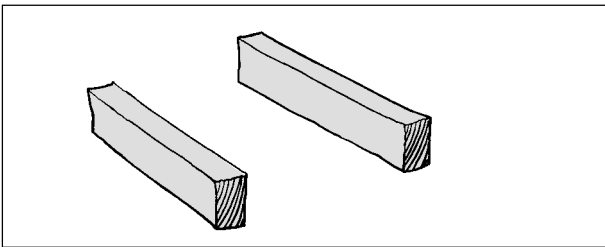
Never lift by the connections or the studs around them.



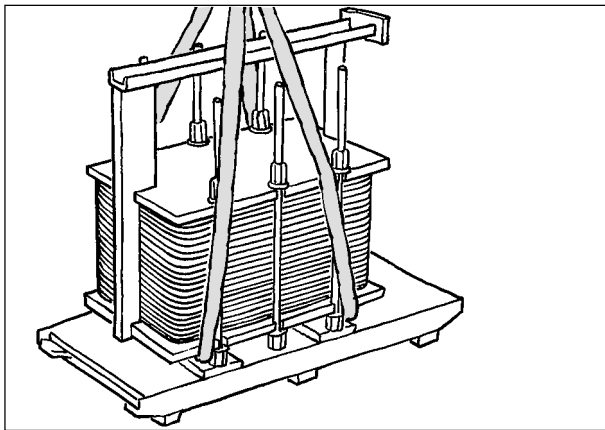
## Raising of PHE



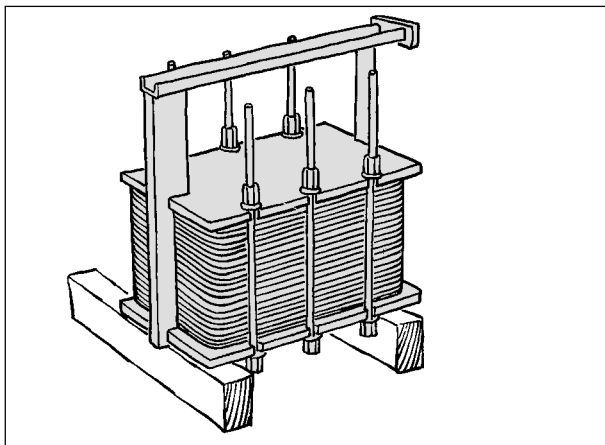
**1** Remove the support feet.



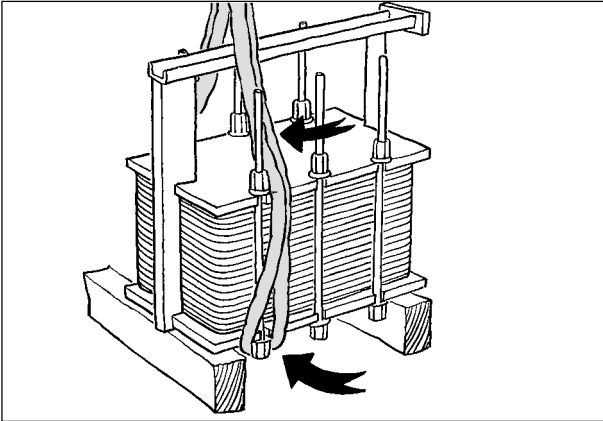
**2** Place two timber beams on the floor.



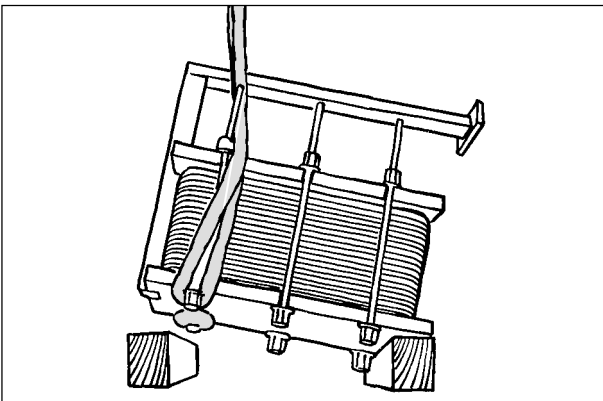
**3** Lift the heat exchanger off pallet using e.g. strops.



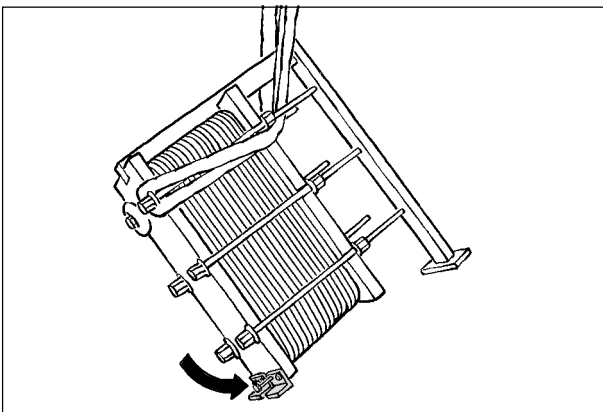
**4** Place the heat exchanger on timber beams.



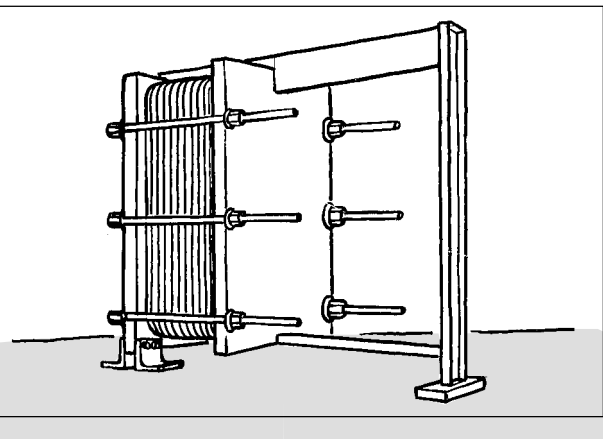
**5** Place straps round one bolt on each side.



**6** Lift the heat exchanger from the timber beams.



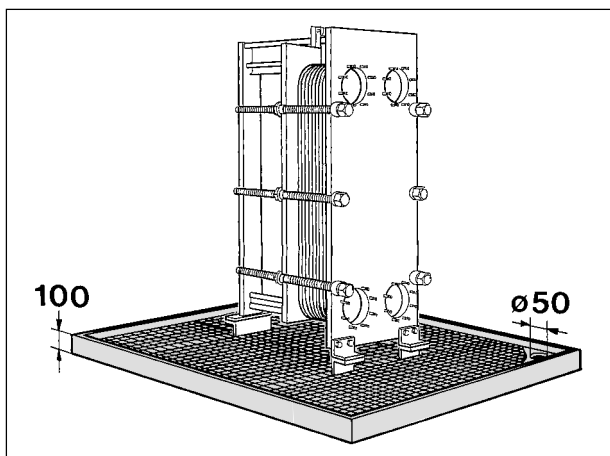
**7** Bolt on the support feet.



**8** Lower the heat exchanger to horizontal and place on floor.

## Foundations

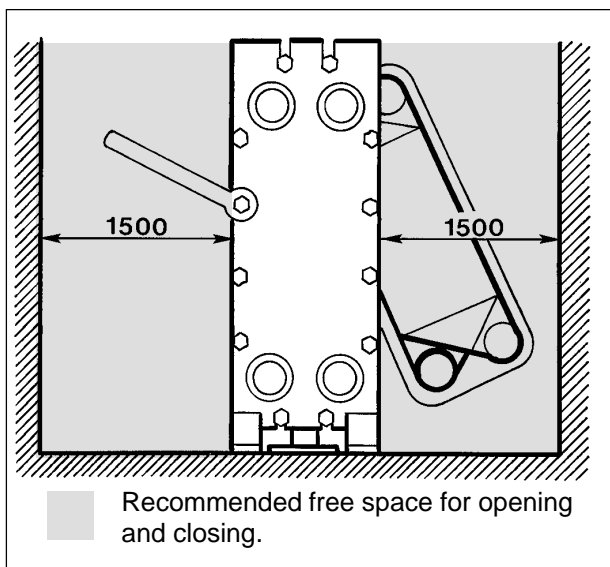
All information necessary for the preparation of the foundation appears from the data sheet provided by Alfa Laval.



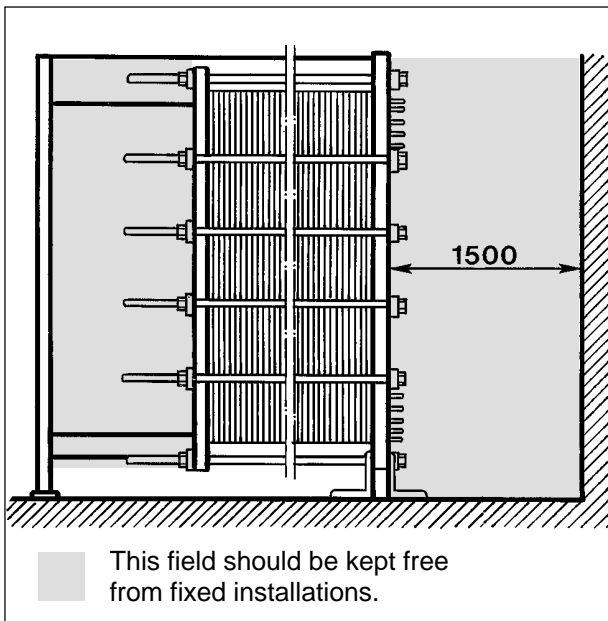
In some cases it may be practical to place the heat exchanger in a **drainage box**, with capacity for the total volume of the heat exchanger (installation onboard a ship, when processing corrosive liquids etc.). The outlet of the drainage box should be generously dimensioned, not less than 50 mm (2") diameter.

## Installation

Before connecting any piping to the heat exchanger, make sure that all foreign objects have been rinsed out of the system!



As will appear from the dimension drawing provided by Alfa Laval, and from the picture above, it is necessary to leave free space around the apparatus, to give access and make future service possible. Except for a place to put the plates, if removed from the heat exchanger, **no further space** is required for servicing the apparatus.

**NOTE!**

The measurements given in the picture are recommended by Alfa Laval, to provide reasonably good working conditions, during installation of the heat exchanger as well as for future maintenance and service. If floor space is restricted then the dimensions suggested can be reduced, and it is left to the purchaser to decide just how much access space can be left.



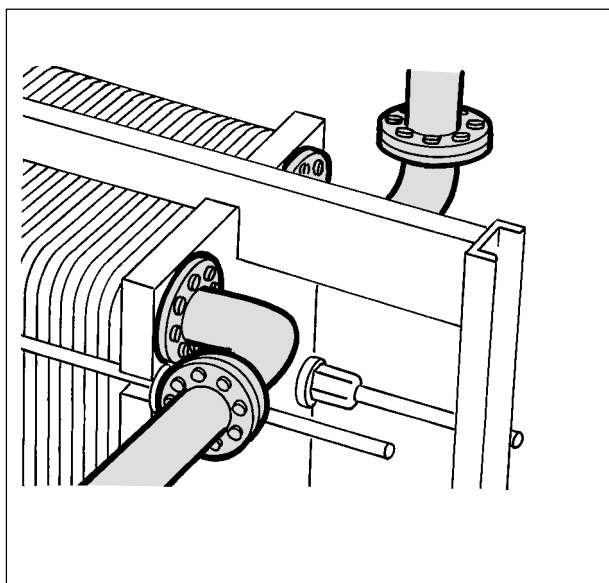
## Pipes

When connecting the pipe system to the heat exchanger make sure that no stress or strain is imposed, by the pipe system, on to the heat exchanger.

## Shut off valves

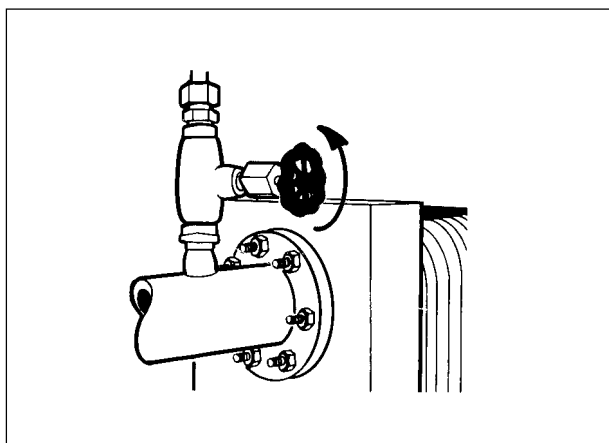
To enable the heat exchanger to be opened when necessary shut off valves should be provided in all connections.

## Connections on the pressure plate



Some plate heat exchangers may have connections also in the pressure plate. In such cases, it is important to check against the drawing or the data print that the plate pack has been tightened to the right measurement before the pipe is connected.

An elbow should be flanged to the connection in the pressure plate, directed upwards or sideways, and with an other flange located just outside the contour of the heat exchanger. It is then convenient to disconnect this second flange – and not the one attached to the pressure plate – when the heat exchanger is to be opened.



Venting of both sides of the heat exchanger must be provided. This is important and enables air to be drawn from the system during commissioning. It also enables air or gas to be removed during operation.

# The main components and their functions

## Function

In Alfa Laval Plate Heat Exchangers, heat is transferred from one medium to another through thin metal plates which have been pressed into a very special pattern.

### Frame plate

### Support column

The two bars are suspended between the **frame plate** – to which in most cases the piping is connected, and a **support column**.

### Carrying bar

### Guiding bar

The plates hang from a **carrying bar** and are kept in line by a **guiding bar** at the lower end.

### Pressure plate

A steel plate called the pressure plate is also hung on the carrier bar and is moveable, as are the heat transfer plates. In some cases pipe may be connected to the pressure plate.

### Connections

Holes matching the piping lead through the frame plate, permitting the media to enter into the heat exchanger.

Threaded studs around the holes secure the pipes to the apparatus. Depending on the application, metallic or rubber-type **linings** may protect the edges of the holes against corrosion.

### Tightening bolts

With the package of thin plates hanging between the frame plate and the pressure plate, a number of **tightening bolts** are used to press the thin plates together, to bring them into metallic contact, and to pressure the gaskets, enough to seal off the narrow passages which have now been formed between the plates

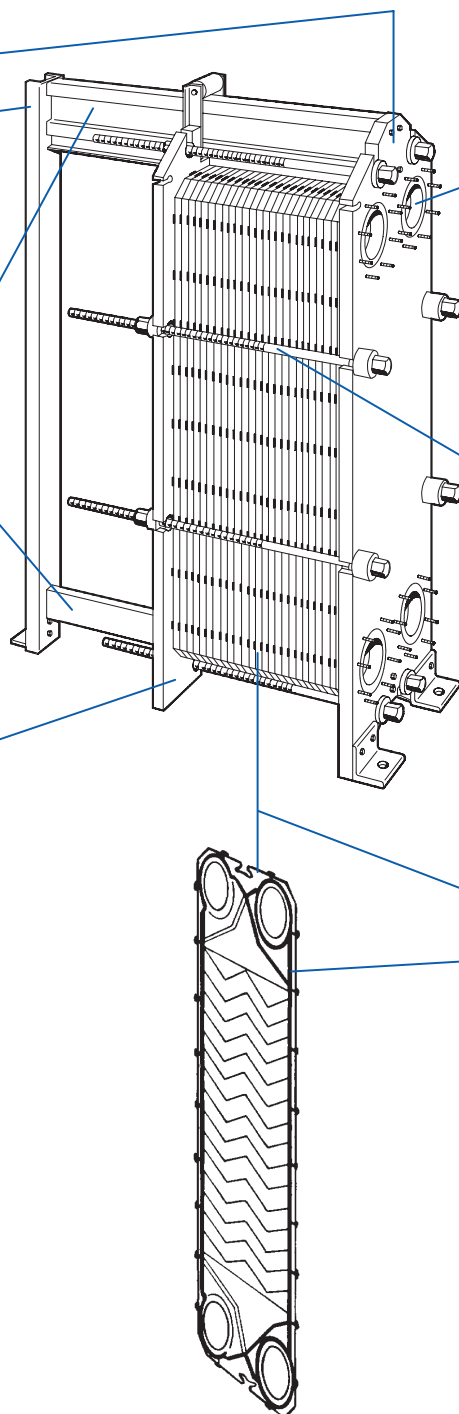
### Channel plates

### Gasket

These plates are called **channel plates**. A groove along the rim of the plate and around the ports hold a **gasket**, usually made of a rubber-type material.

Heat is transferred through the surface which is contained by the gasket, except for some small areas near the corners.

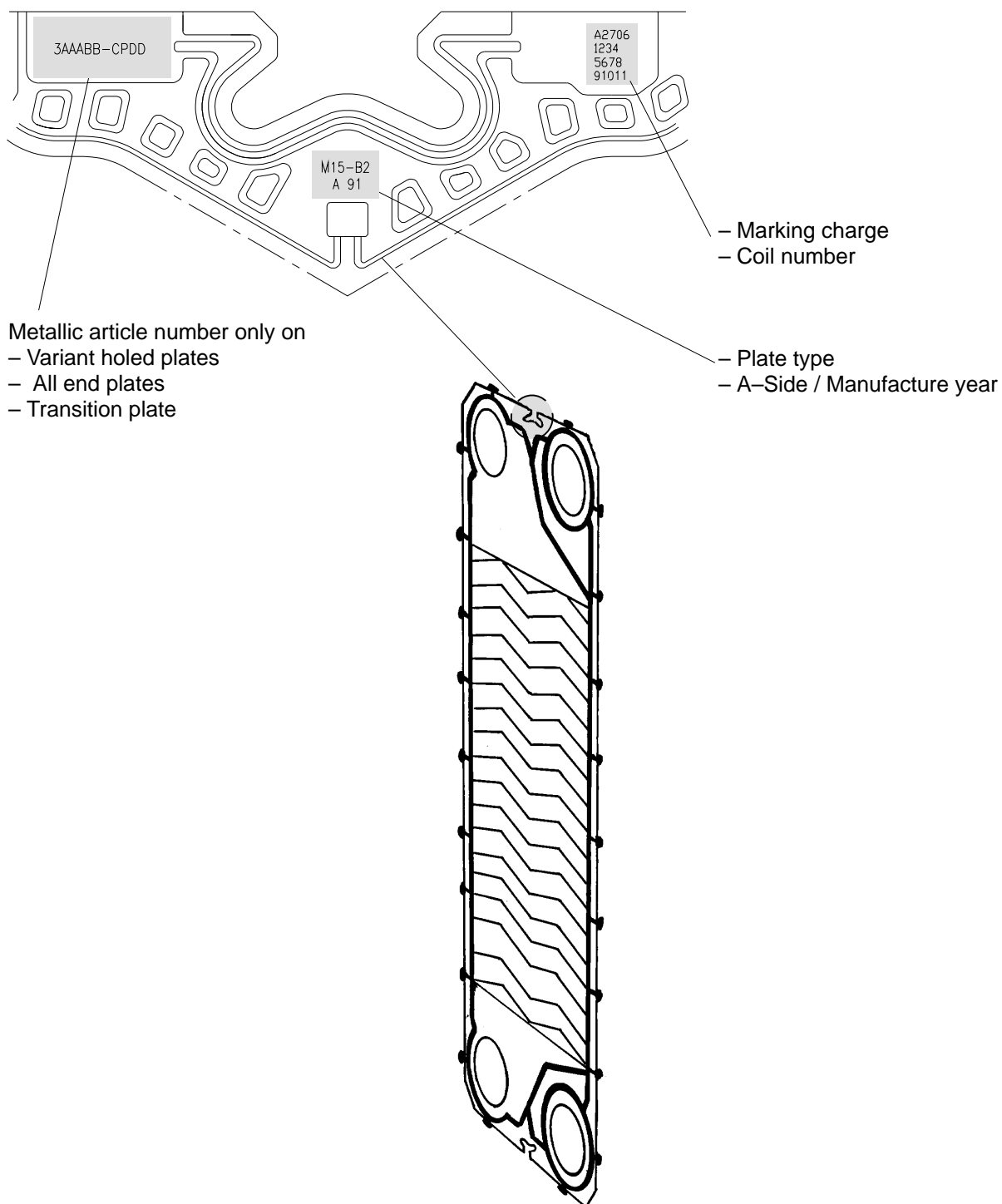
The number of plates in the package of your heat exchanger is determined by the size of the heat transfer surface required.



## Marking of plates

### Plate types: M3, M6–M, M10–M, M10–B, M15–B

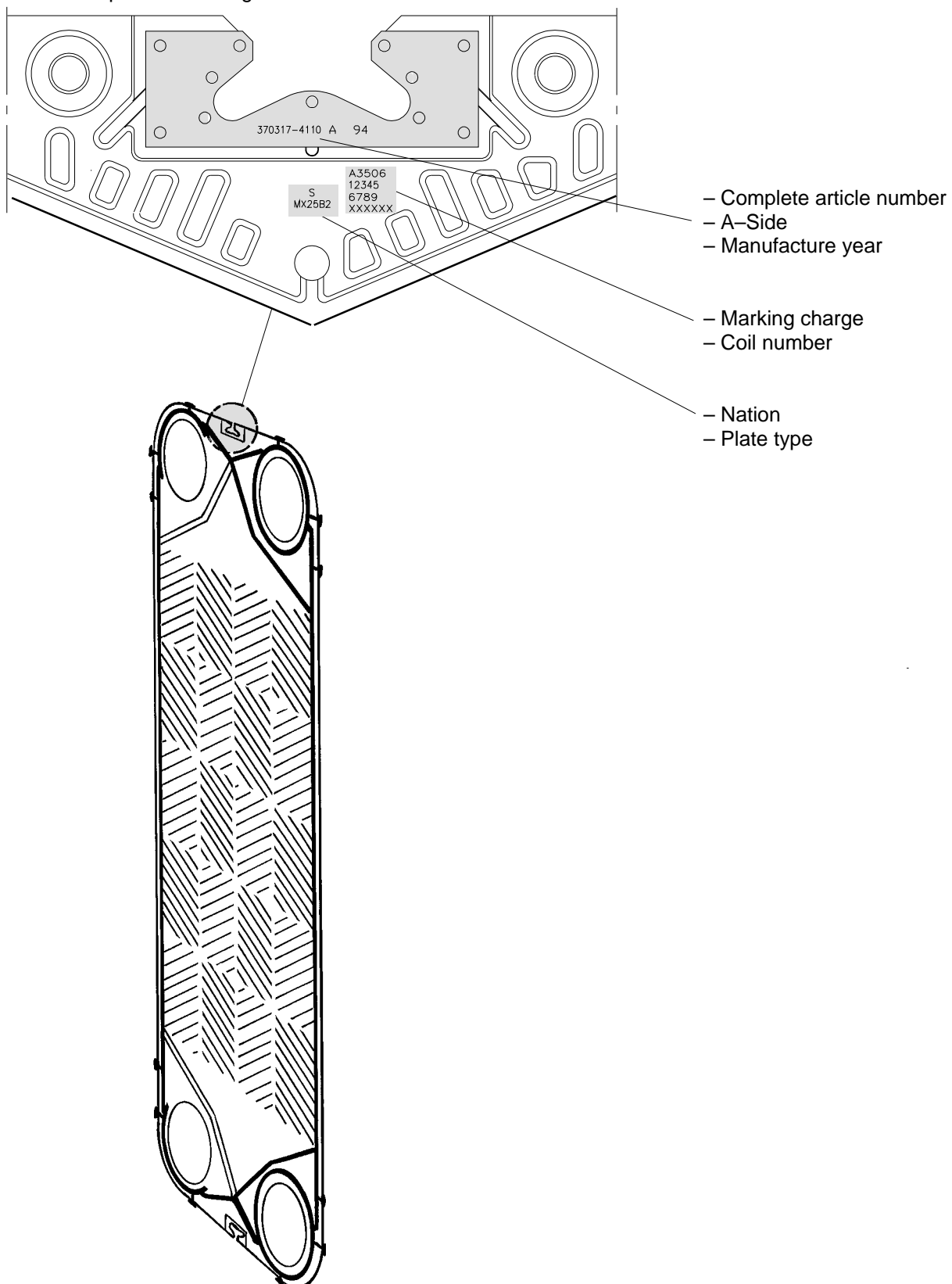
Seen as A–plate from the gasket side.



## Marking of plates

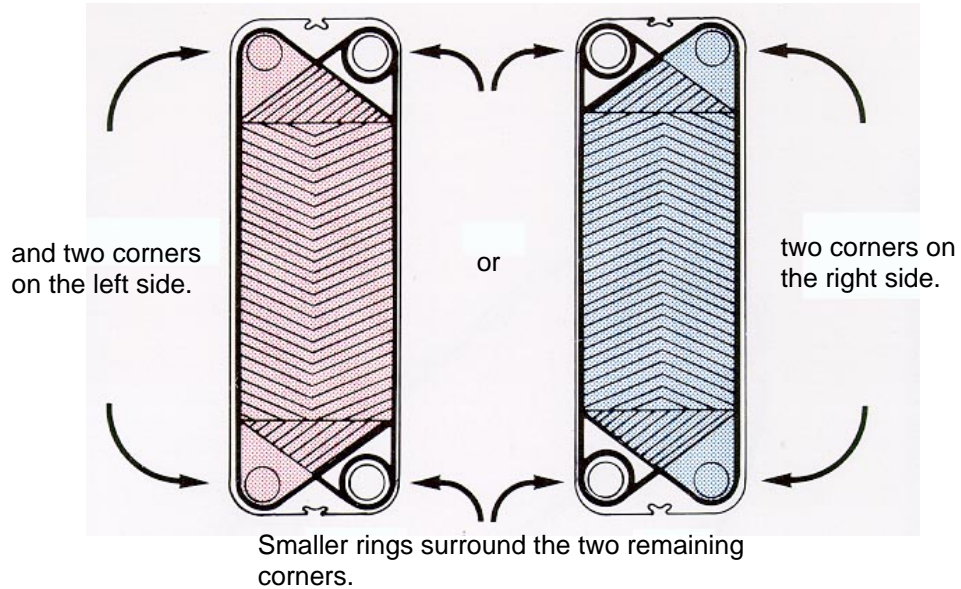
### Plate type: M20-M

Seen as A-plate from the gasket side.



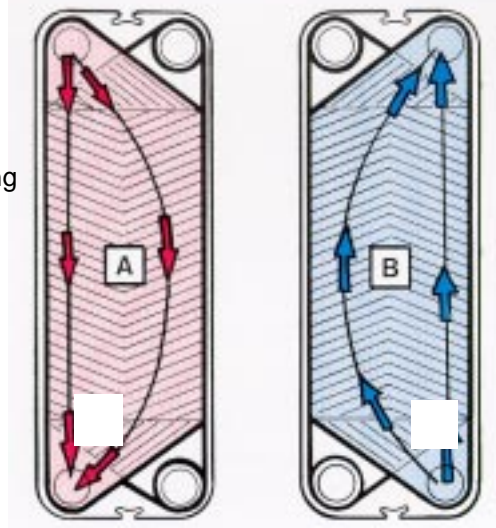
## Plates

Studying the pictures, you will observe that on a plate hanging vertically, the gasket rests in a groove which includes the heat transfer area



We decide that we will name the plates after these two situations.

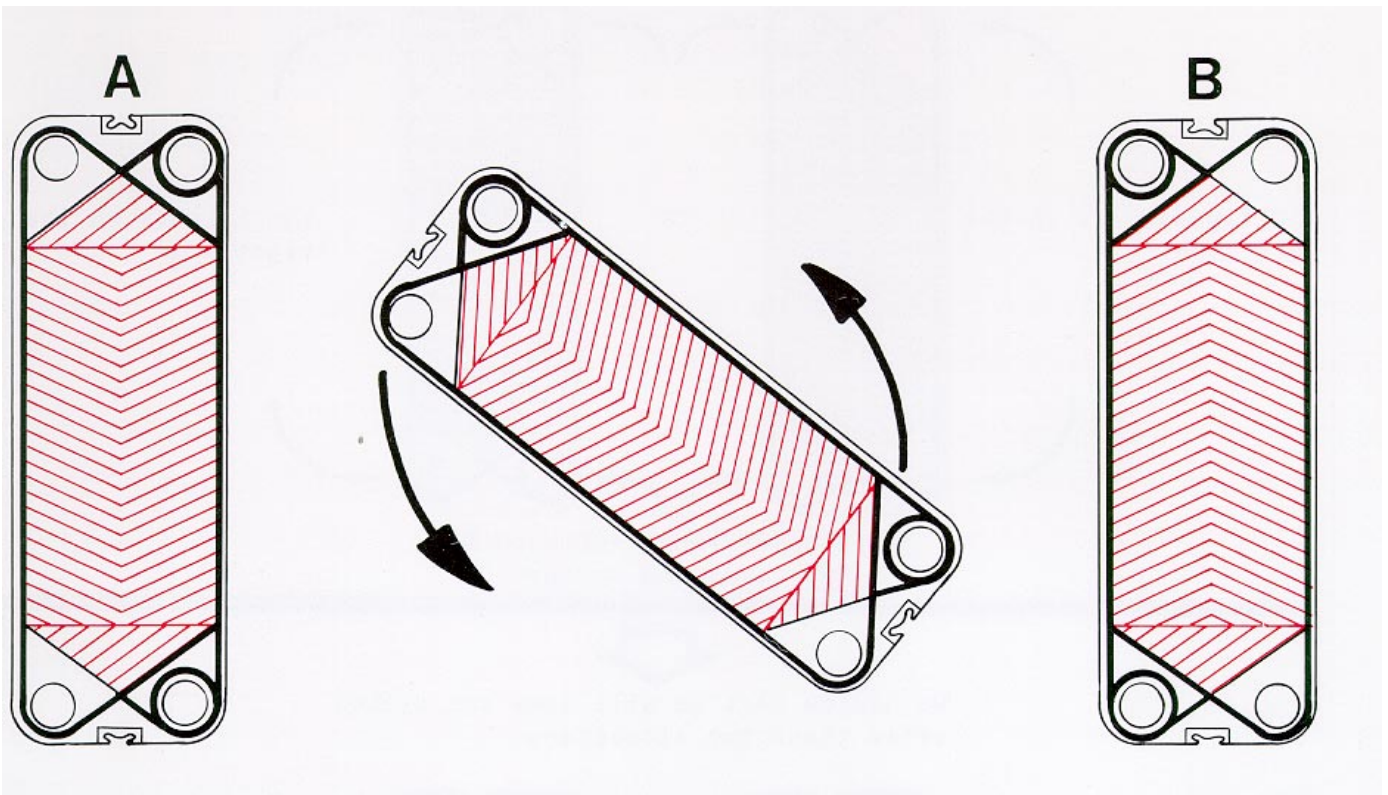
An A-plate is a plate hanging with the chevron pointing downwards.



A B-plate is a plate hanging with the chevron pointing upwards.

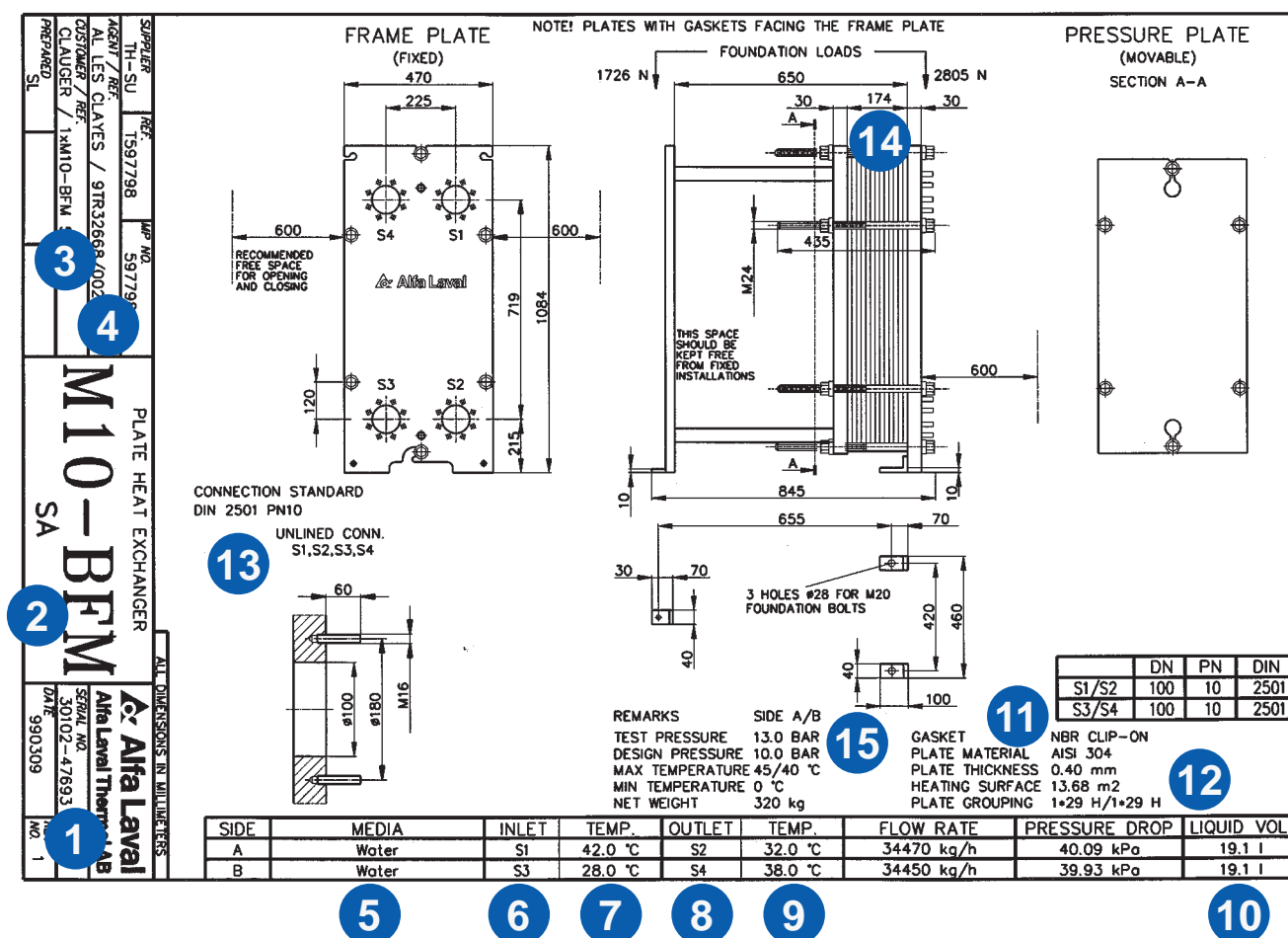
## Plates

It also appears that if we turn an A-plate upside down we will have a B-plate:



## Drawing

The drawing is in the inside pocket of the back cover.  
It gives specific informations about the plate heat exchanger.



1. Manufacturing number
2. Type of PHE
3. Customer
4. Alfa Laval representative through whom the heat exchanger was purchased
5. Media according to the order
6. Location of inlet connections
7. Inlet temperatures
8. Location of outlet connections
9. Outlet temperatures
10. Liquide volume in the PHE
11. Type of materials used for plates and gaskets
12. – Size of heat transfer surface area  
– Plate grouping
13. Type of materials used for connections
14. The plate packet length A
15. – Max. test and design pressure  
– Max. temperature



## Platage specification

On the following page – or pages – is a listing of the plate package, specifying for each plate in sequence from the frame plate to the pressure plate:

30100-06715		PAGE NO. 3				
ED. 1						
PLATE NO.	PLATE CODE	PUNCHED CORNER OF THE PLATE				FLOW DIRECTION ON THE GASKET SIDE OF THE PLATE
		UPPER LEFT	LOWER LEFT	LOWER RIGHT	UPPER RIGHT	
		1	2	3	4	
		->-	-	-	=>	
1	369907-4404A	0	0	0	0	DOWN
2	369907-4403B	0	0	0	0	UP
3	369907-4403A	0	0	0	0	DOWN
4	369907-4403B	0	0	0	0	UP
5	369907-4403A	0	0	0	0	DOWN
6, 8...136	369907-4403B )	)	)	)	)	
7, 9...137	369907-4403A (	(	(	(	(	
138	369907-4403B	0	0	0	0	UP
139	369907-4403A	0	0	0	0	DOWN
140	369907-4203B	0	0	0	0	UP
141	369907-4403A	0	0	0	0	DOWN
142	369907-4203B	0	0	0	0	UP
143, 145...181	369907-4403A )	)	)	)	)	
144, 146...182	369907-4203B (	(	(	(	(	
183	369907-4403A	0	0	0	0	DOWN
184	369907-4203B	0	0	0	0	UP
185	369907-4491A	0	0	0	0	--
PARTITION PLATE		0	0	0	0	
186	369907-4411A	0	0	0	0	UP
187	369907-4403B	0	0	0	0	DOWN
188	369907-4403A	0	0	0	0	UP
189	369907-4403B	0	0	0	0	DOWN
190	369907-4403A	0	0	0	0	UP
191, 193...321	369907-4403B )	)	)	)	)	
192, 194...322	369907-4403A (	(	(	(	(	
323	369907-4403B	0	0	0	0	DOWN
324	369907-4403A	0	0	0	0	UP
325	369907-4203B	0	0	0	0	DOWN
326	369907-4403A	0	0	0	0	UP
327	369907-4203B	0	0	0	0	DOWN
328, 330...366	369907-4403A )	)	)	)	)	
329, 331...367	369907-4203B (	(	(	(	(	
368	369907-4403A	0	0	0	0	UP
369	369907-4203B	0	0	0	0	DOWN
370	369907-4484A	0	0	0	0	--
PARTITION PLATE		0	0	0	0	
371	369907-4404A	0	0	0	0	DOWN
372	369907-4403B	0	0	0	0	UP
373	369907-4403A	0	0	0	0	DOWN
374	369907-4403B	0	0	0	0	UP
375	369907-4403A	0	0	0	0	DOWN
376, 378...506	369907-4403B )	)	)	)	)	
377, 379...507	369907-4403A (	(	(	(	(	
508	369907-4403B	0	0	0	0	UP
509	369907-4403A	0	0	0	0	DOWN
510	369907-4203B	0	0	0	0	UP
511	369907-4403A	0	0	0	0	DOWN
512	369907-4203B	0	0	0	0	UP
513, 515...549	369907-4403A )	)	)	)	)	
514, 516...550	369907-4203B (	(	(	(	(	
551	369907-4403A	0	0	0	0	DOWN
552	369907-4203B	0	0	0	0	UP
553	369907-4403A	0	0	0	0	DOWN
554	369907-4203B	0	0	0	0	UP

The plate identification number

The identification number is also the SPARE PART ORDERING NUMBER

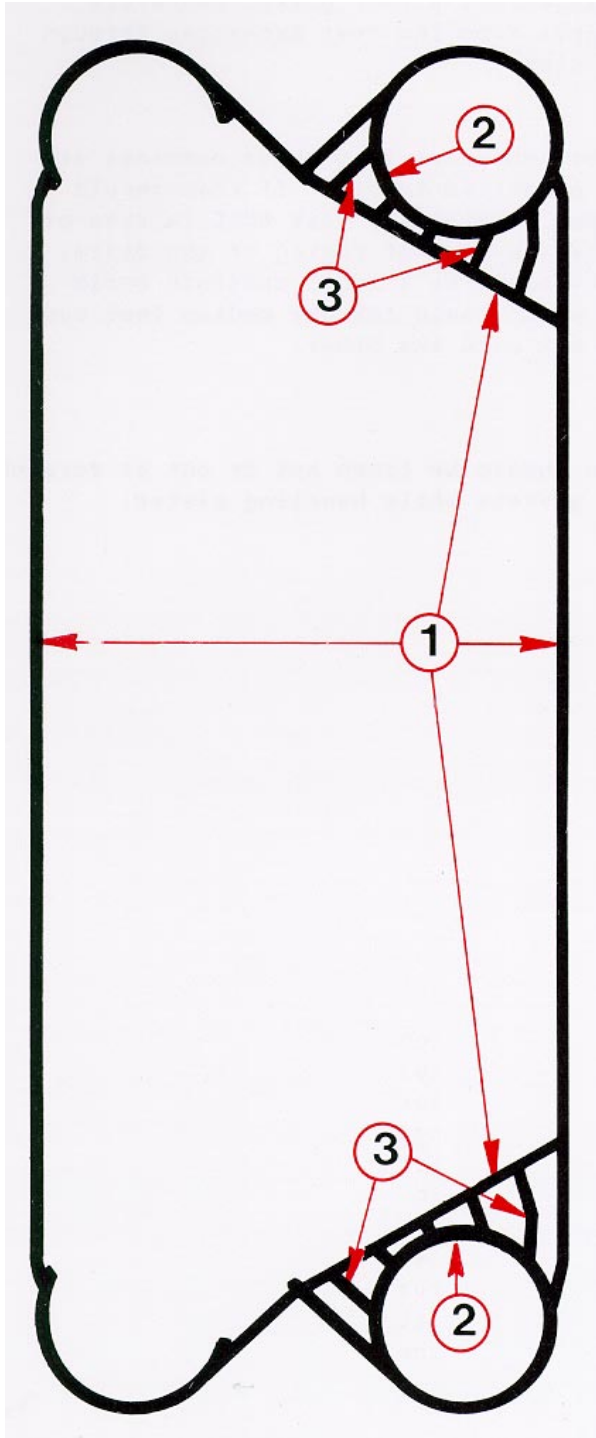
The corners where holes have been punched

The flow direction along the plate

See also chapter 6 Removal and insertion of plates.

## Gaskets

The GASKET is moulded in one piece. The material is normally an elastomer, selected to suit the actual combination of temperature, chemical environment and possible other conditions to be considered.



### Gasket types:

- Glued
- Clip-On

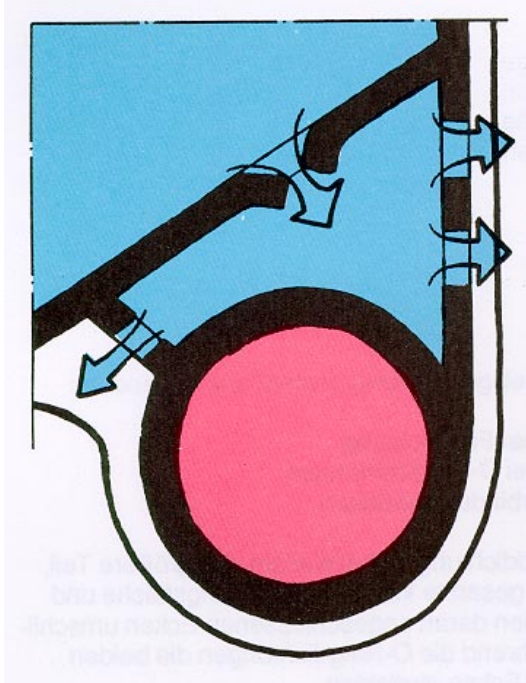
The one-piece gasket is described as consisting of:

- 1 One field gasket
- 2 Two ring gaskets
- 3 Links

The field gasket is by far the larger part containing the whole heat transfer area and the two corners connected to it, while the ring gaskets seal off the remaining two corners.

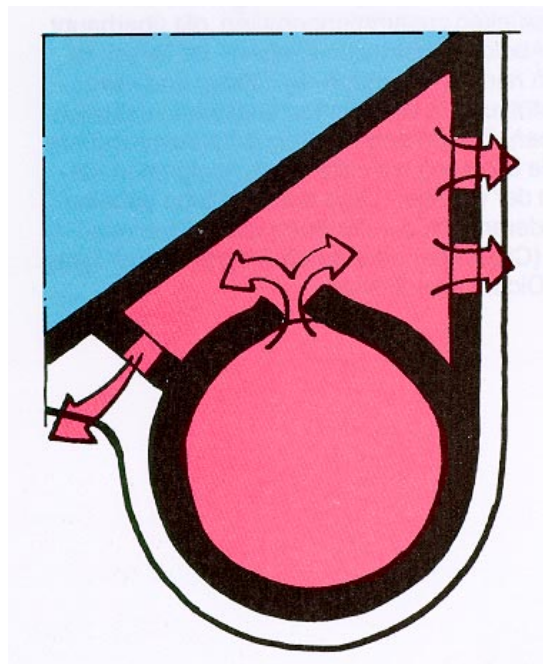
These three pieces are held together by a few short links, which have no sealing function at all – their purpose is simply to tie the pieces together, and to add some support in certain areas.

## Gaskets



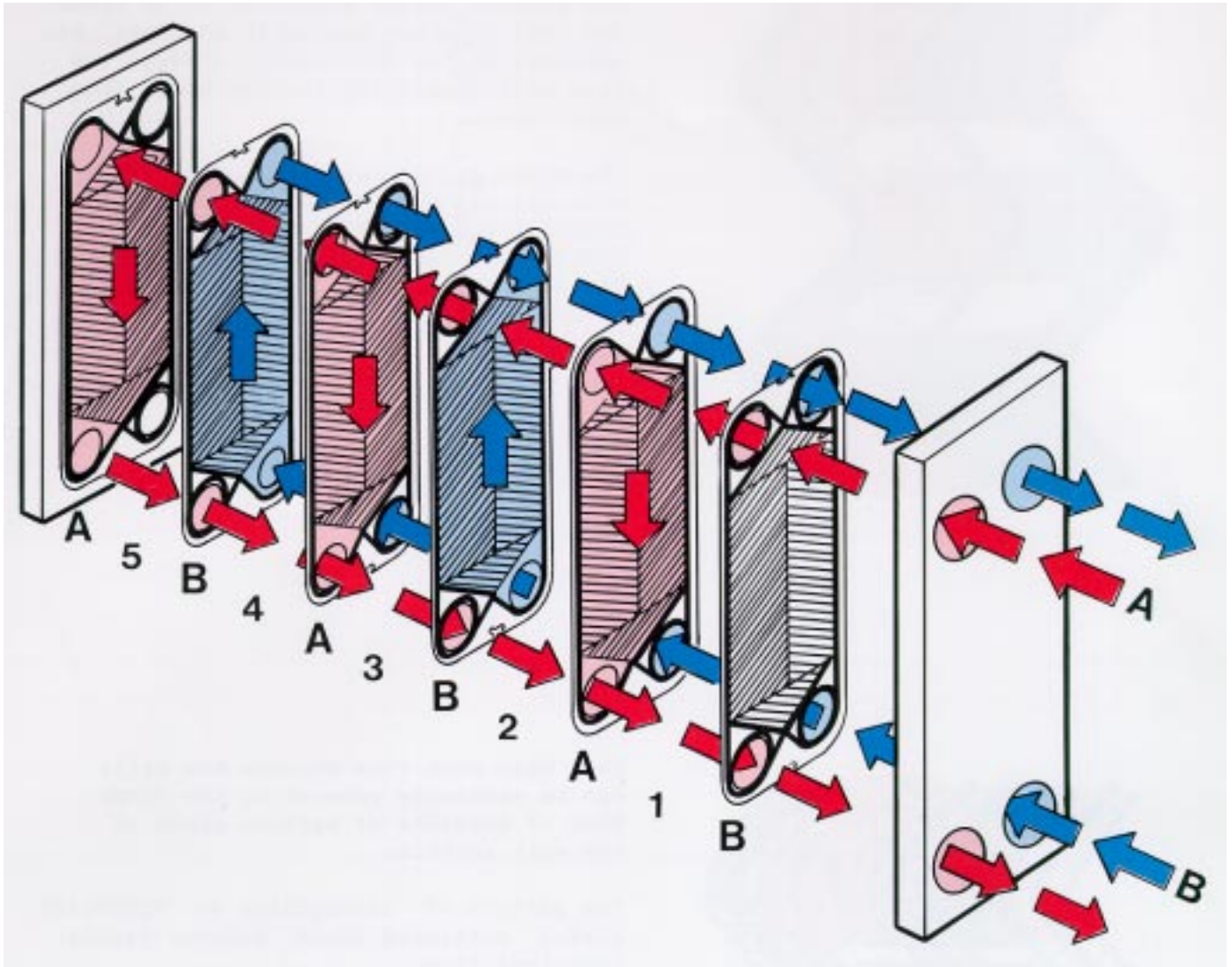
As already demonstrated, the two media are effectively kept apart by the ring and field gaskets. To prevent intermixing of the media in the corner areas where field and ring gaskets are very close to each other, the link pieces have a number of slots opening the area between the field and ring gaskets to atmosphere. Any leakage of media across either gasket therefore escapes from the heat exchanger through the slots.

It is important that these openings are not permitted to plug. If that should happen, there is a risk that in case of a leakage in that region of the plate, there might be a local pressure build-up, which could let one medium leak over and mix with the other.



Care should be taken not to cut or scratch the gaskets while handling plates.

## How it works



When a package of plates are pressed together, the holes at the corners form continuous tunnels or manifolds, leading the media (which participate in the heat transfer process) from the inlets into the plate package, where they are distributed into the narrow passages between the plates.

Because of the gasket arrangement on the plates, and the placing of A and B plates alternately, the two liquids enter alternate passages, e.g. the warm liquid between odd number passages, and cold liquid between even number passages.

Thus the media are separated by a thin metal wall. In most cases the liquids flow in opposite directions.

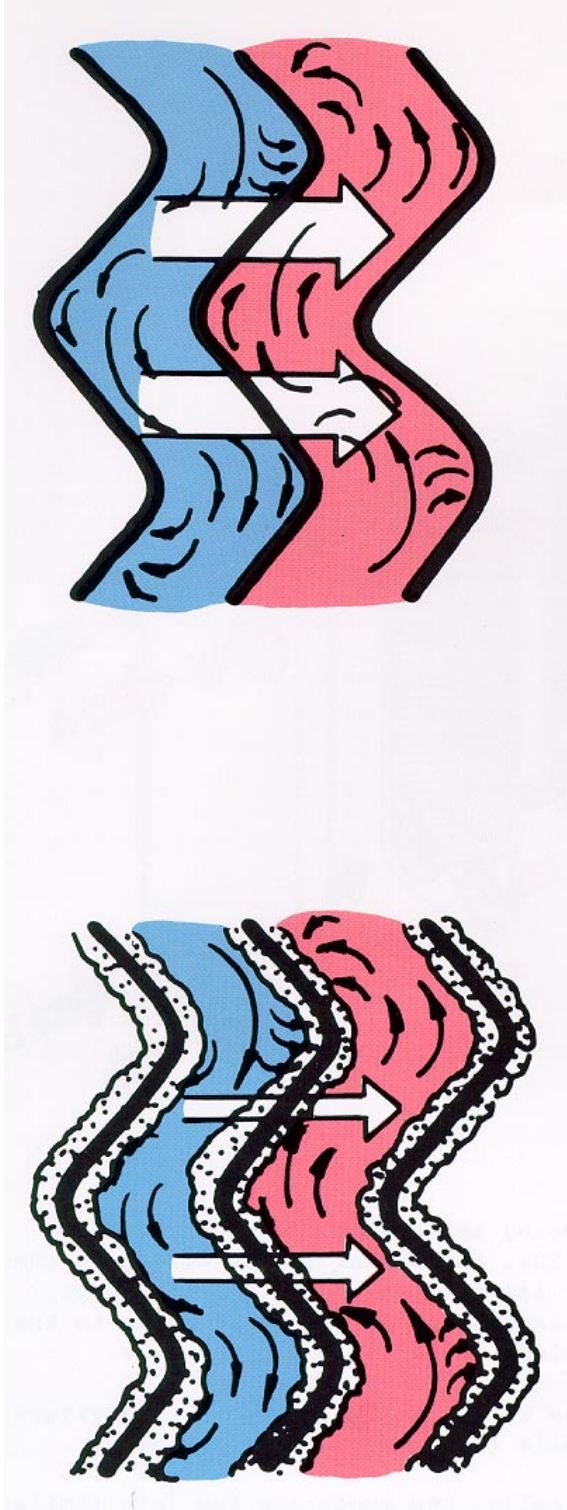
During the passage through the apparatus, the warmer medium will give some of its heat energy to the thin wall, which instantly loses it again to the colder medium on the other side.

The warmer medium drops in temperature, while the colder one is heated up.

Finally, the media are led into similar hole-tunnels at the other end of the plates and discharged from the heat exchanger.



## Heat transfer



The purpose of the apparatus is to transfer heat from one medium to an other, and heat passes very easily through the thin wall separating the two media from each other.

The novel pattern into which the plate material has been formed not only gives strength and rigidity, but greatly increases the rate of heat transfer from the warmer medium to the metal wall and from the wall to the other medium.

This high heat flow through the walls can be seriously reduced by the formation of deposits of various kinds on the wall surfaces.

The pattern of corrugation on Alfa Laval plates mentioned above induces highly turbulent flow. The turbulence gives strong resistance to the formation of deposits on the plate surface; it cannot always eliminate fouling.

The deposits may increase the total "wall thickness" substantially, and they consist of materials that have a much lower thermal conductivity than the metal plate. Consequently a layer of deposits can severely reduce the overall heat transfer rate.

The deposits will be considered under the chapter of **Maintenance** and **Cleaning**. At this point we will only establish that this fouling is unwanted and can under certain circumstances, be harmful to the heat exchanger, because corrosion may occur under the deposits.

## Pressure drop

Pressure drops are wasted energy.

All pipe–systems – and equipment included in them – offer resistance to media flowing through them.

Some pressure drop is unavoidable, but for a given apparatus it should be kept as close as possible to the designed value.

The formation of deposits on the heat transfer surfaces instantly leads to a reduction of the free space between the plates. This means that more energy is needed to get the desired flow through the apparatus.

It is clear that the fouling of the surfaces is undesirable.

Larger particles and fibres may also be drawn into the heat exchanger and clog it, if strainers or other means of protection have not been provided for.

A reduced ability by the heat exchanger to hold the desired temperatures, in combination

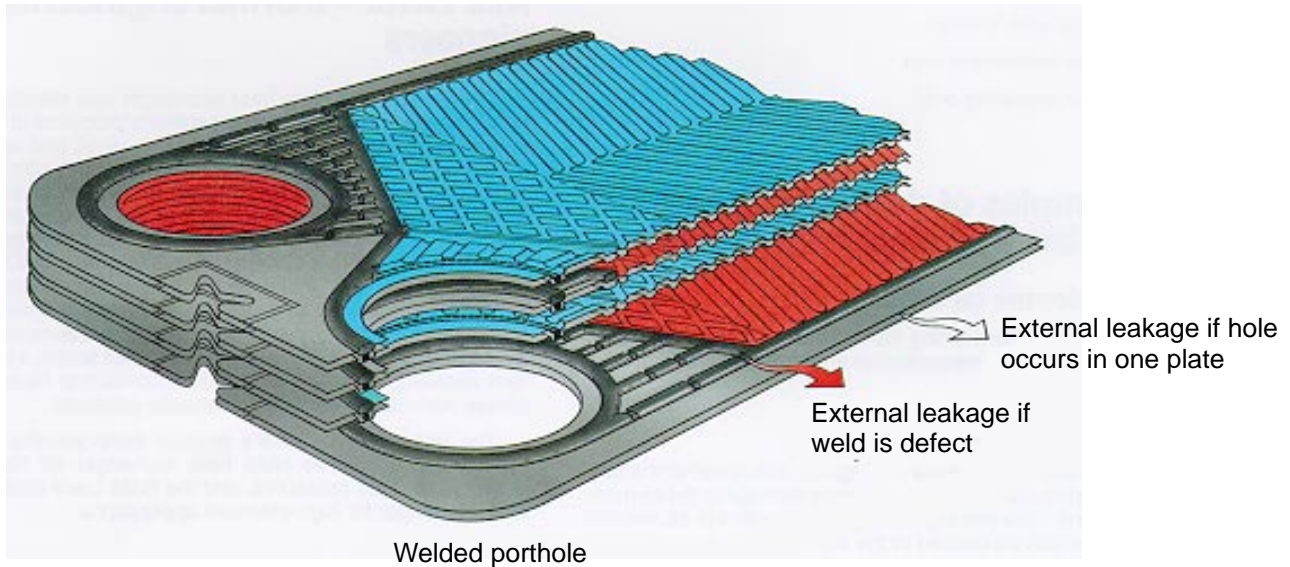
with an increased pressure drop on any of the media, indicates that fouling or clogging is taking place.

For corrective action, study **Maintenance and Cleaning**.

In the unlikely event of leakage of any cause, one of the two media will appear externally. Should a failure occur, whether it is related to the plate, gasket or seal weld, the ensuing leak will be easily visible on the outside of the heat exchanger. For example:

- 1 A hole in one of the double plates will result in external leakage from between the double–plate pair
- 2 A gasket defect will cause an external leak, either directly from the peripheral gasket or from the gasket vents open to the atmosphere
- 3 A defect weld will cause external leakage to appear either from the gasket vents or from between the plates at the site of the failure.

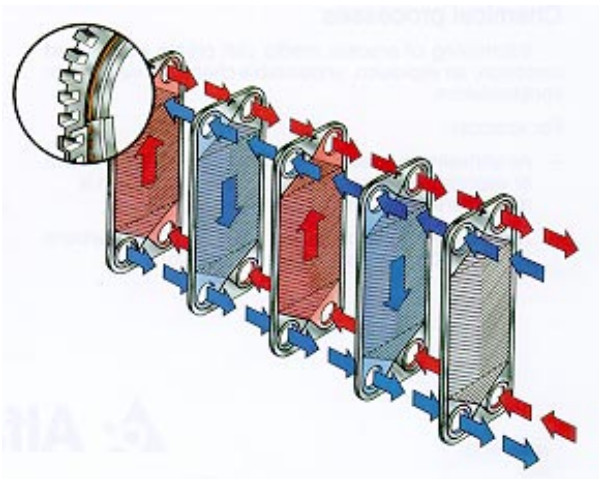
## The double-wall plate heat exchanger



### Design and construction

The Double-wall plate heat exchanger works on the same principle as a conventional plate heat exchanger but differs in that the single plates between the two media are replaced by plate pairs consisting of two identical plates

stacked on top of each other and welded around the portholes. The channels then formed by assembling welded plate pairs in a plate pack are conventional channels sealed by gaskets in the traditional manner.

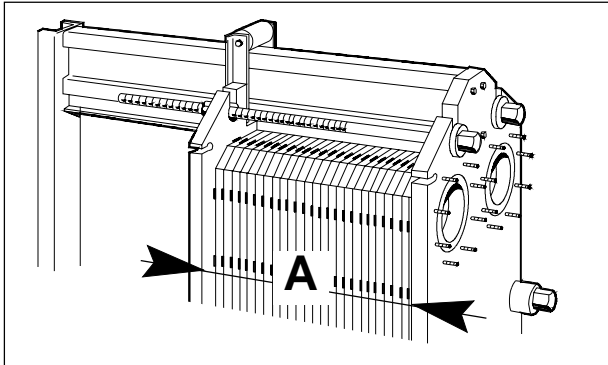


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## Starting up

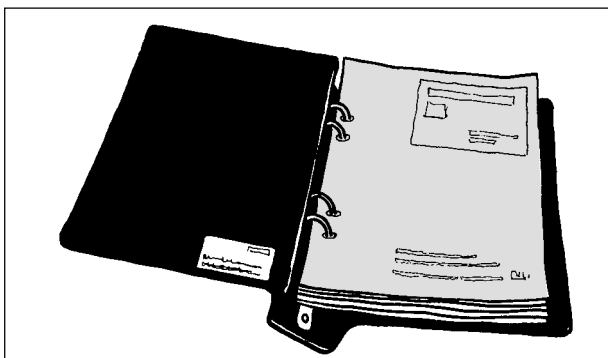


- 1** Before starting up for the first time or after a long time of close-down: **Make sure that the plate pack is compressed to the right measurement A!** Check with the Data-Print, which is located in the inside pocket of the back cover.

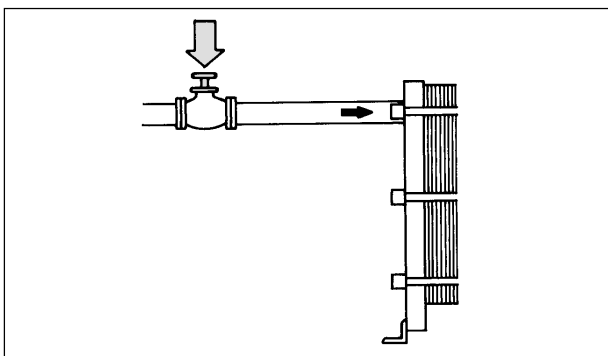
### NOTE!

It is very important that the system to which the heat exchanger is connected, is protected against sudden and extreme variations of temperature and pressure to avoid damages.

This applies not only for the heat exchanger but also for the pipe system itself and every piece of equipment included in it.

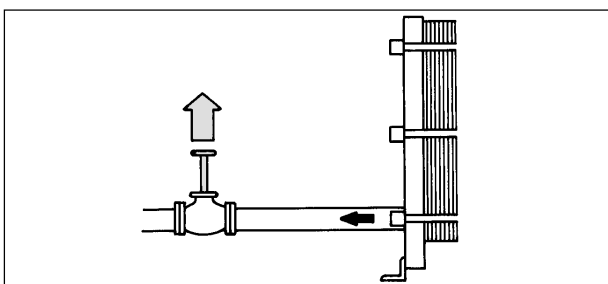


This should be kept in mind whenever a manoeuvre is to be carried out, including starting up of the pumps in the system.

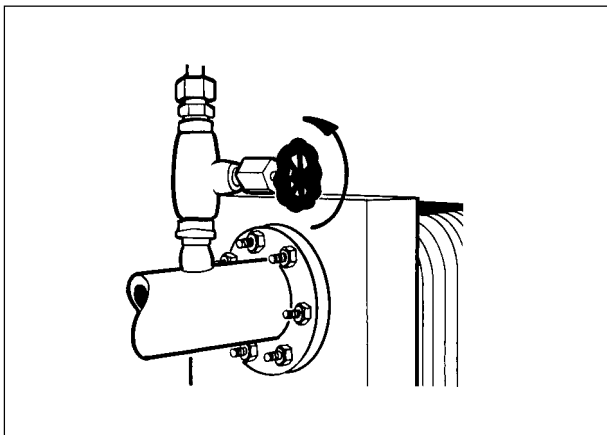


- 2** Before starting any pump, check whether instructions exist, telling you which pump should be started first.

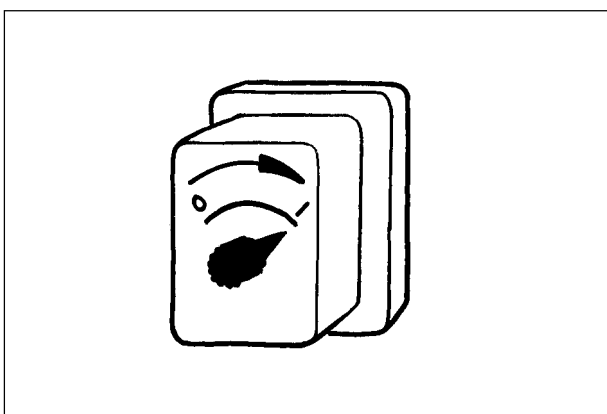
- 3** Check that the valve between the pump and the apparatus, controlling the flow rate of the system which you are about to start up is closed.



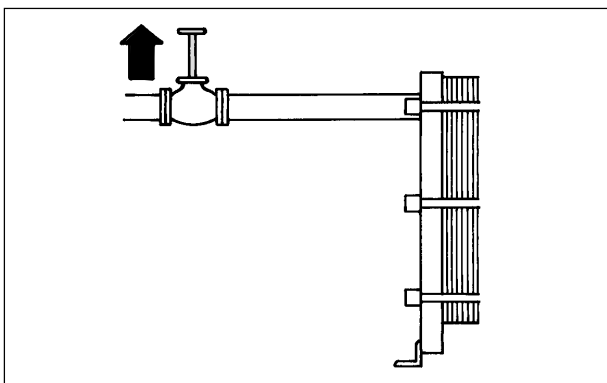
- 4** Check that the valve at the exit – if there is one – is fully open.



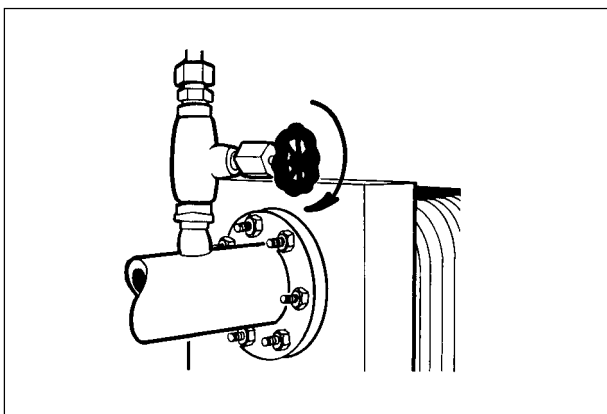
**5** Open the vent.



**6** Start the pump.



**7** Open the valve slowly.



**8** When all air is out, close the vent.  
Repeat the procedure for the other media.

## Unit in operation

Any adjustment of the flow rates required to maintain correct temperatures or pressure drops should be made slowly, in order to prevent shocks to the system.

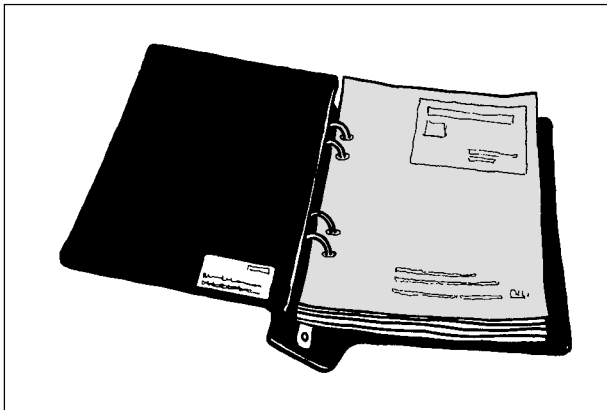
Problems in keeping up the performance of the heat exchanger may be caused by a

change of some of the temperature conditions, the heat load or by fouling.

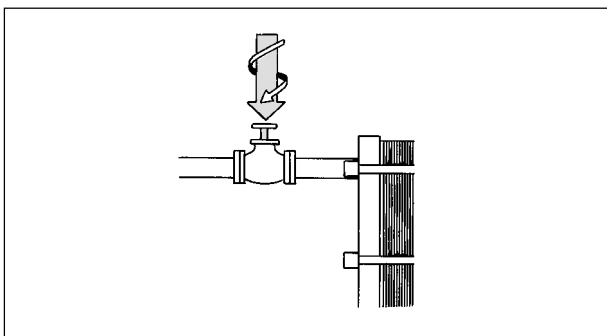
As long as the apparatus is operating to satisfaction, it should be left without any interference.

## Shut-down

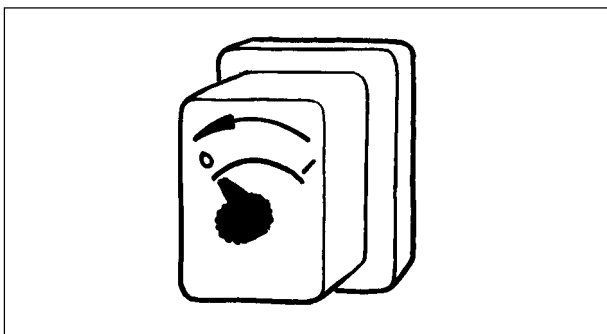
If the heat exchanger is going to be shut down – or if for any reason at all the pumps are to be stopped – the following procedure should be followed:



- 1** First establish whether instructions exist as to which side should be stopped first.



- 2** **Slowly close the valve** controlling the flow rate of the pump you are about to stop.
- 3** When the valve is closed, stop the pump.
- 4** Repeat the procedure for the other side.



- 5** Poor quality cooling water may be hazardous to metallic materials. Typical examples are corrosion of stainless steels and nickel alloys.

If for any reason the heat exchanger is shut down for a longer period (more than a number of days), it should be drained, and depending on the media processed, it is recommendable to rinse and dry it.

## The risks of not complying with the start-up and shut-down procedures

A liquid in motion in a pipe system represents a lot of energy, and it must be very carefully dealt with.

Particularly when the fluid is stopped it is imperative that this is done smoothly.

Valves must be operated gradually. The longer the pipes and the higher the flow rate, the more important this becomes.

### **NOTE!**

For this reason fast-closing valves should not be used unless the pipes of the system are very short.

WATER HAMMER is the name given to a short-lasting pressure peak, travelling along the pipe as a wave at the speed of sound, and resulting from a sudden deceleration of the motion of the fluid in a closed system.

Thus, it is usually related to the shutting down of a system. However, when starting up a system with open valves and empty pipes, the fluid may burst into some obstacle, like a fine-mesh strainer, a flow meter or a heat exchanger, causing a sudden reduction of the flow velocity – if not a complete halt –, and so we may have the conditions of a Water Hammer.

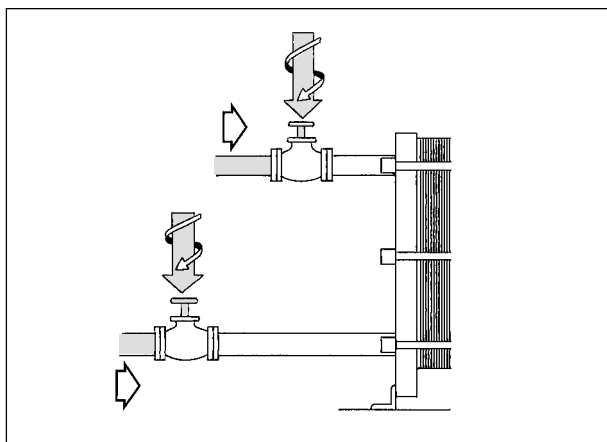
In the worst case, the pressure surge caused by such a sudden stop of the motion of a fluid, can be several times the normal pressure of the system.

Therefore it is very important for the protection of the whole installation that start-ups and close-downs are carried out with great care.

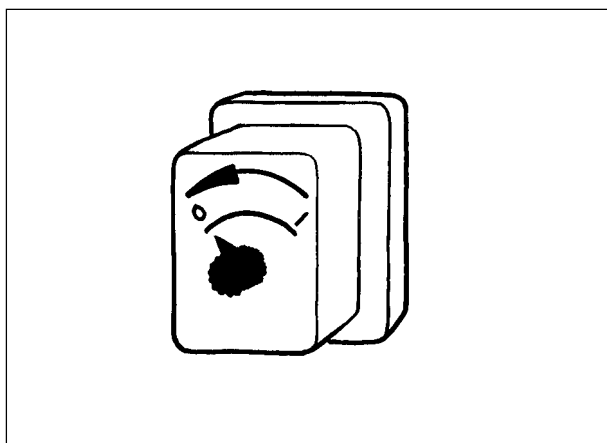
# Opening and closing of the plate package

## 6

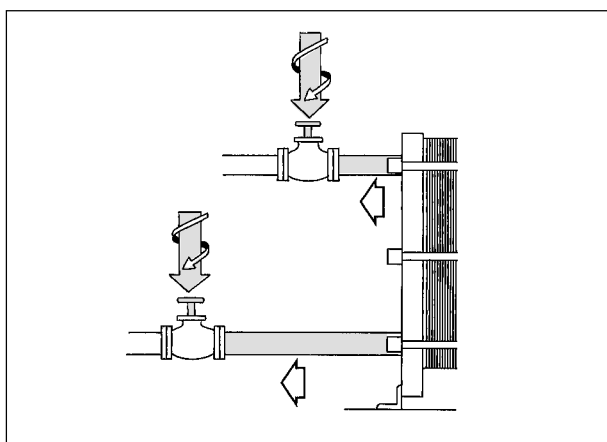
### Opening



- 1** Slowly close the valves on the inlets. Shut off the inlet side, closing the highest pressure first.

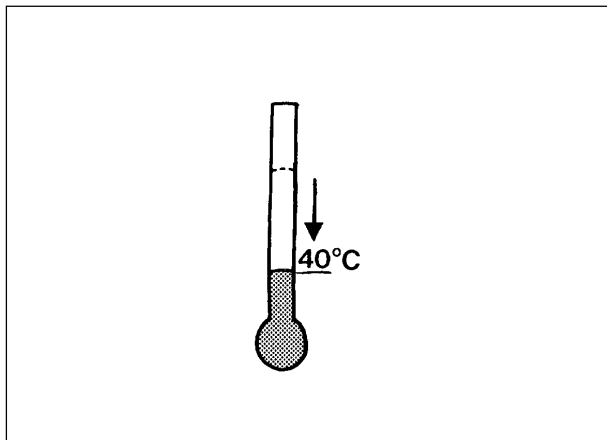


- 2** Switch off pumps.

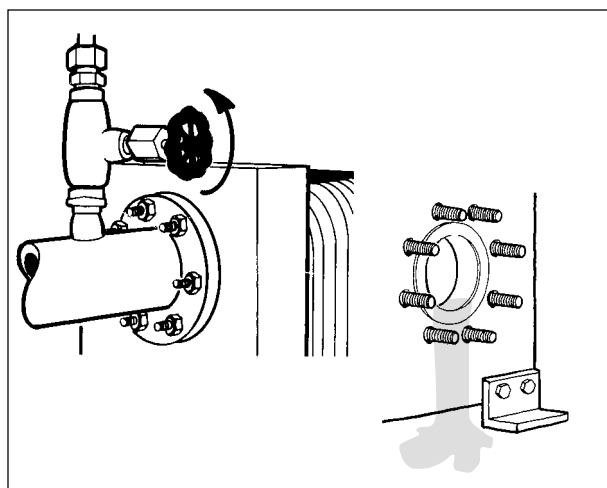


- 3** Close the valves on both outlets.

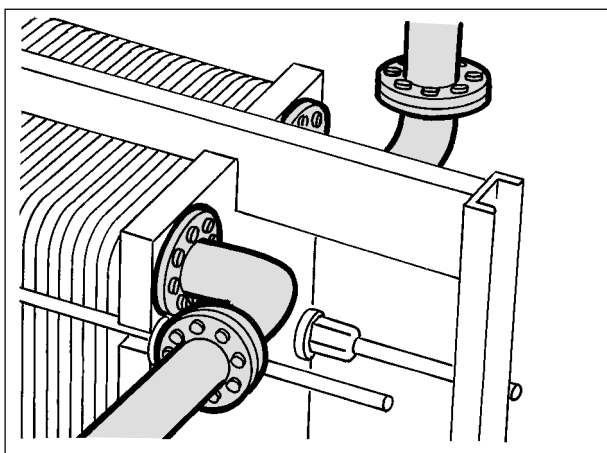
## Opening



- 4** If the heat exchanger is hot, wait until it has cooled down to about 40°C

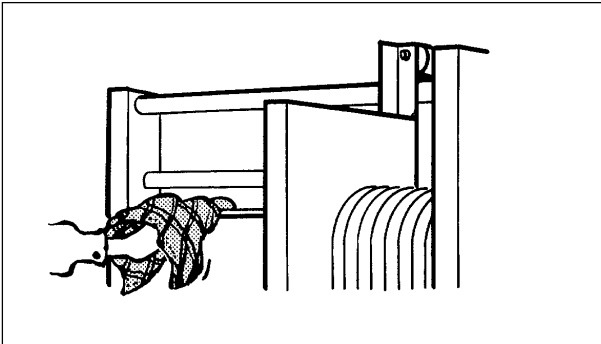


- 5** Drain.

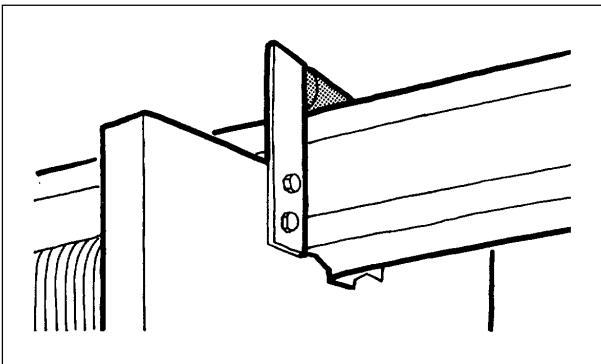


- 6** Dismantle any pipe bends connected to the pressure plate, so that it can be moved freely along the carrying bar.

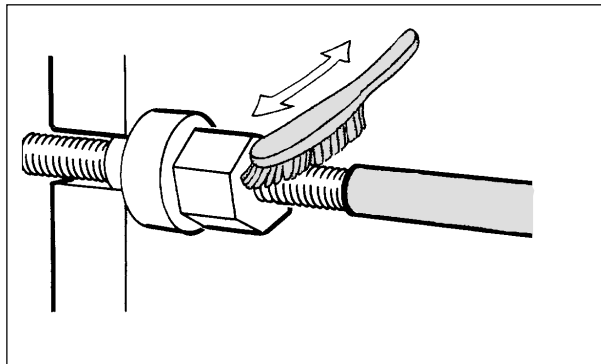
## Opening



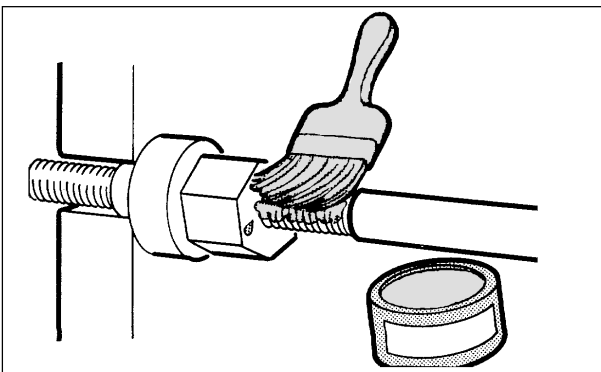
- 7** Inspect the sliding surfaces of the carrying bar and wipe clean.



- 8** Inspect pressure plate roller.



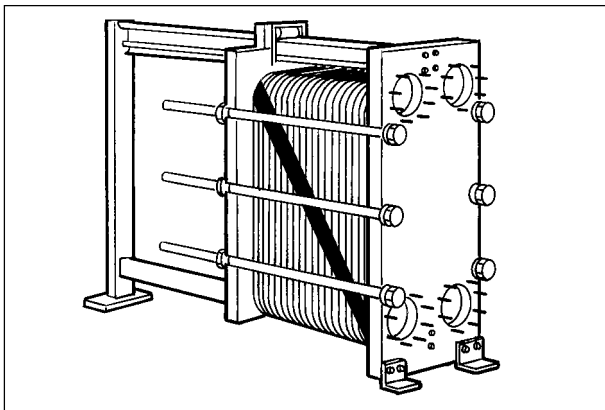
- 9** Pull back the plastic covers on the tightening bolts; brush the threads clean with a steel wire brush.



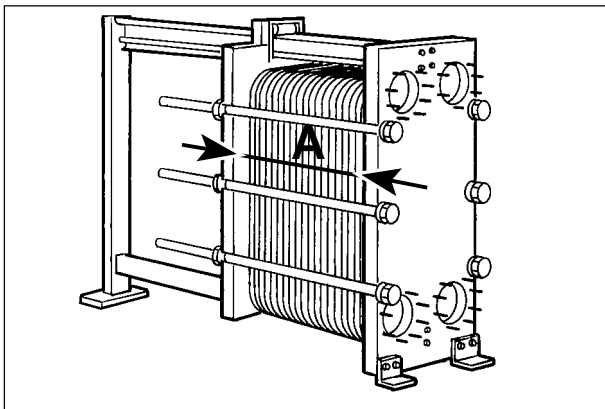
- 10** Lubricate the threads with a thin layer of grease, e.g. Gleitmo 800 or equivalent.



## Opening

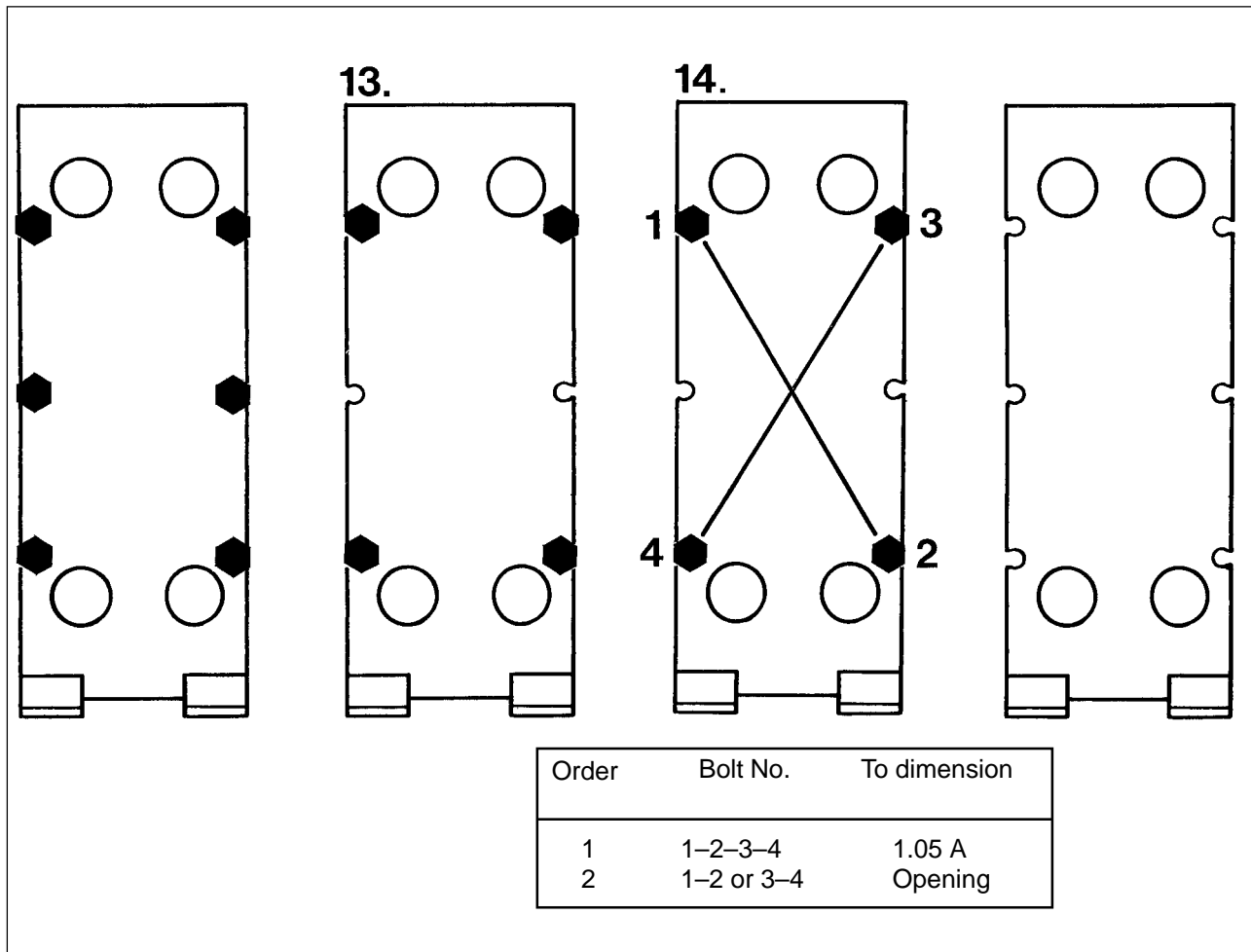


**11** Mark the plate assembly on the outside by a diagonal line, or number the plates in sequence.



**12** Measure and note down the dimension A.

## Opening (PHE-Types M3, M6, M10, M15, AM20, A15-BFM, M20, AK20)

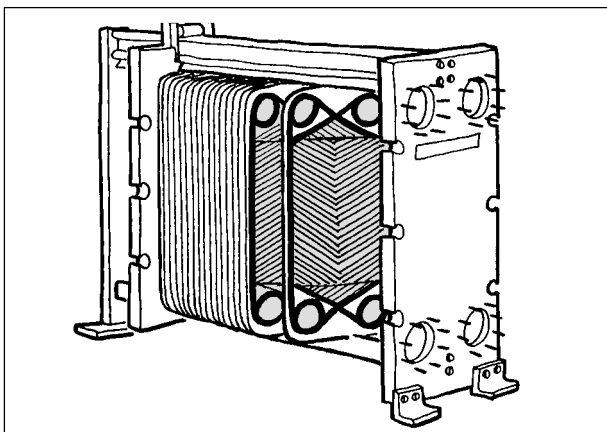


**13** Bolts which are not fitted with bearing boxes are loosened and removed.

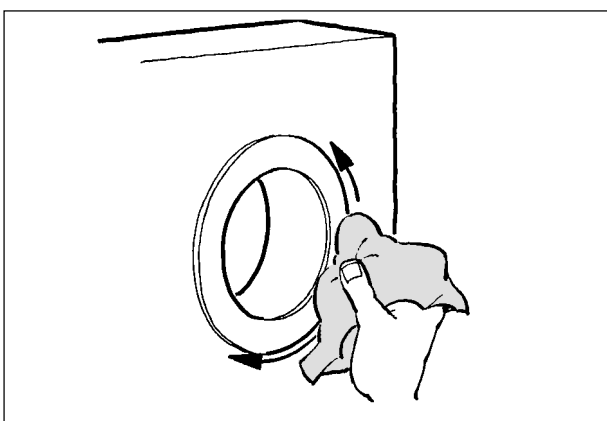
**14** The pairs of bolts that are fitted with bearing boxes are opened alternately and diagonally, as shown in the figure above.

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.

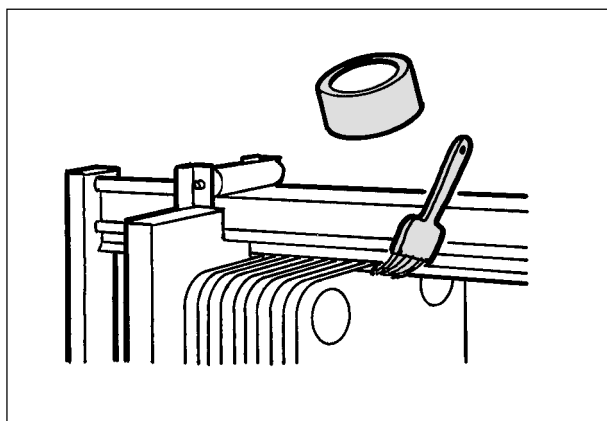
## Closing



- 1** Check that all the sealing surfaces (i.e. surfaces in contact with the heat transfer medium) are clean.

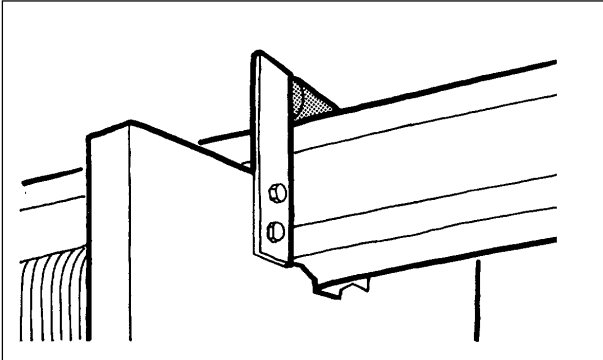


- 2** Check that the ring gaskets, when fitted in connections, are in position and are in good condition.



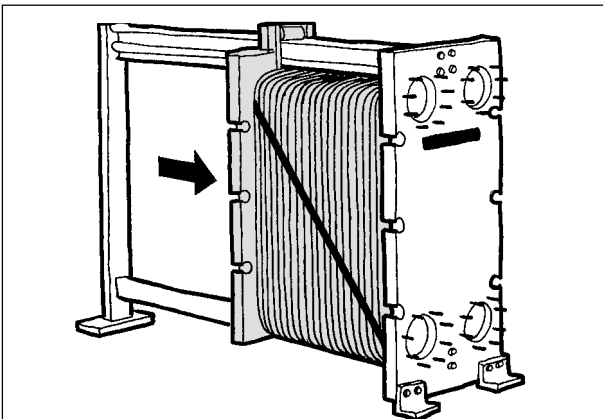
- 3** Clean and lubricate the sliding surfaces of the carrying bar.

## Closing

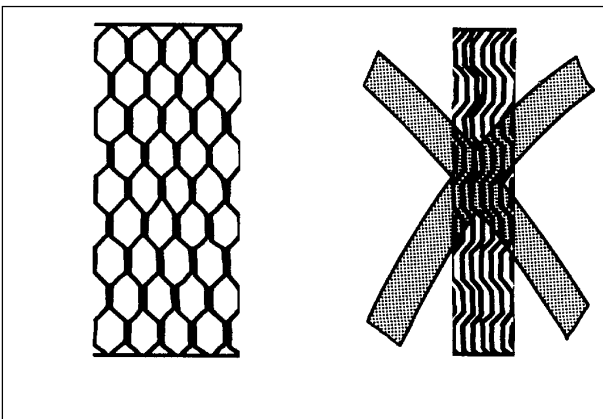


**4** Inspect the pressure plate roller.

**5** Check against the data printout (located in the inside pocket of the back cover) to make sure that the plates are hanging in the correct order.



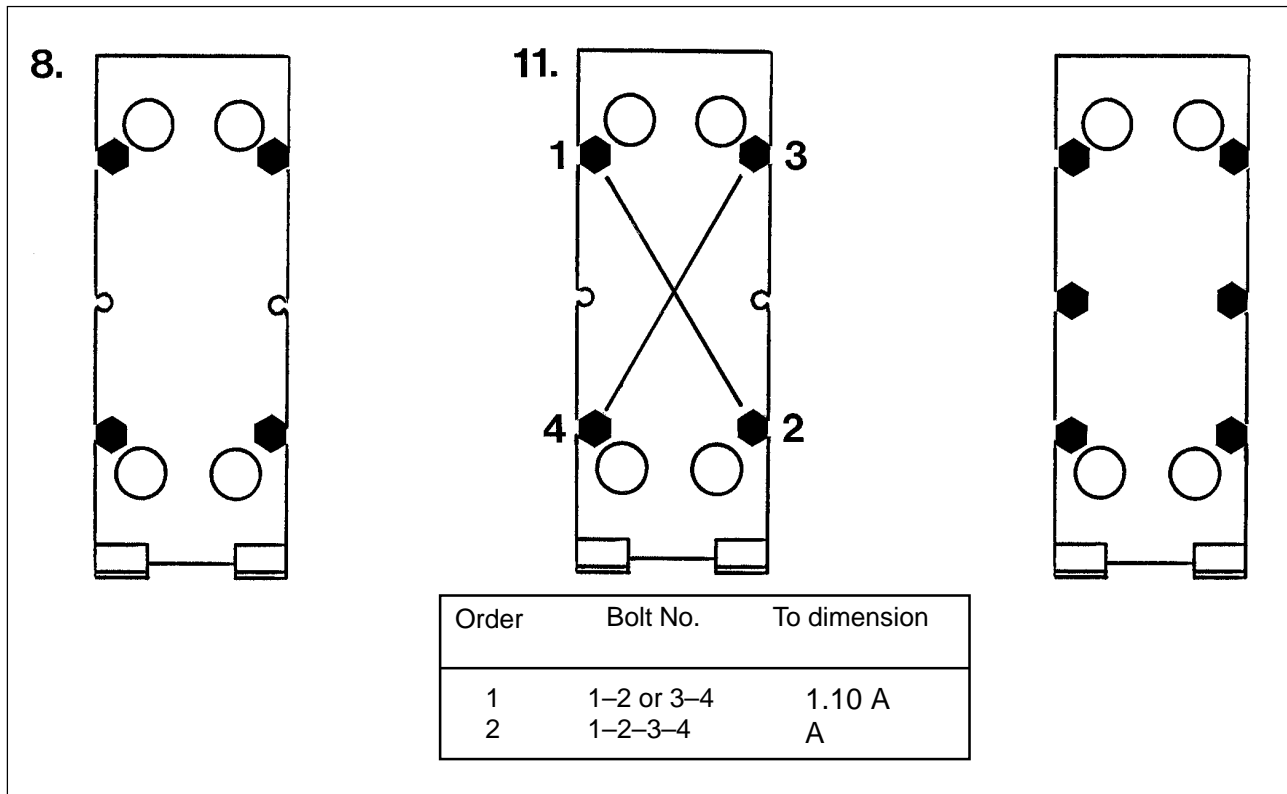
**6** Press the plate assembly together.



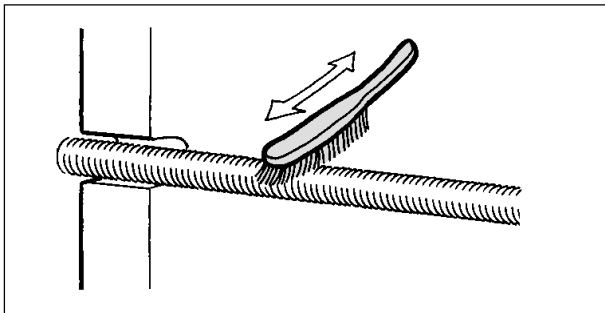
**7** If the plates are correctly assembled, the edges form a "honeycomb" pattern.

If the plate pack has been marked on the outside (fig.6) check this.

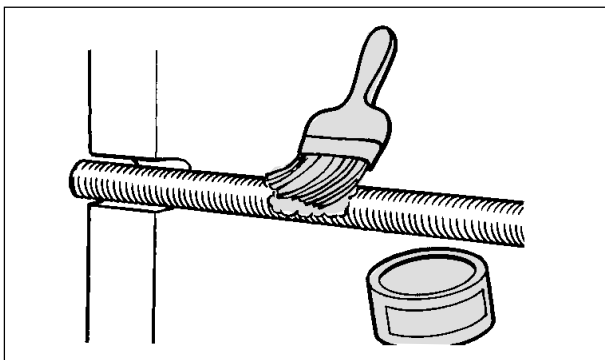
## Closing (PHE-Types M3, M6, M10, M15, AM20, A15-BFM, M20, AK20)



**8** Place the bolts that are fitted with bearing boxes in position.



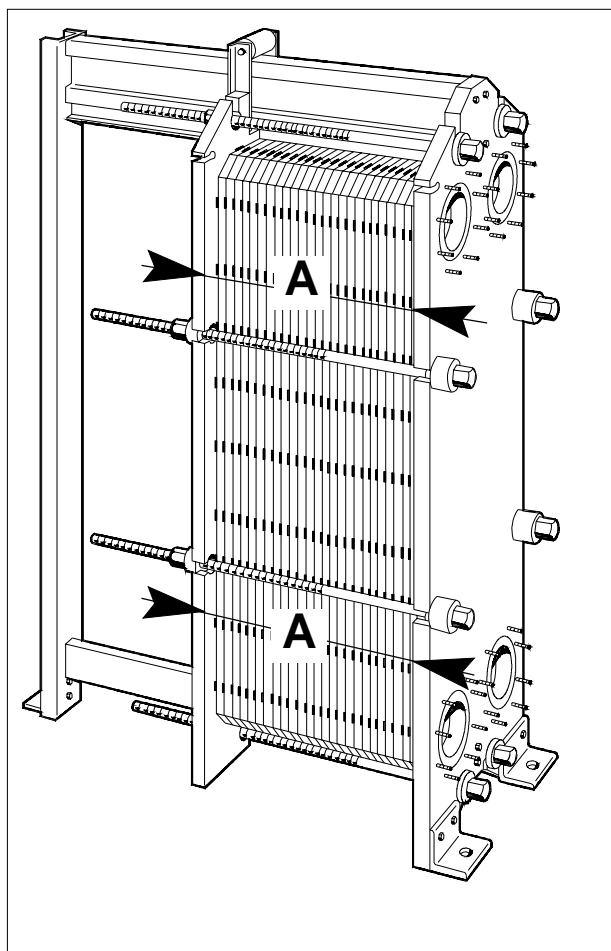
**9** Brush the threads of the bolts clean, using a steel wire brush.



**10** Lubricate the threads with a thin layer of grease, e.g. Gleitmo 800 or equivalent.

**11** Tightening is carried out alternately and diagonally, as shown on the figure above.

## Closing



**12** Check the dimension A during tightening at the positions of the bolts that are being used. Skewing of the pressure plate during tightening must not exceed 10 mm (2 turns per bolt) across the width and 25 mm (5 turns per bolt) vertically.

Nominal plate pack length A can be exceeded in exceptional cases, the tightening can be stopped at the following dimensions:

Plate pack length/plate	Plate pack length
>4 mm	A + 1 %
>3 mm, <4 mm	A + 1,5 %
<3 mm	A + 2 %

### NOTE!

When a pneumatic tightening device is used, it should be set at the maximum torque according to table at the next page. Dimension A must, however, still be measured during tightening.

## Closing

### Max tightening torque

Bolt size	Bolt with bearing box		Bolt with washers	
	Nm	Kpm	Nm	Kpm
M24			450	45
M30			900	90
M39	1300	130	2000	200
M48	2100	210	3300	330

When the bolts are tightened by hand using a wrench, the tightening moment is estimated.

### 13 Place the other bolts in position.

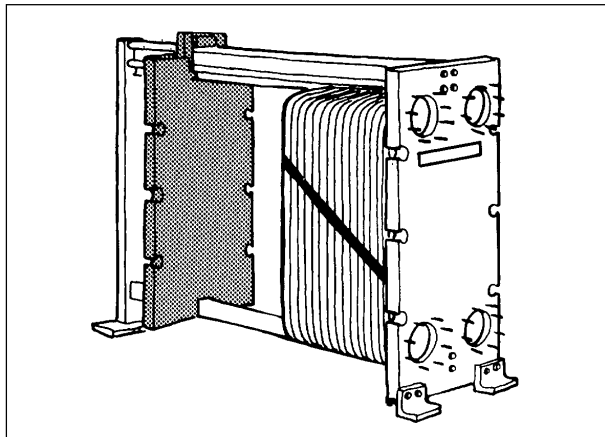
- Inspect the washers.
- When fully tightened, the bolts should all be equally tensioned.
- The difference between the plate pack lengths measured at adjacent bolts should not exceed:
  - 2 mm when dimension A is <1000 mm
  - 4 mm when dimension A is >1000 mm
- The plate pack length at all bolts must not differ with more than 1%.
- If the unit does not seal fully, it can be tightened to give dimension A–1%. The maximum tightening torque must not, however, be exceeded.

### If dimension A is not reached with application of maximum tightening torque

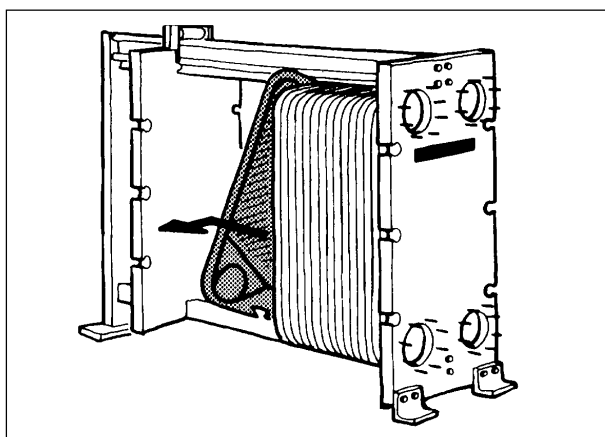
- Check the number of plates and dimension A.
- Check that all the nuts and bearing boxes are running freely. If not, clean and lubricate or replace.
- Fit all the bolts, and tighten alternately.

## Removal and insertion of plates

### Removal of plates



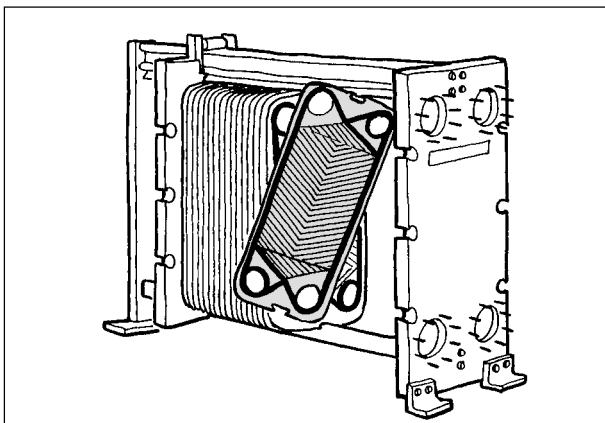
- 1** Push the pressure plate against the support column.



- 2** Remove the plates.



## Insertion of plates



- 3** Hang the plates with their backs towards the pressure plate (the side without gasket).

30100-13641  
ED. 1

PAGE NO. 3

PLATE NO.	PLATE CODE	PUNCHED CORNER OF THE PLATE				FLOW DIRECTION ON THE GASKET SIDE OF THE PLATE
		UPPER LEFT	LOWER LEFT	LOWER RIGHT	UPPER RIGHT	
		S	1	2	3	4
		->-	<-	=<=	=>=	
1	369906-4483B	0	0	0	0	--
2	369906-4603A	0	0	0	0	UP
3	369906-4403B	0	0	0	0	DOWN
4	369906-4603A	0	0	0	0	UP
5	369906-4403B	0	0	0	0	DOWN
6	369906-4603A	0	0	0	0	UP
7	369906-4403B	0	0	0	0	DOWN
8	369906-4603A	0	0	0	0	UP
9	369906-4403B	0	0	0	0	DOWN
10	369906-4603A	0	0	0	0	UP
11	369906-4403B	0	0	0	0	DOWN
12	369906-4403A	0	0	0	0	UP
13	369906-4403B	0	0	0	0	DOWN
14	369906-4403A	0	0	0	0	UP
15, 17, 119	369906-4403B	)	)	)	)	)
16, 18, 120	369906-4403A	(	(	(	(	(
121	369906-4403B	0	0	0	0	DOWN
122	369906-4403A	0	0	0	0	UP
123	369906-4403B	0	0	0	0	DOWN
124	369906-4403A	0	0	0	0	UP
125	369906-4416B	----	----	0	0	DOWN
		T	1	2	3	4

- 4** Read the table of plates from the bottom and up, since in fact you are starting at the end of the plate pack, instead of the beginning, when doing this.



**Caution!**

## Chlorine as growth inhibitor

Chlorine, commonly used as growth inhibitor in cooling water systems, reduces the corrosion resistance of stainless steels (including Hastelloy, Incoloy, Inconel and SMO).

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, Alfa Laval Thermal AB must be consulted.

Contact the following address:

Alfa Laval Thermal AB  
Department TPI-RM  
Box 74  
S-221 00 LUND, Sweden

### **NOTE!**

Titanium is not effected by chlorine.

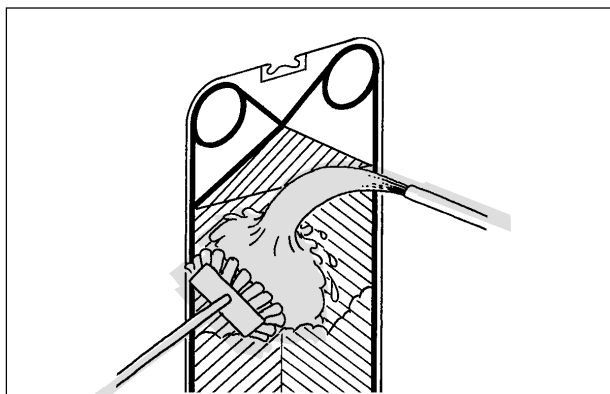
## Cleaning

### Gross fouling



- Seaweeds
- Wood chips/fibres
- Mussels
- Barnacles

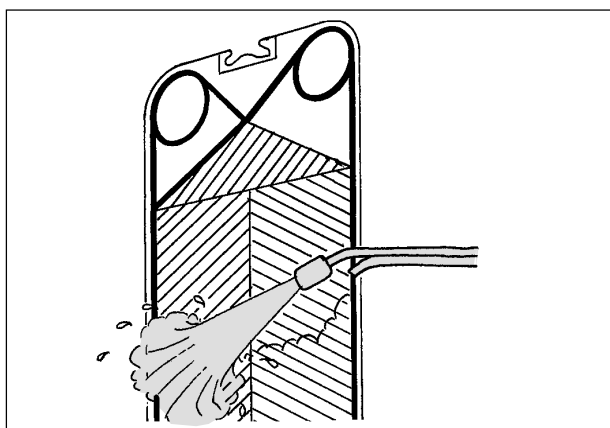
### Mechanical cleaning after opening



- 1 Soft brush and running water.

**NOTE!**

Avoid gasket damage.



- 2 High pressure hose.

- 3 Back-flushing of the unopened heat exchanger can sometimes be sufficiently effective.

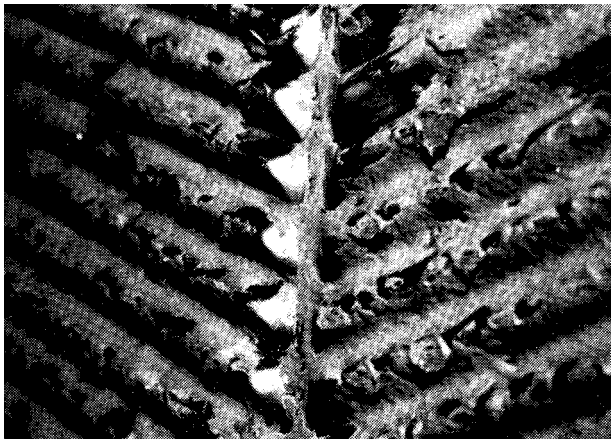
**NOTE!**

Under no circumstances should hydrochloric acid be used with **Stainless steel plates**. Water of more than 300 ppm Cl may not be used for the preparation of cleaning solutions.

It is very important that carrying bars and support columns in aluminium are protected against chemicals.

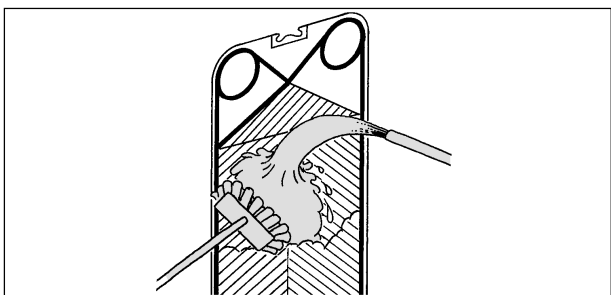
## Cleaning

### Biological growth – slime



- Bacteria
- Nematodes
- Protozoa

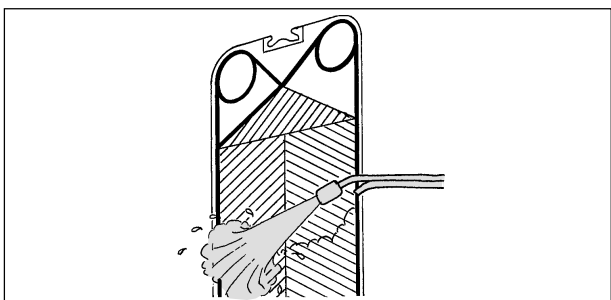
### Mechanical cleaning after opening



- 1 Soft brush and running water.

**NOTE!**

Avoid gasket damage.



- 2 High pressure hose.

- 3 Chemical cleaning using alkaline cleaning agents:

- Sodium hydroxide
- Sodium carbonate
- Cleaning effect can be considerably increased by the addition of small quantities of hypochlorite or agents for the formation of complexes and surfactants.

Concentration max 4%.  
Temperature max 80°C.

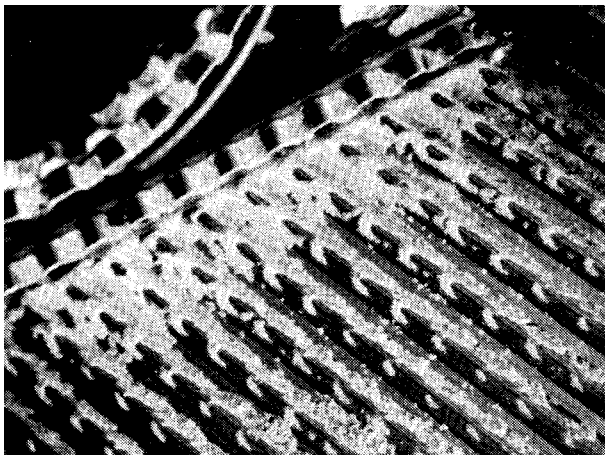
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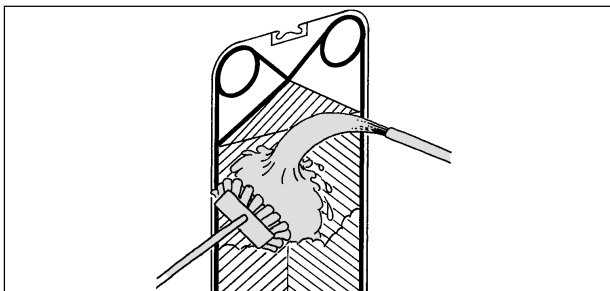
## Cleaning

### Incrustation – scaling



- Calcium carbonate
- Calcium sulphate
- Silicates

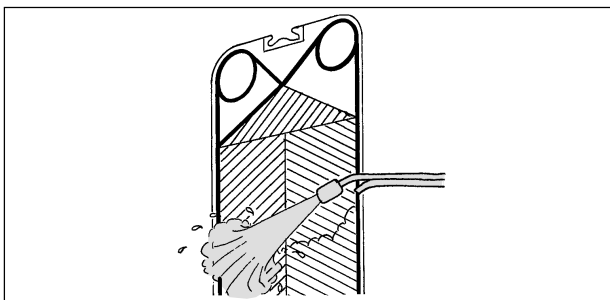
### Mechanical cleaning after opening



- 1 Soft brush and running water.

**NOTE!**

Avoid gasket damage.



- 2 High pressure hose.
- 3 Chemical cleaning on opened unit by using:
  - Nitric acid
  - Sulfamic acid
  - Citric acid
  - Phosphoric acid
  - Complexing agents (EDTA, NTA)
  - Sodium polyphosphates

Concentration max 4%.  
Temperature max 60°C.

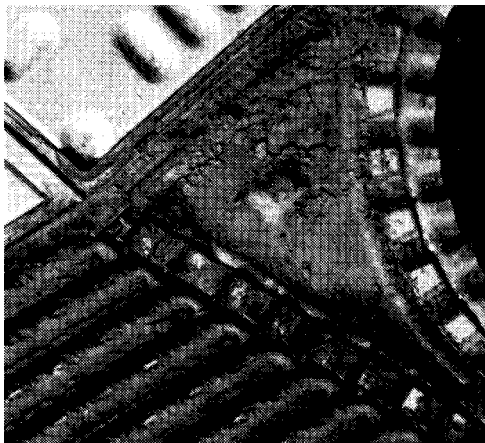
**NOTE!**

Under no circumstances should hydrochloric acid be used with **Stainless steel plates**.  
Water of more than 300 ppm Cl may not be used for the preparation of cleaning solutions.

It is very important that carrying bars and support columns in aluminium are protected against chemicals.

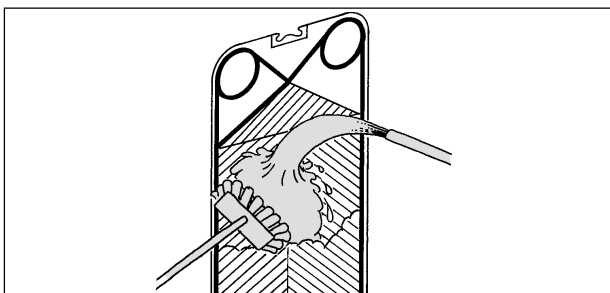
## Cleaning

### Sediment



- Corrosion products
- Metal oxides
- Silt
- Alumina
- Diatomic organisms and their excrement of various colours.

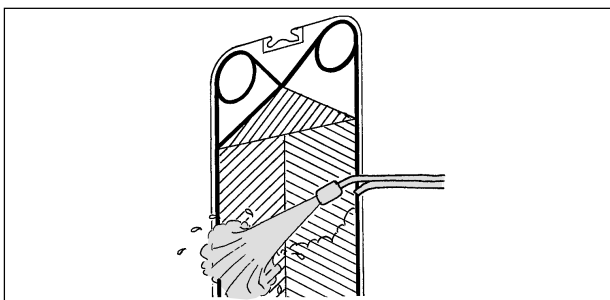
### Mechanical cleaning after opening



- 1 Soft brush and running water.

**NOTE!**

Avoid gasket damage.



- 2 High pressure hose.
- 3 Chemical cleaning on opened unit by using:

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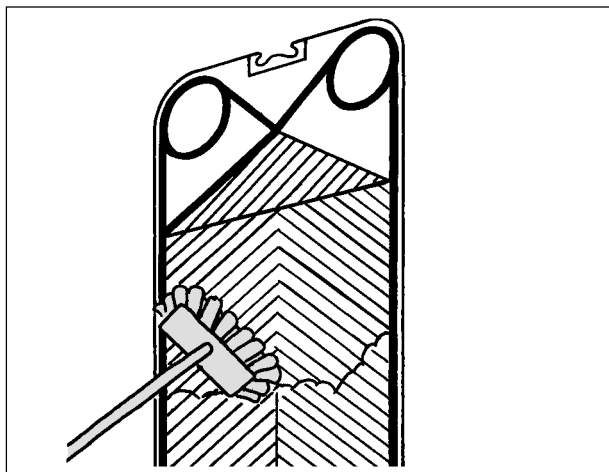
It is very important that carrying bars and support columns in aluminium are protected against chemicals.

## Cleaning

### Oil residues, asphalt and fats

- Oil residues
- Asphalt
- Fats

#### Mechanical cleaning after opening



- 1 Hydrocarbon-based deposits may be removed by using a soft brush and a PARAFFINIC or NAPHTHA-BASED solvent (e.g. KEROSENE).

**NOTE!**

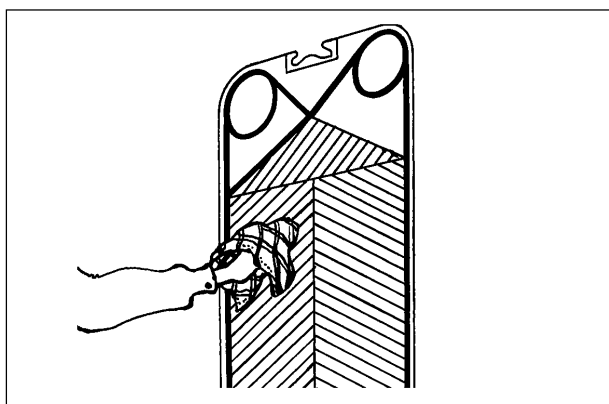
Gaskets in natural, butyl and EPDM rubber swell in these media.

Contact time should be limited to 0.5 hour.

The following solvents should not be used:

- Ketones (e.g. Acetone, Methyl ethyl ketone, Methyl isobutyl ketone)
- Esters (e.g. Ethyl acetate, Butyl acetate)
- Halogenated hydrocarbons (e.g. Chloroethene, Carbon tetrachloride, Freons)
- Aromatics (e.g. Benzene, Toluene)

- 2 Dry with a cloth or rinse with water.



## Regasketing

Alfa Laval has two types of glue – GC11 and GC8 for repairs and exchange of gaskets in plates. A special glue, is recommended for viton and silicone gaskets.

### GC11

- A two–component, cold curing epoxy glue which gives a strong joint for higher temperatures.
- Future removal of gaskets usually requires heating or freezing of the joint.
- The shelf life is limited to approx. 1year when stored at room temperature but can be prolonged when kept in a refrigerator.

### NOTE!

Separate gluing instructions will be delivered together with the glue

### GC8

- A single–component rubber–based solvent adhesive.
- Is normally used for repair work in an uncured condition.
- Can be used for operating temperatures below 95°C.
- For operating temperatures above 95°C and oil coolers/heaters, the glued joints should be cured at 120°C for one hour.
- Future removal of the gasket can usually be carried out without heating of the cement joint.
- The storage life at room temperature is about two years. This period can be extended after checking the glue.

## Alfa Laval regasketing service

In addition to supplying gaskets for your plate heat exchangers, we are able to provide a **Specialised Regasket Service** to fulfil your service requirements quickly and efficiently.

Our regasketing service includes a liquid nitrogen debonding process with chemical cleaning, crack detection and regasketing using a special epoxy/phenolic resin adhesive.

This regasketing process requires special oven curing of the cement to ensure the

strongest possible bond strength between plate and gasket, similar to the process used during manufacture. This is one reason why our service is guaranteed.

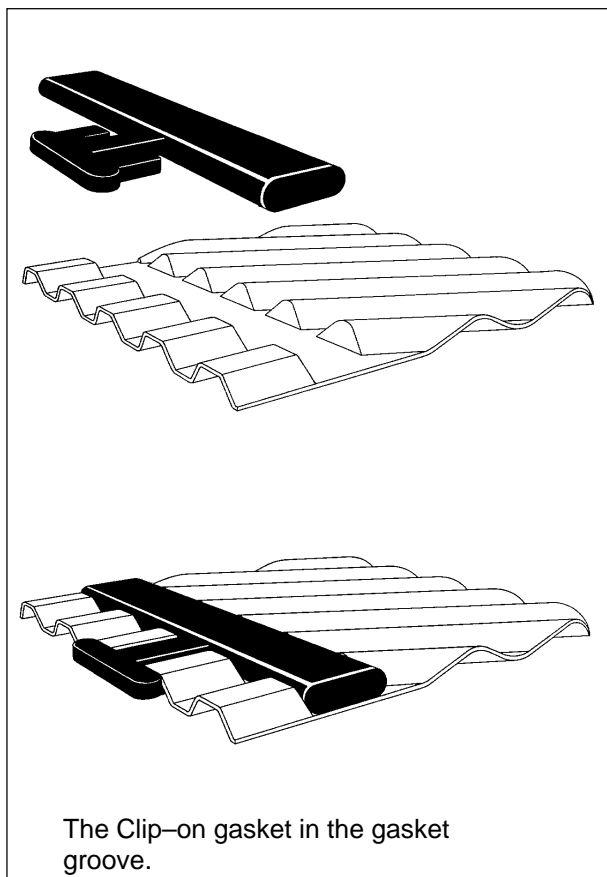
In most cases our regasketing service has proved more economical and much faster when compared with on–site regasketing methods.

For further details please contact your local **Alfa Laval Representative**.



## Regasketing

### The Clip-on gasket a glue-free gasket system



The Clip-on gasket is attached to the plate by two gasket prongs which slip under the edge of the plate to hold the gasket securely in alignment in the gasket groove.

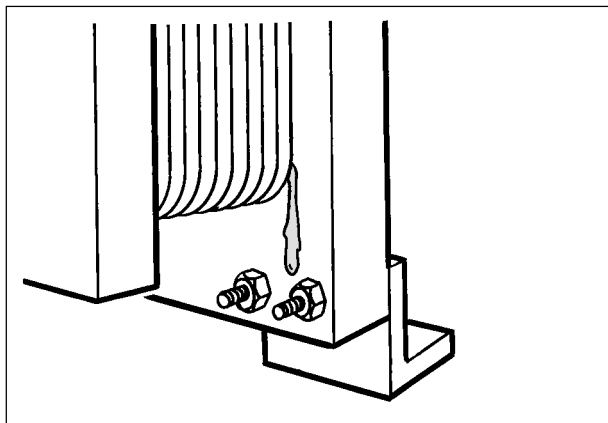
The prongs are situated at regular intervals around the periphery of the plate.

When the plate heat exchanger is then assembled and tightened, the gasket provides a tight seal around the plate.

**NOTE!**

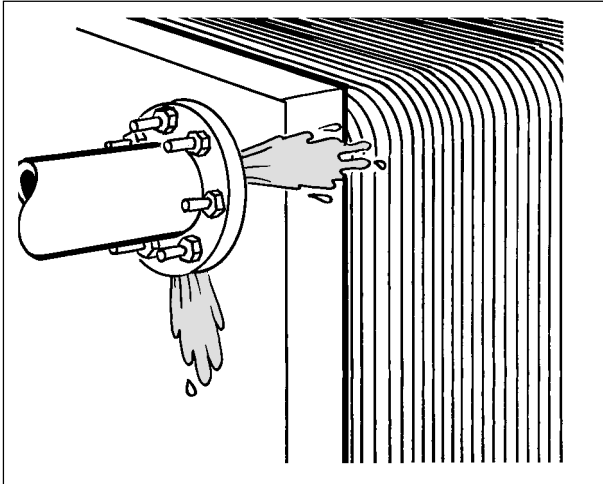
Before closing of the apparatus: Check that the two gasket prongs are in correct position.

## Leakage between plate pack and frame



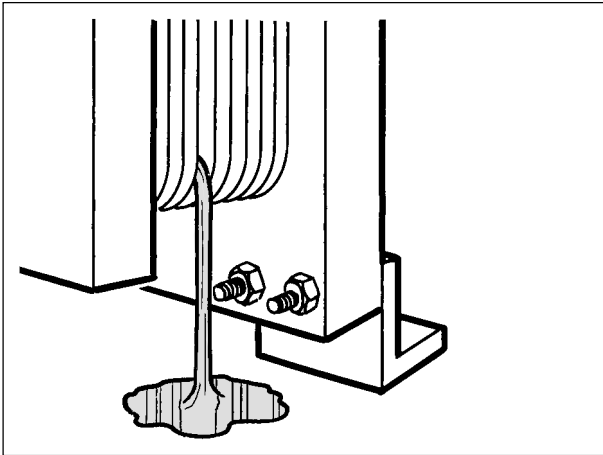
Action	Correction
<p>Mark with a felt tip marker or similar the area where the leakage seems to be, and open the heat exchanger.</p>	
<p>1 Investigate the gasket condition of the end plate and the connection if applicable, look for dislocation, foreign objects, scars and other damage to the gasket surfaces.</p>	<p>1</p> <ul style="list-style-type: none"> <li>• Relocate the gasket.</li> <li>• Remove foreign matter.</li> <li>• Replace damaged gasket.</li> <li>• Replace connection lining if applicable.</li> </ul>
<p>2 Check the surface of the pressure plate for unevenness, foreign objects sticking to it, etc., that might spoil the joint between the gasket and the adjacent surface.</p>	<p>2 Remove anything disturbing the joint between gasket and pressure plate surface.</p>
<p>3 Check the plate itself for cracks or holes.</p>	<p>3 A perforated end plate must be replaced.</p>

## Leakage between flange and frame



Action	Correction
1 Disconnect the flange, and look for misalignment between flange and connection, dislocation or damaged gasket, foreign objects on the surface of the gasket or the flange.	1 <ul style="list-style-type: none"><li>• Rearrange the pipe in order to eliminate stress and to correct alignment.</li><li>• Relocate gasket.</li><li>• Replace damaged gasket.</li><li>• Replace connection lining if applicable.</li><li>• Remove foreign matter from flange and gasket.</li><li>• Reassemble, taking care to avoid misalignment.</li></ul>

# Leakage between plates to the outside



## NOTE!

On a Plate Heat Exchanger specially designed for high temperature duties, extreme and sudden temperature drops may sometimes cause a temporary leakage. A typical example is a sudden shutting-off of the hot medium flow. The heat exchanger will normally seal again, as soon as the temperatures of the apparatus have stabilized.

Action	Correction
<p>Mark the leakage area with a felt tip marker on the two plates next to the leakage, check and note the length of the plate pack between inside frame plate and inside pressure plate, and then open the heat exchanger.</p> <ol style="list-style-type: none"> <li>1 Check for loose, dislocated or damaged gasket.</li> <li>2 Check for plate damage in the area, and also check plate pack length against drawing to see if possible plate or gasket damage could be caused by over-tightening of the plate pack, or the leakage itself simply be caused by insufficient tightening.</li> </ol>	<ol style="list-style-type: none"> <li>1 <ul style="list-style-type: none"> <li>• Relocate gasket.</li> <li>• Recement loose gasket.</li> <li>• Replace damaged gasket.</li> </ul> </li> <li>2 A damaged plate must in most cases be taken out for repair or replacement. If it is a regular plate with 4holes: take the damaged plate and the 4-hole plate just in front or just behind it out of the plate pack. The heat exchanger can now be reassembled and put back in service PROVIDED THE PLATE PACK IS TIGHTENED TO A NEW MEASUREMENT, WHICH IS EQUAL TO THE ONE ON THE DRAWING, REDUCED BY TWO TIMES THE SPACE REQUIRED PER PLATE. The small reduction of the heat transfer area is normally of no importance, at least not for a short period of time. <ul style="list-style-type: none"> <li>• Insufficient tightening must be corrected – see the drawing.</li> </ul> </li> </ol>

Action	Correction
3 Check hanger recess at both plate ends for deformations, which could cause misalignment between the plates.	3 Damaged hanger recesses must be repaired if possible, or the plate replaced. For temporary arrangement with reduced number of plates – see paragraph 2 above.
4 Make sure that the plates are hanging correctly as A–B–A– (see SECTION 4).	4 Incorrect sequence of plates must be corrected (A–B–A–B–...). MAKE SURE THAT NO PLATE HAS BEEN DAMAGED, BEFORE REASSEMBLING THE PLATE PACK!
5 Check for perforation of the plate (corrosion).	5 Perforated plates must be replaced. For temporary solution, see paragraph 2.

## Mixing of media

Action	Correction
1 Check that the piping is connected to the heat exchanger at correct locations.	1 Relocate piping to correct connections.
2 Open the lower connection on one side, raise pressure on the other side and by looking into the open connection try to detect any liquid from the pressurized side leaking in, and if so approximately how far into the plate pack the leakage is located. If no leakage is detected, the reason for the mixing of media must be sought elsewhere. (See paragraph 5).	
3 If a leakage was detected, note the position of the leakage along the plate pack and then open the plate heat exchanger.	
4 Before starting on the plates themselves, check that the corner areas between the ring and the field gaskets are clear, that the leakage slots are open. This ensures that any leakage is out of the plate heat exchanger and is to atmosphere. Therefore no pressure can build up to force the media across the gasket sealing off the other liquid.	4 All deposits or material which can block the free exit from the area must be removed. If the leak channels of the gasket have been destroyed, they must be reopened with a suitable tool, or the gasket replaced.
5 If it has not been possible to locate the leakage as described in paragraph 2 above, it will be necessary to check each single plate for possible perforations, using any of the following methods: <ul style="list-style-type: none"> <li>– put a strong light behind the plate and watch for light coming through fine holes or cracks</li> <li>– use a magnifying glass to check suspect area</li> <li>– use a chemical penetrant, after having cleaned the plates well.</li> </ul>	5 Plates with holes are generally speaking destroyed and to be replaced. For temporary solution with reduced number of plates, see "LEAKAGE between plates to the outside".

## Pressure drop problems

Pressure drop has increased.

Action	Correction
<p>Check that all valves are open including non return valves.</p> <p>Measure the pressure just before and just after the heat exchanger, and the flow rate. For viscous media a membrane manometer with a diameter of at least 30 millimeters should be used. Measure or estimate the flow rate if possible. A bucket and a watch showing seconds may be sufficient for small flow rates. For larger flow rates, some type of flowmeter is required.</p> <p>Compare the pressure drop observed with the one specified for the actual flow rate. (See data print out).</p>	
<p>1 If the pressure drop is higher than specified, the temperature program should also be checked:</p> <p>1.1 If the thermometer readings correspond to those specified, the heat transfer surface is probably clean enough, but the inlet to the heat exchanger may be clogged by some objects.</p> <p>1.2 If the thermometer readings are NOT corresponding to the specified, heat transfer is obviously dropping below specifications, because of deposits on the heat transfer surface, which at the same time also increase the pressure drop, since the passage becomes narrower.</p> <p>2 If the pressure drop is corresponding to the specifications, there is no need for any action.</p> <p>3 If the pressure drop is lower than specified, the pump capacity is too small or the observation is wrong.</p>	<p>1 See next paragraph.</p> <p>1.1 Open the apparatus and take out whatever is clogging the passage, or use the back-flush system if there is one to rinse out the cloggings.</p> <p>1.2 If a "cleaning-in-place system" is available, follow the instruction and use it to wash out the deposits. If not, open the apparatus and clean the plates.</p> <p>3 See pump instruction manual.</p>

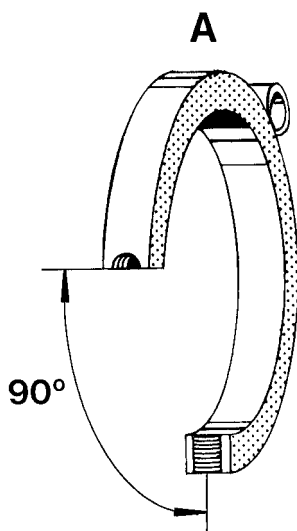
## Heat transfer problems

The heat transfer capacity is dropping.

Action	Correction
<p>Measure temperatures at in- and outlets and – also flow rates – on both media, if possible. At least on one of the media, both temperatures and the flow rate must be measured.</p> <p>Check to see if the transferred amount of heat energy corresponds to the specifications.</p> <p>If great precision is important, it will be necessary to use laboratory thermometers with an accuracy of 0.1 degree Celsius, and also to use the best equipment available for flow measurement.</p>	<p>If the heat transfer capacity of the apparatus has dropped below specified values, the heat transfer surface, must be cleaned. Either use the "cleaning-in-place" arrangement provided or open the heat exchanger for visual inspection and manual cleaning.</p>



## Instrument ring

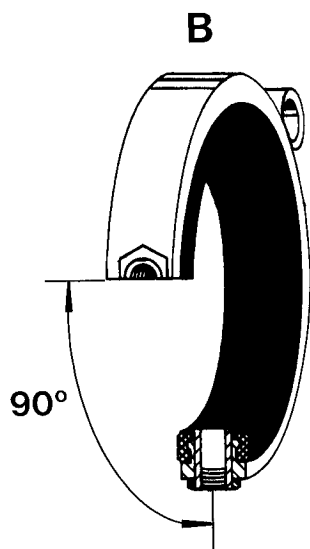


An instrument ring is sometimes provided to facilitate the location of, for instance, an instrument, a connection for remote monitoring or a drain, next to the heat exchanger rather than on the piping.

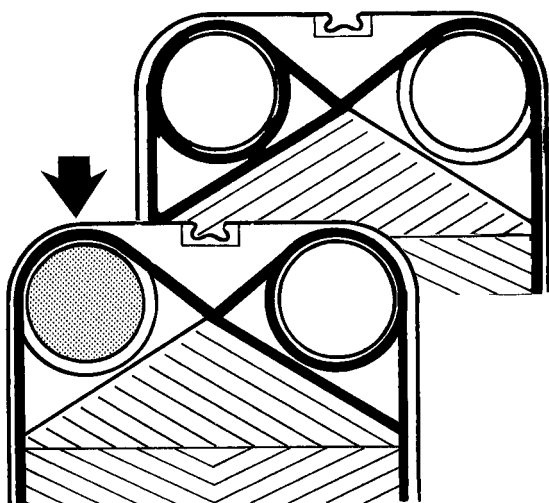
The ring is clamped between the frame or pressure plate and the flange of the pipe. It requires longer studs around the connection.

The instrument ring has two nipples pointing radially, with 90 degrees between them. The lining may be metallic (A) or made of an elastomer (B).

An elastomer lining can be replaced with a spare part, while in case of a metallic lining, the whole instrument ring will have to be replaced.



## The partition plate – for special cases only

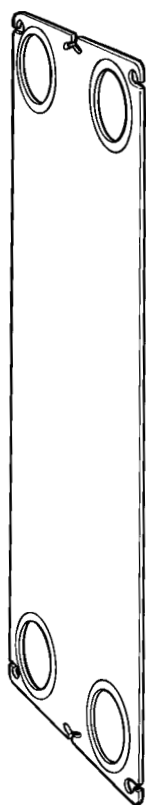


If for instance the thermal programme requires that at least one of the media is lead in more than one group through the plate package, there will be heat transfer plates with fewer than 4 holes.

In order to prevent the thin metal collapsing under the differential pressure, unpunched corners on larger plates require extra strong support, while the smaller plates are sufficiently strong as pressed.

The extra support is provided by a partition plate – approximately the size of a channel plate – made of about 15 millimeters (5/8") thick carbon steel, solid at the corners in need of support, and with lined holes at those where a free passage is required.

The partition plate is suspended from the carrying bar. Where partition plates are required, there will be one at every turning point in a multi-grouped plate package.



### NOTE!

#### Protection sheets

Depending on the nature of your process or circumstances related to it, you may be responsible under the law or other regulations for adequate protective measures at your plant.

Alfa Laval provides protection sheets for all of our Plate heat exchangers, for the prevention of possible harmful effects caused by a sudden leakage from the plate package.

## Identification and ordering of spare parts

As the next sheet in this manual you will find a listing of spare parts for this type of plate heat exchanger. It includes a complete listing of parts that can be used to build any size or version of it. Therefore, for some items you will find a number of options. As an example, carrying bars are available in various lengths, but in your apparatus only one length is used.

Also, several illustrations show you what the various parts look like, and to each part shown, a reference number has been assigned. These reference numbers are also represented in the second column from the left in the spare parts listing, and in a chronological order.

To identify the ORDERING NUMBER, proceed as follows:

- 1** Find the illustration of the part for which you need a replacement and read its reference number.
- 2** Find this number in the second column of the listing, and if more than one option is offered, select the line with the one representing your case.
- 3** Note the long number in the extreme right hand column, which is then your ORDERING NUMBER for the spare part.