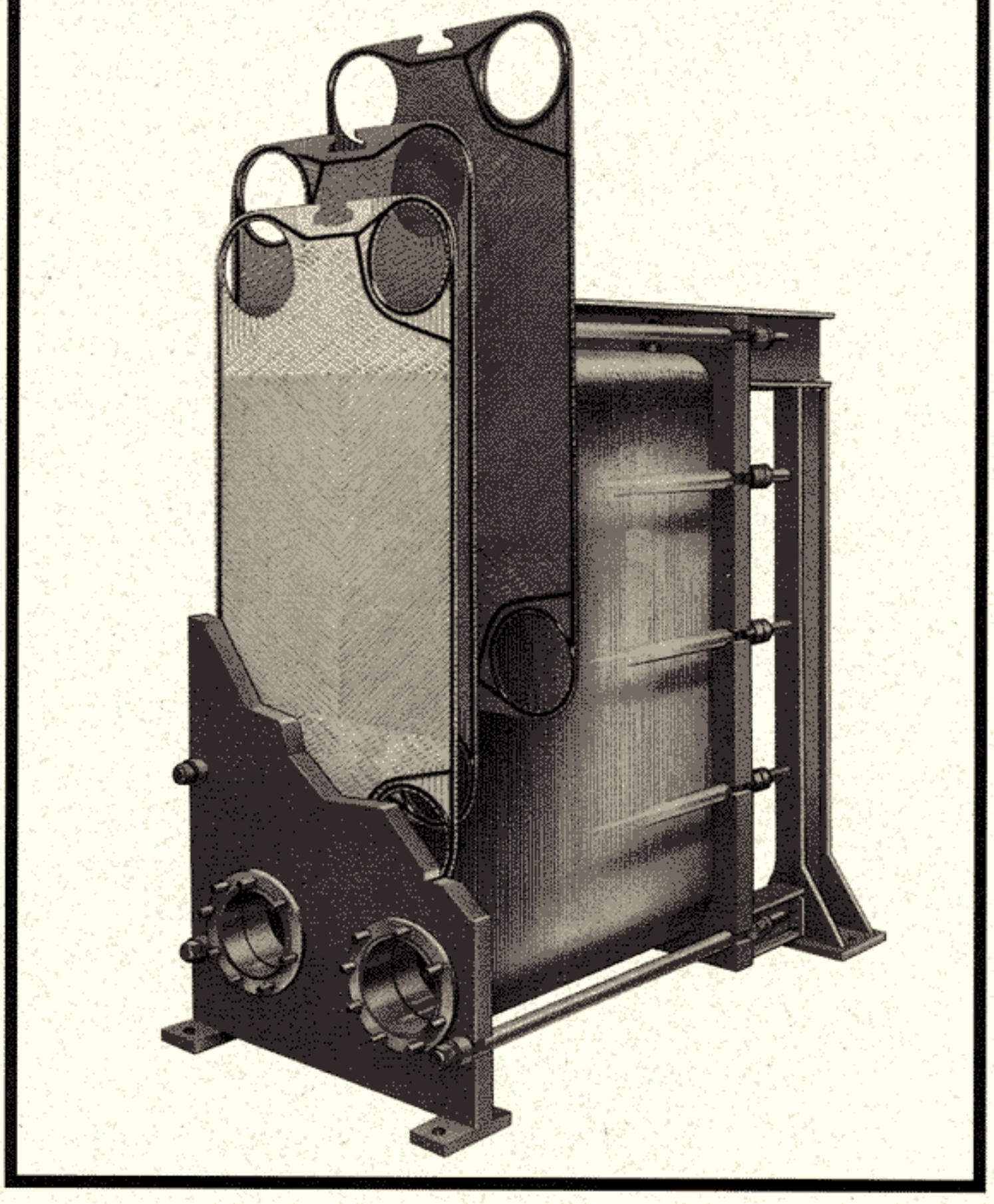
Installation, Operation and Maintenance Manual



Plateflow®

Plate & Frame

Heat Exchangers

Southgate Process Equipment, Inc.

Standard Xchange
a xylem brand

ITT Standard

ITT Industries
Engineered for life

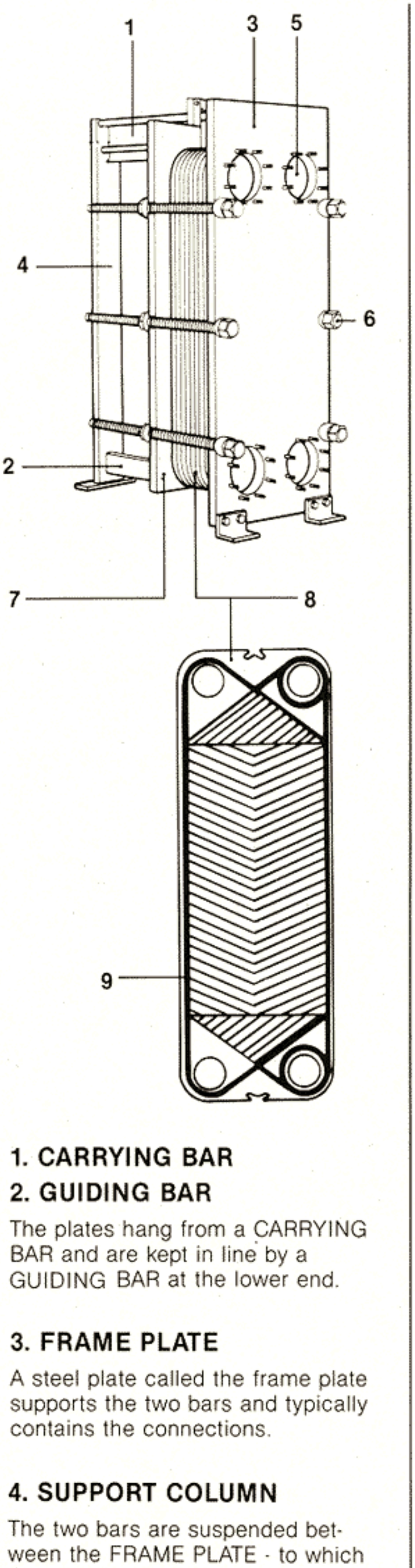
Southgate Process Equipment, Inc. / Phone: (770) 345-0010 / Email: sales@southgateprocess.com

Plate & Frame Heat Exchangers

CONTENTS:

A. BASIC CONSTRUCTION & FUNCTION

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



1. CARRYING BAR
2. GUIDING BAR

The plates hang from a CARRYING BAR and are kept in line by a GUIDING BAR at the lower end.

3. FRAME PLATE

A steel plate called the frame plate supports the two bars and typically contains the connections.

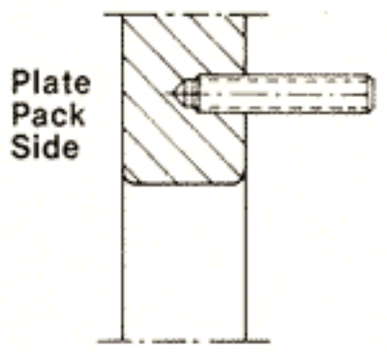
4. SUPPORT COLUMN

The two bars are suspended between the FRAME PLATE - to which in most cases the piping is connected, and a SUPPORT COLUMN.

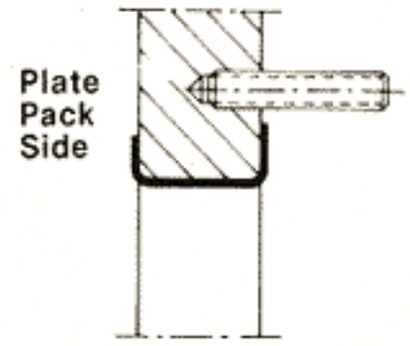
5. CONNECTIONS

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

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

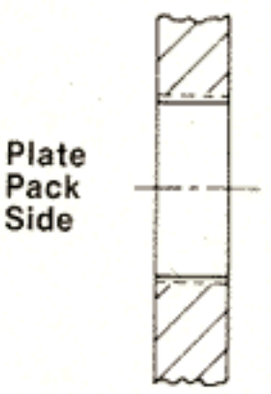


Carbon Steel · No Liner

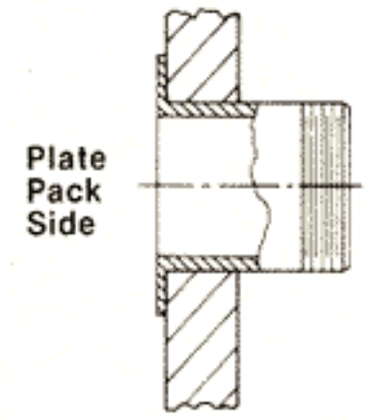


With Alloy or Rubber Lining

For smaller connection sizes NPT type connections may be used.



Carbon Steel



With Alloy Nozzle

6. TIGHTENING BOLTS

The "Plate Pack," consisting of channel plates & gaskets assembled in the proper order, hangs between the frame plate and the pressure plate. A number of TIGHTENING BOLTS are used to press the channel plates together, bringing them into metallic contact and to compress the gaskets enough to seal the narrow passages which have now been formed between the plates.

7. PRESSURE PLATE

A steel plate called the pressure plate is also hung on the carrying bar and is movable as are the channel plates. In some cases, the pipinng connections may be located on the pressure plate.

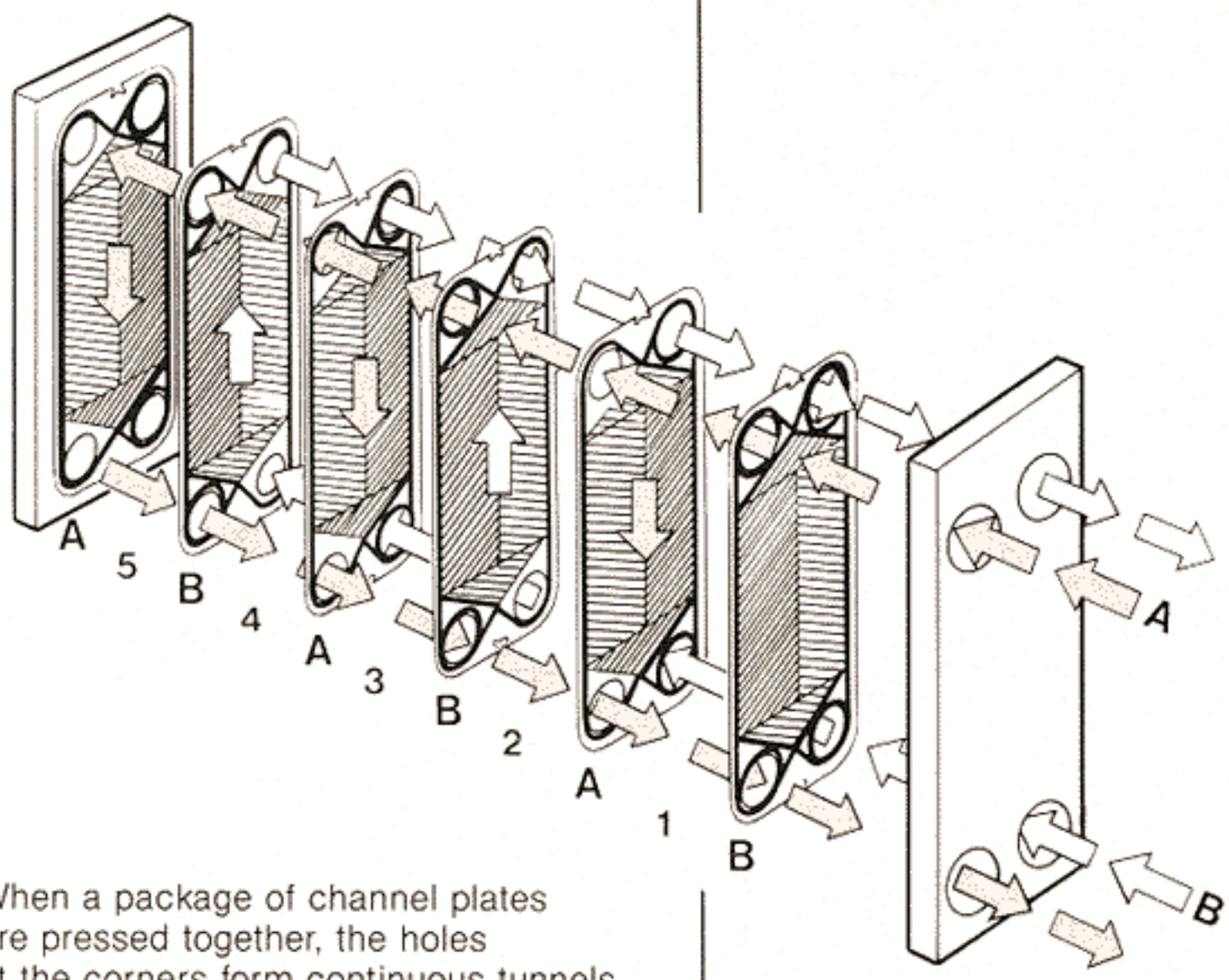
8. CHANNEL PLATES

Also called heat transfer plates, are thin metal plates through which heat is transferred. The number of channel plates in a given exchanger is determined by the amount of heat transfer surface required to perform the given service.

9. GASKETS

A groove along the rim of the plate and around the ports hold a GASKET, usually made of a rubber-type material.

HOW IT WORKS



When a package of channel plates are pressed together, the holes at the corners form continuous tunnels or manifolds, leading the media (which perform the heat transfer process) from the inlets into the plate pack, 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 plate pack, 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 manifolds at the other end of the plates and discharged from the heat exchanger.

The purpose of the equipment is to transfer heat from one medium to another, 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 the 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 the thermal 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 and increase fluid pressure drop.

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 given equipment 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 required to get the desired flow through the heat exchanger.

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 used.

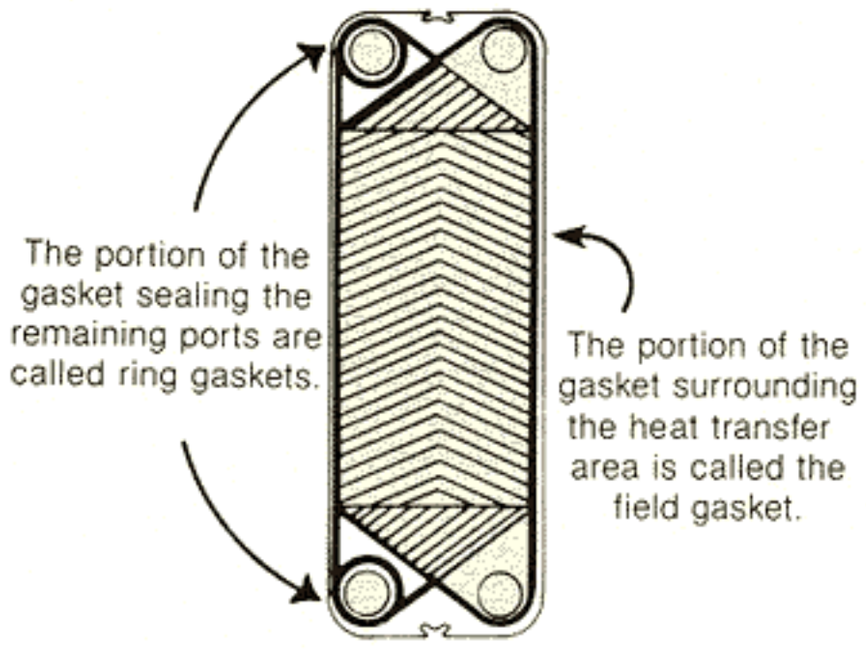
A reduced ability by the heat exchanger to hold the desired temperatures, in combination with an increased pressure drop on any of the media, indicates that fouling or clogging is taking place.

For corrective action, study MAINTENANCE and CLEANING.

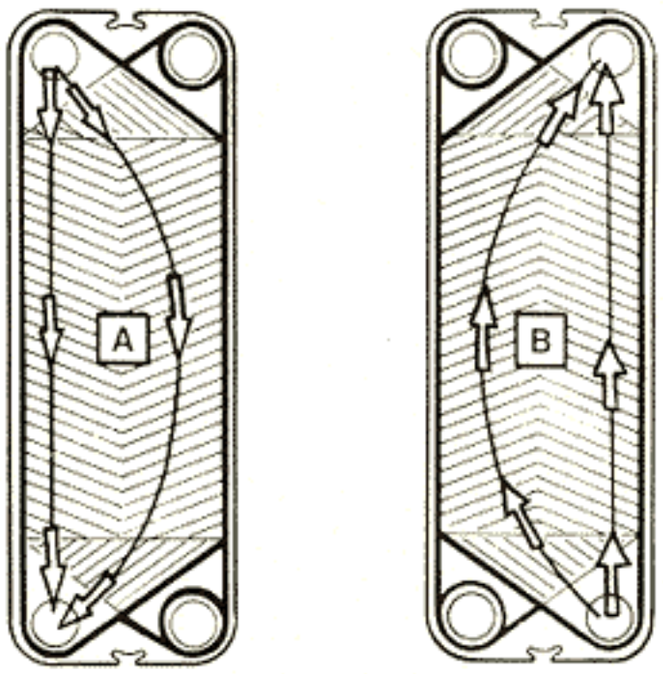
Plate & Frame Heat Exchangers

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 and smaller rings surround the remaining corners.



Depending on which two corners are included with the heat transfer area, the plate is called an A- or a B-plate.

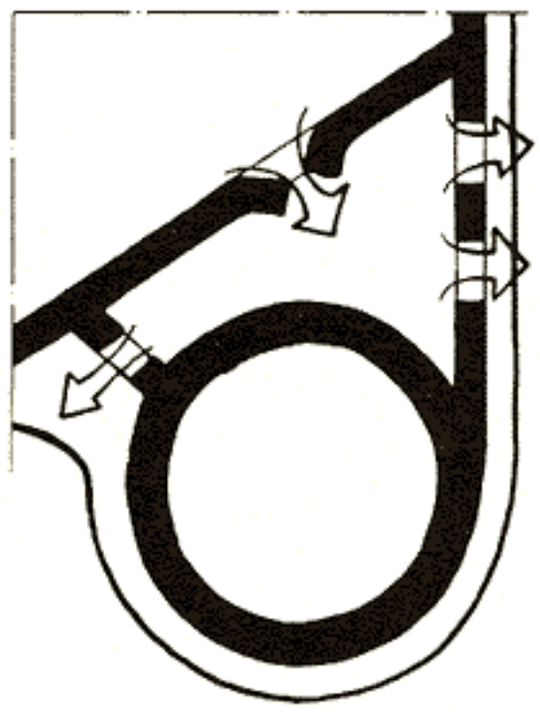


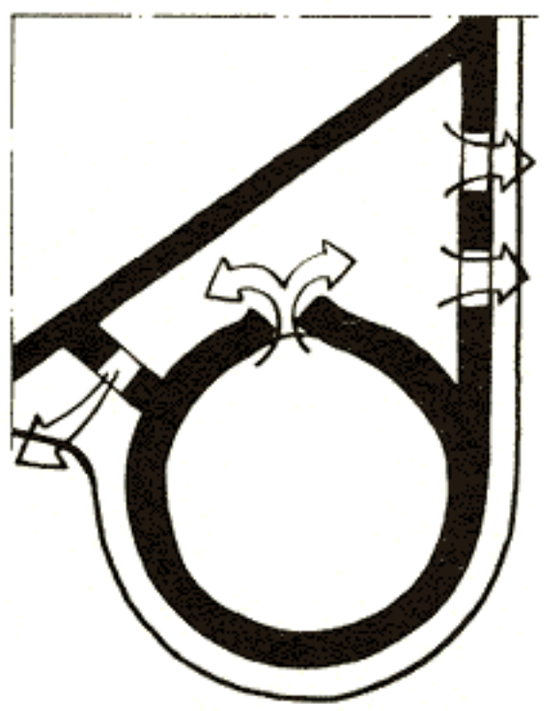
An A-plate is a plate hanging with the chevron pointing downwards.

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

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 fluid 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.

B. INSTALLATION

1. Lift the plate heat exchanger by the carrying bar tightening bolts. (See Fig. 1)

⚠ CAUTION: The Heat Exchanger must not be lifted by the nozzle connections.

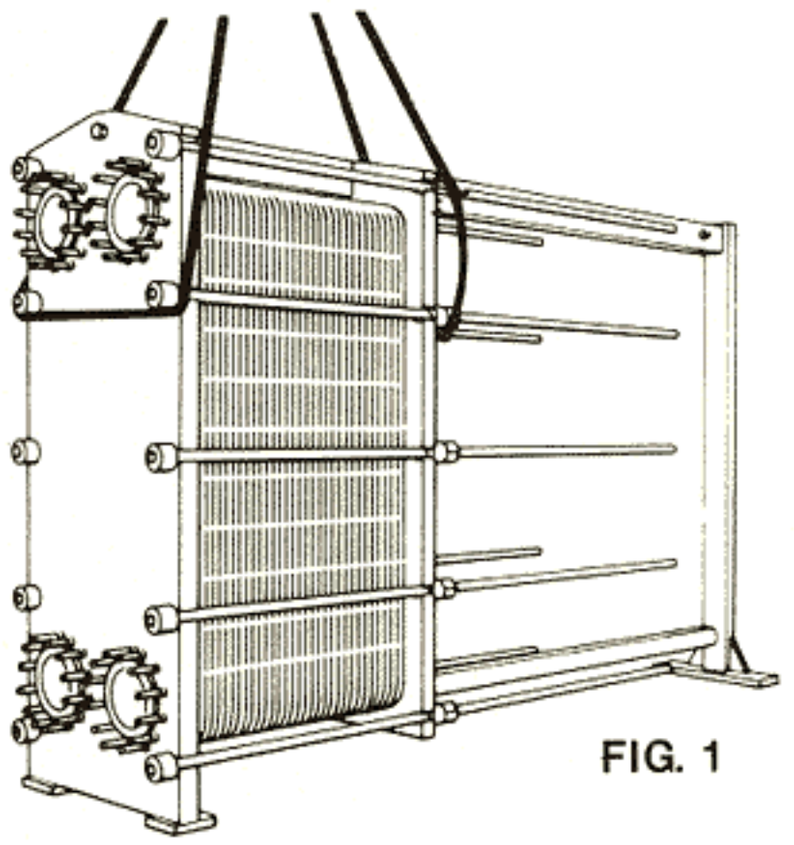
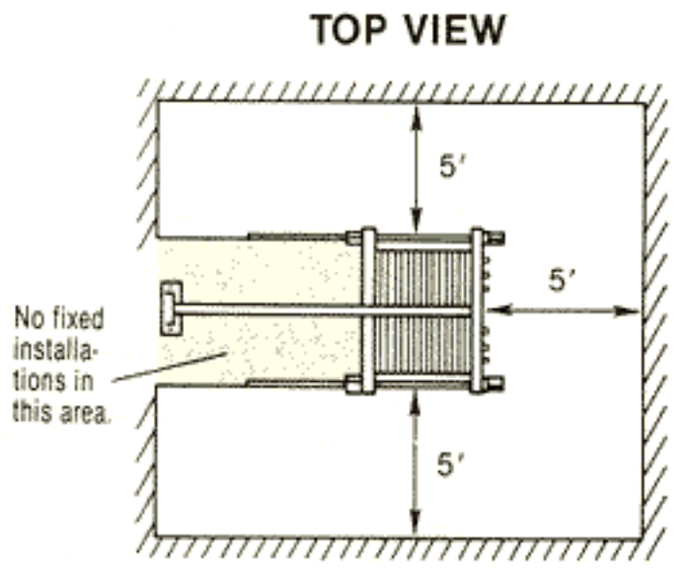


FIG. 1

2. Provide sufficient clearance so that the unit can be serviced.



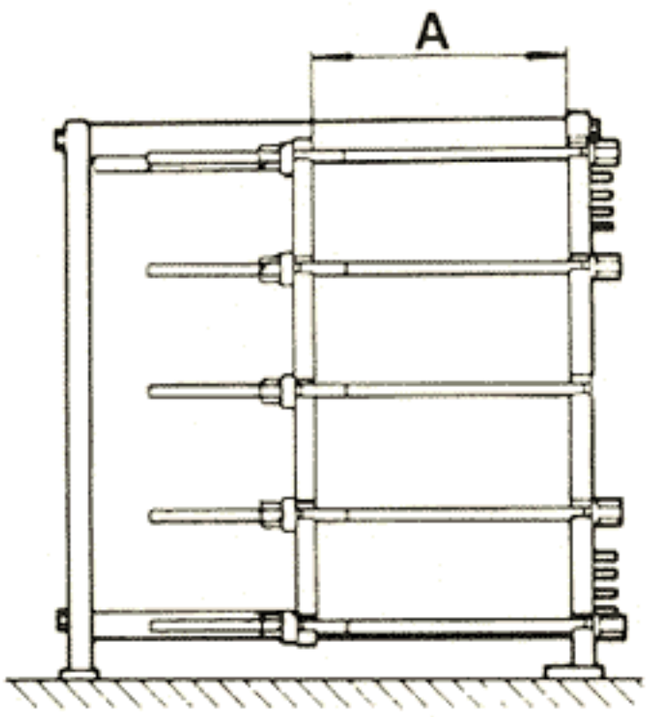
The clearances given above are suggested practice to provide reasonably good working conditions during installation of complete unit as well as for future servicing.

If floor space is at a premium, the user at his own discretion may reduce these dimensions.

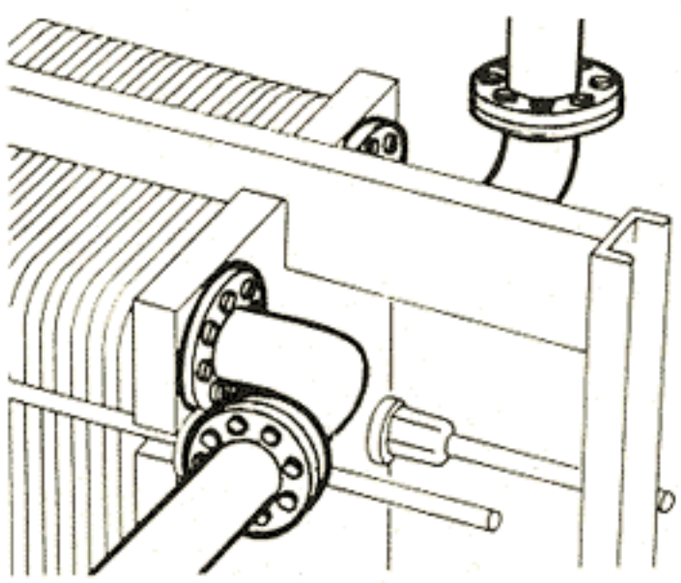
3. For installations when processing corrosive liquids, shipboard installations, etc., it may be practical to place the heat exchanger over a drip pan. The drip pan should have capacity for the total volume of the heat exchanger.

4. Foundation must be adequate so that the heat exchanger will not settle and cause piping strain.
5. Set heat exchanger level and square so that pipe connections may be made without creating a piping strain.
6. When delivered, the plate pack has been properly assembled and tightened for immediate installation.
7. All pipe connections to the heat exchanger should be fitted with shut-off valves. The piping should be installed so that thermal expansion does not affect the heat exchanger. Two pipe wrenches should be used when mounting piping to nozzles to prevent nozzles from rotating.

FIG. 2



8. When connecting piping to parts of the heat exchanger other than the fixed frame plate, such as the pressure plate, the piping must be connected so the weight of piping or other external loads are not transferred to pressure plate.
9. The nozzle connections in the pressure plate must allow dimensions A in Fig. 2 to vary ±1% of the value shown on standard submittals.
10. The pressure plate must be loosened for service work. When connecting piping to pressure plate, provisions must be made for convenient disconnecting.



11. Provide thermometer wells and pressure gauge connections in all piping to and from the unit, and locate them as near to the heat exchanger as possible.
12. Provide air vents near top of piping so unit can be purged of air.
13. Inspect all openings in exchanger for foreign material. Do not store units outdoors with nozzle or flange protectors removed from unit, since water may enter and cause severe damage due to freezing.
14. To prevent plugging of plate channels with sand or refuse, be sure entire system is clean before starting operation.

⚠ CAUTION: During times of shutdown, volumetric expansion can occur. We recommend the installation of a properly sized relief valve on both sides of the heat exchanger.

C. OPERATION

1. When placing a unit in operation, open the vent connections and start to circulate the cold fluid by slowly opening the valves. Be sure that the passages in the exchanger are filled with the cold fluid before closing the air vents. The hot fluid should then be introduced in the same manner until all passages are filled with fluid.

⚠ WARNING:
Fluids must be gradually introduced to the unit. Failure to do so can cause damage to plate pack.

2. When empty or cold, do not admit hot fluid to the unit suddenly. Do not shock unit with cold fluid when unit is hot.
3. During start-up there may be some leakage until the plates and gaskets reach their working temperature. Should leakage continue, check that dimension "A" in Fig. 3 is correct within ±1% of the value shown on the channel plate assembly instructions.
4. Do not operate equipment exceeding design conditions as specified on nameplate.
5. The PLATEFLOW must never be subjected to pressure greater than the maximum differential pressure given on the nameplate.
6. Sudden rises in pressure may cause leakage or damage plates and gaskets.

D. STORAGE

1. If the PLATEFLOW is going to be out of operation for over six months time; it is advisable to empty, separate, and clean the plates. Leave the heat exchanger in untightened or slightly tightened condition.

⚠ CAUTION: Cover the heat exchanger with dark plastic to protect it from welding light and dirt (rubber gaskets are sensitive to welding light).

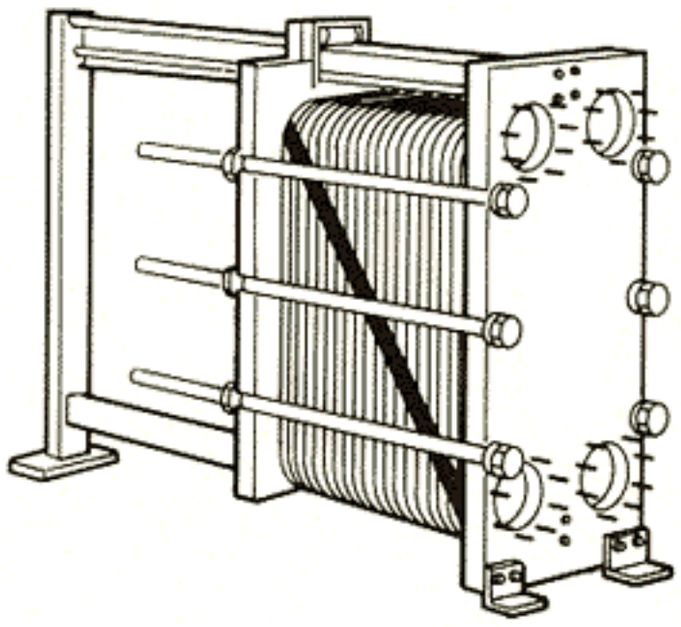
Do not store organic solvents or acids in the room. Avoid heat or ultraviolet radiation.

Plate & Frame Heat Exchangers

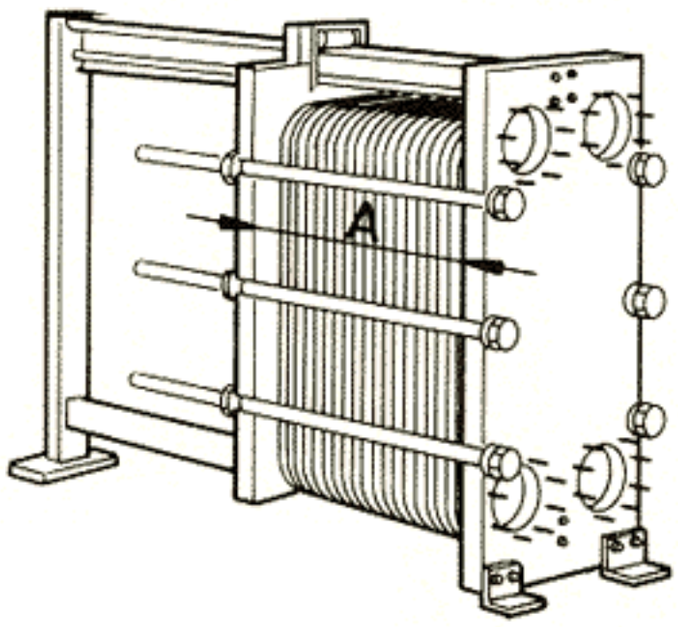
E. OPENING AND CLOSING

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.
4. If the heat exchanger is hot, wait until it has cooled down to about 100°F.
5. Drain both sides of exchanger.
6. Dismantle any pipe bends connected to the pressure plate so that it can be moved freely along the carrying bar.
7. Inspect the sliding surfaces of the carrying bar and wipe clean.
8. Brush the threads of the tightening bolts clean with a steel wire brush.
9. Lubricate the threads with a thin layer of grease e.g. molybdenum disulphide or equivalent.
10. Remove protective splash guard.



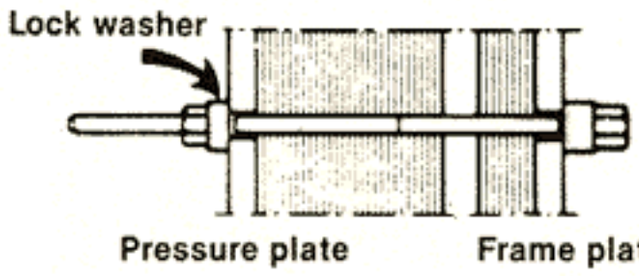
11. Mark the plate assembly on the outside by a diagonal line, or number the plates in sequence.



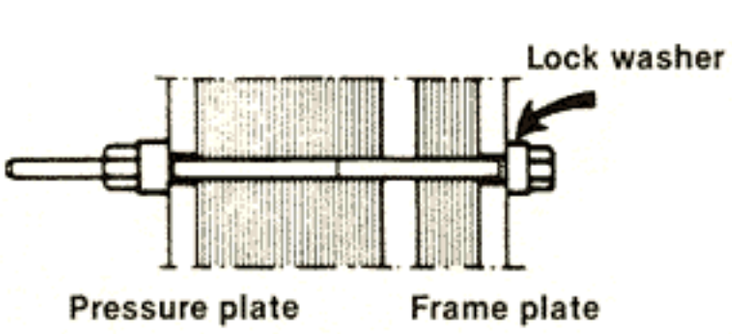
12. Measure and note down the dimension A.

> ⚠ **CAUTION:** Knowledge of tightening dimension is critical for reassembly. Carefully measure and record before opening unit.

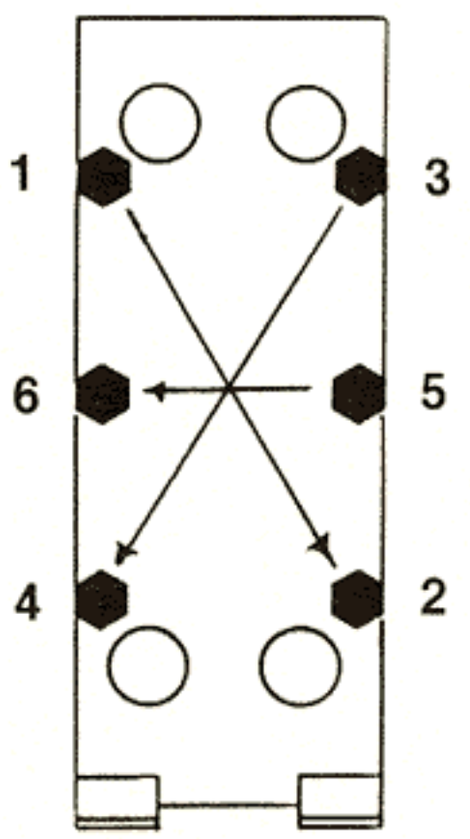
13. The tightening bolts of certain units are provided with a locking washer and wear guide washers. The locking washer is normally placed under the nut at the pressure plate. Loosening and tightening of the bolts are thus carried out via the bolt-head (frame plate).



For installations with limited access, so that tightening from the frame plate is not possible, the locking washer can be placed under the bolt head. Loosening and tightening can then be carried out from the pressure plate end.



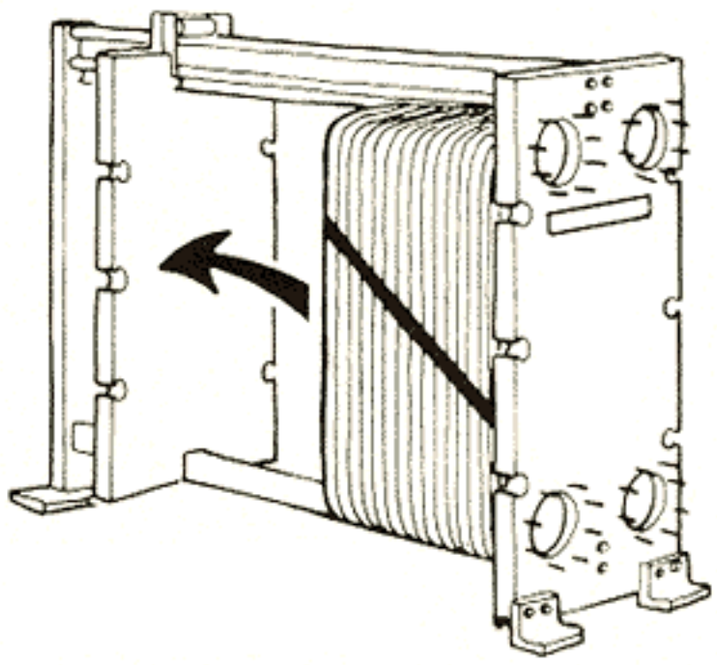
14. If the exchanger has more than six bolts, remove the corner bolts first in order to avoid damage to the channel plate corners. The corner bolts must not be used for opening the heat exchanger.



15. Opening of the heat exchanger is now possible by loosening diagonally opposite pairs. Opening must be carried out evenly so that the pressure plate is not out-of-parallel to the frame plate by more than ⅜" (2 turns per bolt) horizontal plane and 1" in the vertical plane.
16. With the tightening bolts removed the pressure plate can be slid back and channel heat transfer plates can also be slid back for inspection or cleaning.

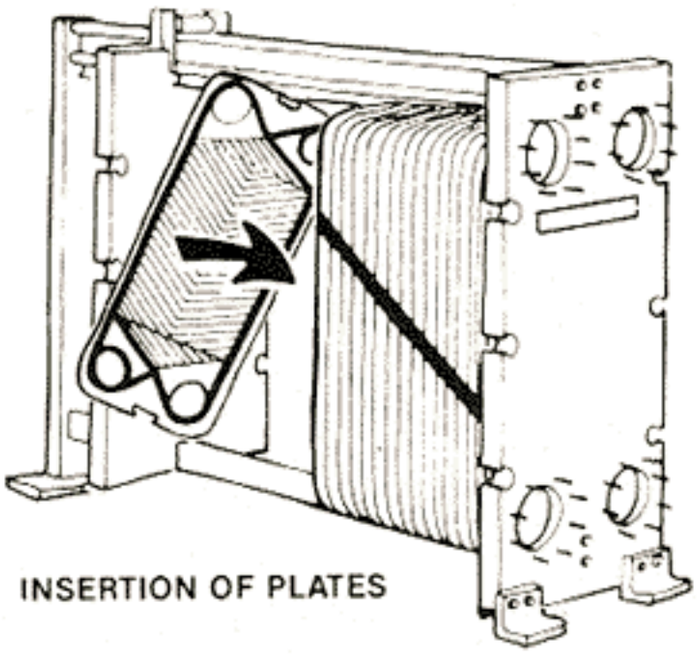
REMOVAL AND INSERTION OF PLATES

> ⚠ TO AVOID HAND INJURIES WHEN HANDLING PLATES, USE PROTECTIVE GLOVES.



REMOVAL OF PLATES

1. Push the pressure plate against the support column.
2. Remove the plates and number or stack them in sequence.



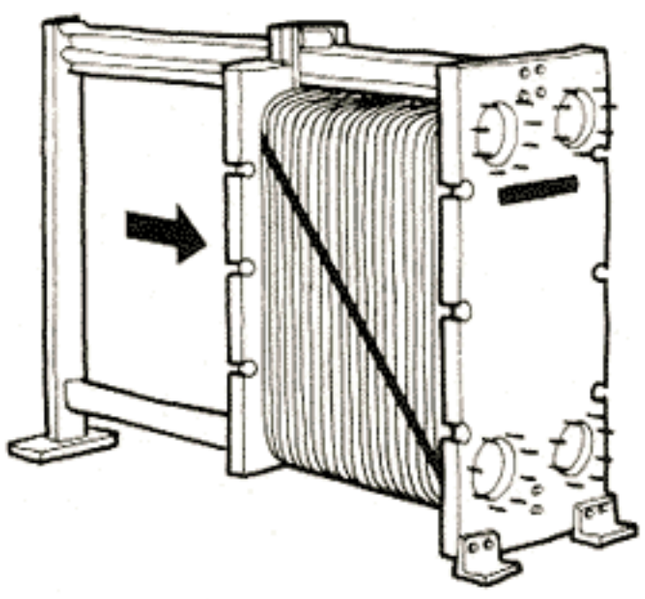
INSERTION OF PLATES

3. Hang the plates with their backs towards the pressure plate (the side without gasket) unless otherwise specified.
4. Always consult plate pack drawing to insure proper plate sequence.
5. Install plates one at a time, pushing them forward toward frame plate.

CLOSING

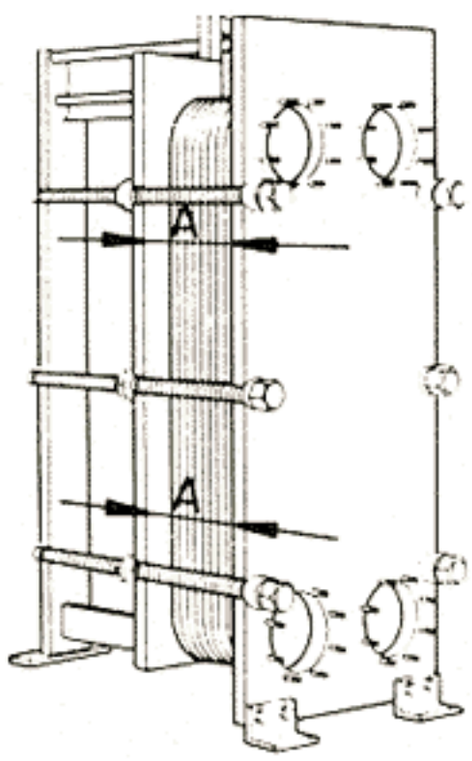
1. Check that all the sealing surfaces (i.e. surfaces in contact with the heat transfer medium) are clean.
2. Check that connection fittings are in position and are in good condition.
3. Clean and lubricate the sliding surfaces of the carrying bar.
4. Inspect the pressure plate roller (if provided).
5. Check drawing to make certain that the plates are hanging in the correct order.
6. Press the plate assembly together.
   If the plate pack has been marked on the outside (Fig. 3) check this.

FIG. 3



7. If the plates are correctly assembled, the edges form a "honey comb" pattern.

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.
11. Tighten the plate pack using diagonally opposite bolt pairs, the opposite to opening procedure 15 until the plate pack length is reduced to ±1% of dimension "A" in the channel plate assembly instructions supplied with unit. During tightening, the pressure plate must not be out-of-parallel to the frame plate by more than ⅜" in the horizontal plane and 1" in the vertical plane.



12. Check the plate pack length ("A") during closing in at least four locations close to the bolts being used.
13. Place the remaining bolts in position and tighten them. This does not apply to the corner bolts on plate heat exchangers with more than six bolts.
14. Now insert the corner bolts and tighten, maintaining dimension "A" of drawing. To avoid damaging the channel plate corners, it is important that the corner bolts are not used for closing the plate heat exchanger.
15. Nominal plate pack length A can be exceeded in some cases, the tightening can be stopped at A + 2% and pressure tested.

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

MAX TIGHTENING TORQUE

Bolt size	Bolt with bearing box LBF-FT	Bolt with washers LBF-FT
⅝"	N/A	400
1"	N/A	700
1½"	1000	1500
2"	1500	2500

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

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.

16. FINAL CHECKS

- 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:
  0.079 inches when dimension A is < 39.50 inches
  0.158 inches when dimension A is > 39.50 inches
- The plate pack length at all bolts must not differ 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.

17. Replace protective splash guard.

F. MAINTENANCE AND CLEANING

1. CLEANING - GENERAL

Cleaning the unit may be accomplished by either backflushing, circulating cleaning agents in unit or by disassembly. If the water contains suspended foreign material, deposits can accumulate in the flow passages. Under these circumstances, backflushing may be adequate to clean unit. If this method is ineffective for the removal of hard scale, you may want to circulate buffered cleaning agents in unit to remove scale or disassemble unit for manual cleaning. To disassemble unit for manual cleaning follow steps given earlier for disassembly.

2. CLEANING PROCEDURES

Plates can be cleaned while hanging on frame or removed depending on how much work is required.

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 aluminum are protected against chemicals. Do not use brushes with carbon steel bristles or steel wool. A fiber type brush is recommended but as a last resort use a brush of similar material to thermal plates. Be careful not to scratch plates or damage gaskets if they are to be reused. After brushing rinse each plate with water. For better sealing wipe all gaskets dry.

THE FOLLOWING SOLVENTS **SHOULD NOT** BE USED IN CONTACT WITH GASKETS

- Ketones (e.g. Acetone, Methyletylketone, Methylisobutylketone)
- Esters (e.g. Ethylacetate, Butylacetate)
- Halogenated hydrocarbons (e.g. Chlorothene, Carbon tetrachloride, Freons)
- Aromatics (e.g. Benzene, Toluene)

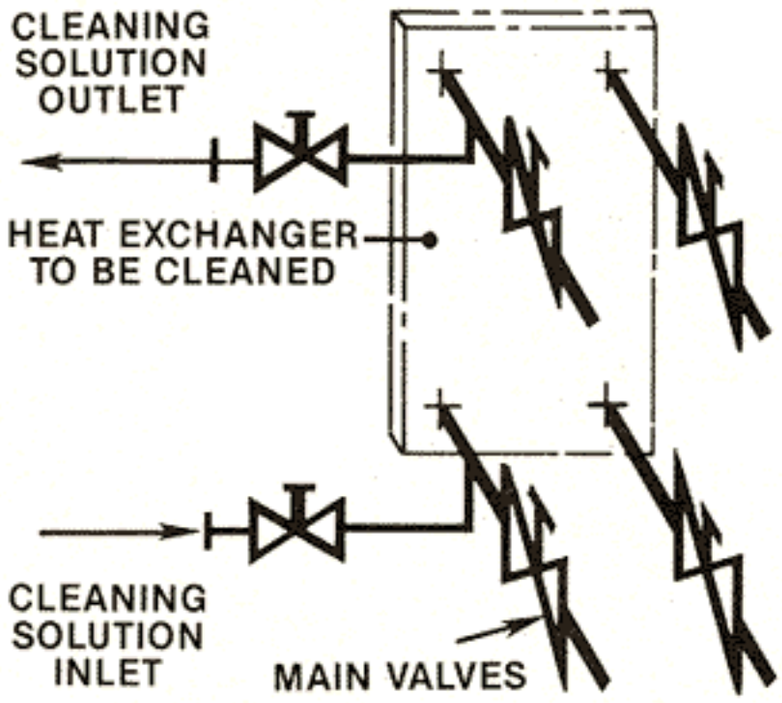
⚠ CAUTION: Care must be exercised when handling certain fluids. Follow manufacturers instructions. Use eye and skin protection. Wear a respirator when required.

RECOMMENDED CLEANING PROCEDURES

TYPE OF FOULING	CAUSE	CLEANING METHOD	CHEMICAL CLEANING	NOTES
Gross Fouling	Seaweeds Wood Chips Fibres	1. Soft brush & running water NOTE: Avoid gasket damage 2. High pressure hose 3. Backflushing of unopened unit can sometimes be effective	None Required	
Biological Growth-Slime	Bacteria Nematodes Protozoa	1. Soft brush & running water NOTE: Avoid gasket damage 2. High pressure hose 3. Chemical cleaning	Sodium Hydroxide Sodium Carbonate NOTE: Cleaning effect can be enhanced by addition of hydrochlorite or agents for formation of sulfactants	**Maximum concentration 4%** Maximum temp. 140°F
Incrostation Scaling (Lime Deposits)	Calcium Carbonate Calcium Sulphate Silicates	1. Soft brush & running water NOTE: Avoid gasket damage 2. High pressure hose 3. Chemical cleaning	Nitric Acid Sulfamic Acid Citric Acid Phosphoric Acid Complexing Agents (EDTA, NTA) Sodium Polyphosphates	**Maximum concentration 4%** Maximum temp. 140°F
Sediment	Corrosion Products Metal Oxides Silt Alumina Diatomic Organisms	1. Soft brush & running water NOTE: Avoid gasket damage 2. High pressure hose 3. Chemical cleaning 4. Addition of surfactants can improve cleaning effect	Nitric Acid Sulfamic Acid Citric Acid Phosphoric Acid Complexing Agents (EDTA, NTA) Sodium Polyphosphates	**Maximum concentration 8%** Maximum temp. 140°F
Residual	Oils Asphalt Fats	1. Hydrocarbon based deposits may be removed by using a soft brush and a paraffinic or naptha based solvent (ex. Kerosene) 2. Dry with a cloth or rinse with water	None Required	Gaskets in Nitrile, Butyl and EPDM Rubber swell in these media. Limit contact time to 0.5 hours

3. CLEANING IN PLACE (CIP)

In applications where extremely corrosive fluids are being used a clean in place system is recommended to lengthen the life of the thermal plates.



CLEANING IN PLACE PROCEDURE

a. Close main isolating valves and completely drain the unit thru CIP system
b. Rinse the unit with warm water (100-110°F) until water becomes clear and/or all traces of process fluid are gone.
c. Completely drain rinse water from system.
d. Refill system with water and then add appropriate cleaning solution.
e. Circulate cleaning solution at approximately 180°F for 3-6 hours.
f. Drain cleaning solution from unit and rinse with water as in step 2 and 3.
g. Close CIP system and open main isolating valves.

4. BACKFLUSHING

a. Many applications utilize fluids that may contain solids and sediments that can be trapped and plug up a plate heat exchanger. If this problem is anticipated it is very beneficial to make provisions in your piping for backflushing the unit.
b. Backflushing should be done with water at 1½ times the process flow rate.
c. It is recommended that fluids containing particulate enter at the bottom of the unit and exit at the top. This will cause some solids to collect in bottom of inlet nozzle instead of going into plate pack and clogging.
d. Another alternative to backflushing is to arrange piping so both fluids can be periodically reversed.

5. GASKET REPLACEMENT— GLUED GASKET TYPE

a. Before removing the old gaskets; new gaskets, glue (if required) and degreasing fluid should be obtained. Part numbers for spare gaskets can be found on the spare parts list.
b. A suitable gasket glue is PLIOBOND 20.
c. Suitable gasket groove cleaning fluids are methyl ethyl ketone, petroleum naphtha, and carbon tetrachloride.
d. A suitable degreasing fluid is Trichloroethylene.

> ⚠ **CAUTION:** Care must be exercised when handling these fluids. Follow manufacturers instructions. Use eye and skin protection. Wear a respirator when required.

e. Remove the old gaskets and proceed as follows:
   aa. Clean the gasket grooves of the plates carefully with cleaning fluid.
   bb. Degrease the gaskets with a cloth moistened with degreasing fluid.
   cc. Apply a thin even coating of glue in the bottom of the gasket groove and on the back of the gasket.

NOTE: Large excess of glue is undesirable as this can lead to joining of adjacent plates and/or derformation of the plates due to hardened glue interfering at metal contact points.

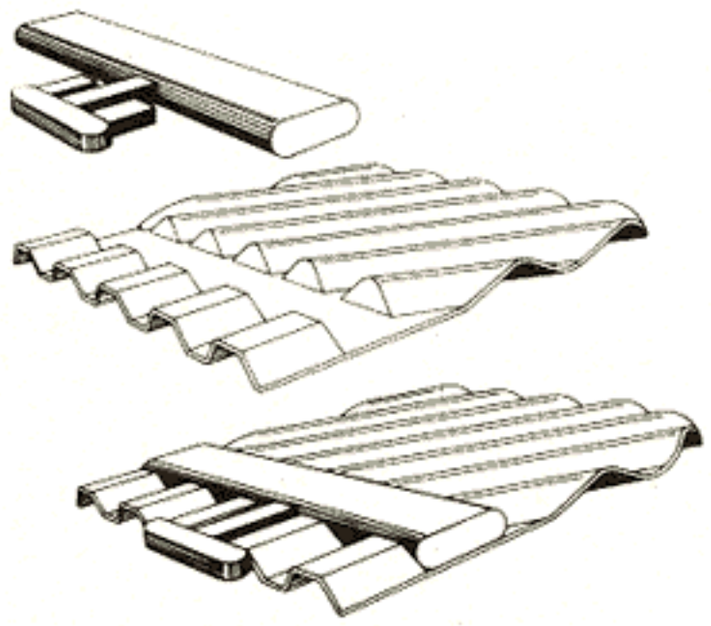
   dd. When the glue is almost dry (usually 3-5 minutes), insert the gasket in the gasket groove, first in the plate ends and after that in the straight gasket grooves along the side of the plate

> ⚠ **CAUTION:** Gasket may have to be stretched prior to installation to fit the gasket groove. Avoid excess stretching as damage to gasket can result.

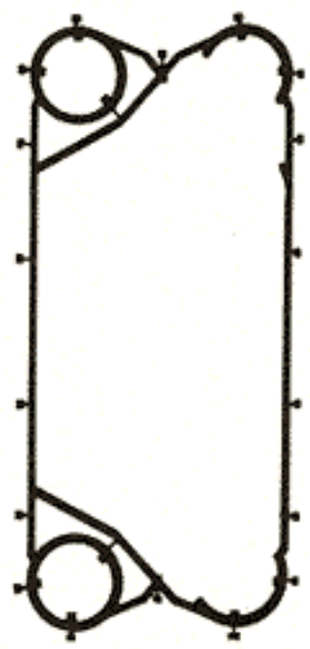
   ee. Evenly press the gasket well down into the gasket groove. Care shall be taken that the gasket is correctly placed in the gasket groove with no part of it being outside the groove. If necessary tape can be used to keep gasket from lifting and twisting until glue hardens and tape is removed for installation.
   ff. The plates should then be placed horizontally on a table during glueing. Stack the plates as they are finished. Powder the back of the gasket groove with talcum powder in order to prevent the plates from sticking together.
   gg. After all the plates have had the gaskets glued in place reassemble the plate pack and tighten. The glue will cure at the heat exchanger operating temperature.

6. GASKET REPLACEMENT— GLUELESS GASKET TYPE

a. Peel old gasket off of plate making sure all parts of gasket are removed.
b. Wipe gasket groove clean making certain no foreign material remains that would cause gasket to seat unevenly.
c. Installation of ***CLIP TYPE*** *glueless gasket*



Attach the clip type gasket to the plate using the gasket prongs which slip under the edge of the plate to hold the gasket securely in alignment in the gasket groove.



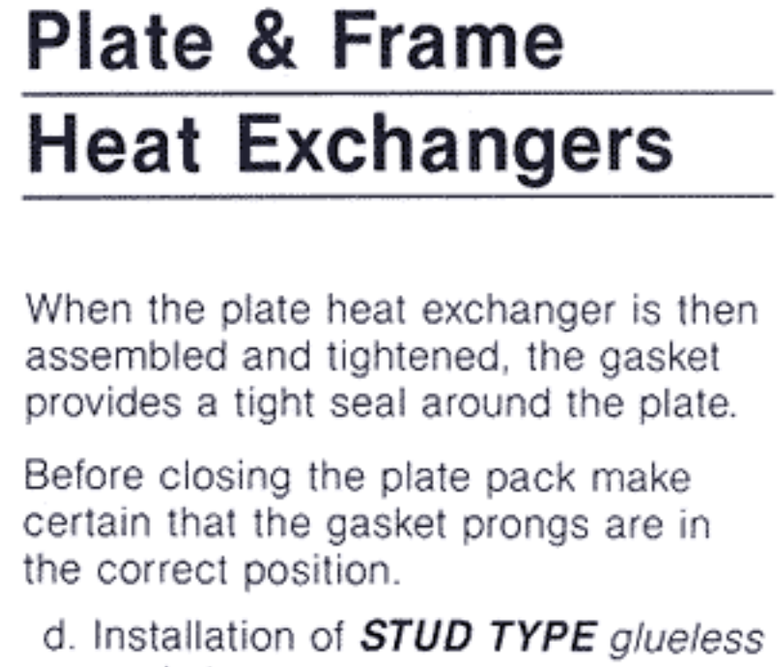
The prongs are situated at regular intervals around the perimeter of the plate.

Plate & Frame Heat Exchangers

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

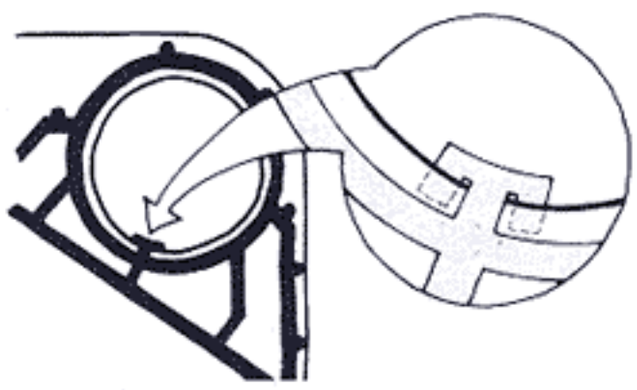
Before closing the plate pack make certain that the gasket prongs are in the correct position.

d. Installation of ***STUD TYPE*** *glueless gasket*



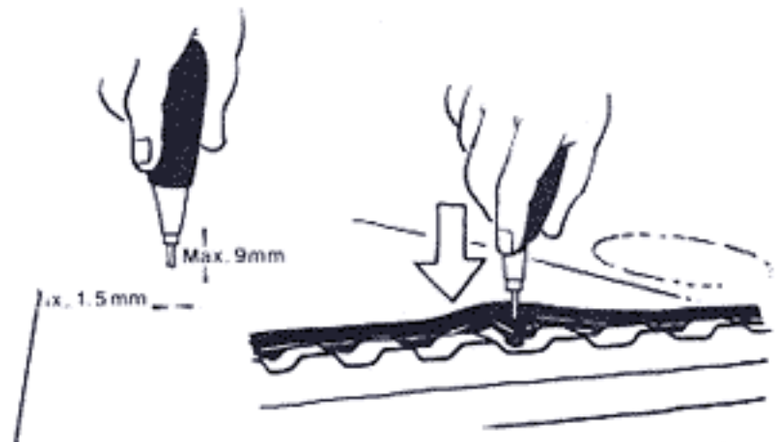
The stud type gasket is attached to the plate by a stud projection being forced through holes on the outer edge of the thermal plates. The studs are at regular intervals around the perimeter of the plate to assure proper allignment of gasket and insure a good seal.

Place the gasket with stud type projections downwards into the gasket groove.



Place the ring gaskets in the groove and fix them with the gasket prong.

Use any tool with similar dimensions to push the stud through the hole in the plate.



Remove the tool and repeat process on remaining studs.

Before closing the plate pack make certain that the gasket prongs are in the correct position.

7. REPLACING GASKETS ON ENDPLATE (FIRST THERMAL PLATE AGAINST FRAME PLATE)

1. Take two standard plate gaskets.
2. Cut gaskets as indicated in Figure 1.

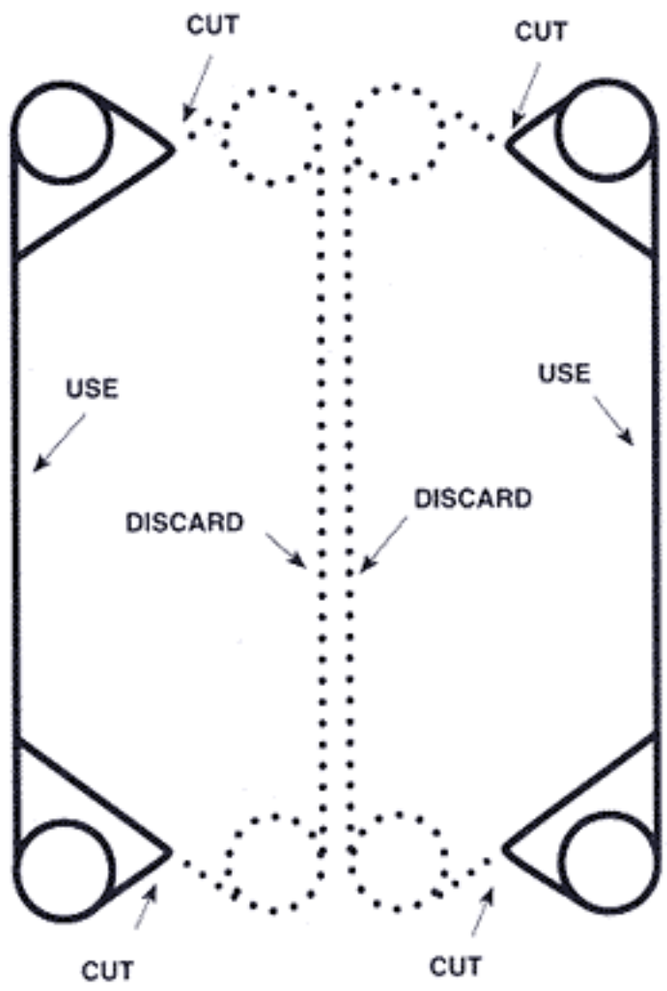


FIGURE 1

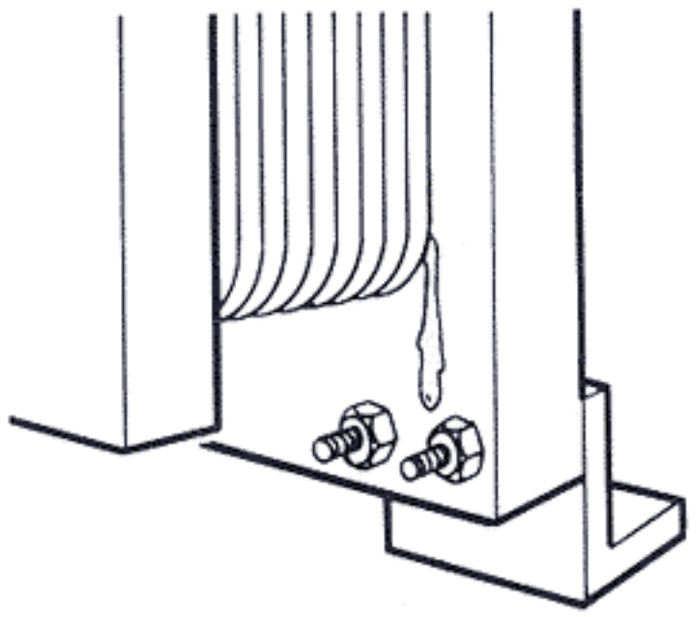
3. Attach gasket to plate as indicated in Figure 2.

FIGURE 2

G. FAULT DETECTION

⚠WARNING: Always relieve pressure before removing splash guard. Test at room temperature with clear water where possible. If not possible, proper precautions must be taken (special clothing, equipment, etc...) to protect personnel from injury due to escaping fluid.

SYMPTOM
LEAKAGE between plate pack and frame.



ACTION
Mark with a felt tip marker the area where the leakage seems to be, and open the heat exchanger.

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.

CORRECTION
- Relocate the gasket.
- Remove the foreign matter.
- Replace damaged gasket.
- Replace connection lining if applicable.

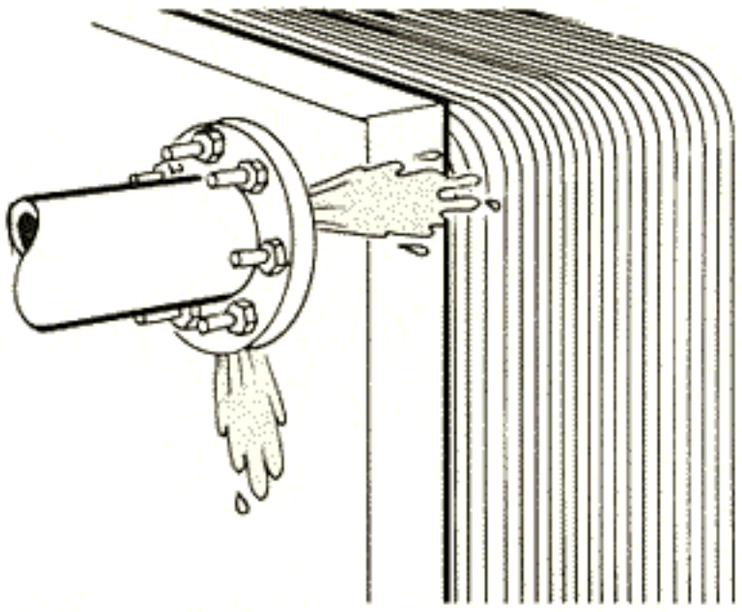
ACTION
Check the surface of the pressure plate for unevenness, foreign objects sticking to it, etc., that might spoil the joint between the gasket and the adjacent surface.

CORRECTION
- Remove anything disturbing the joint between gasket and pressure plate surface.

ACTION
Check the plate itself for cracks or holes.

CORRECTION
- A perforated end plate must be replaced.

SYMPTOM
LEAKAGE between flange and frame.

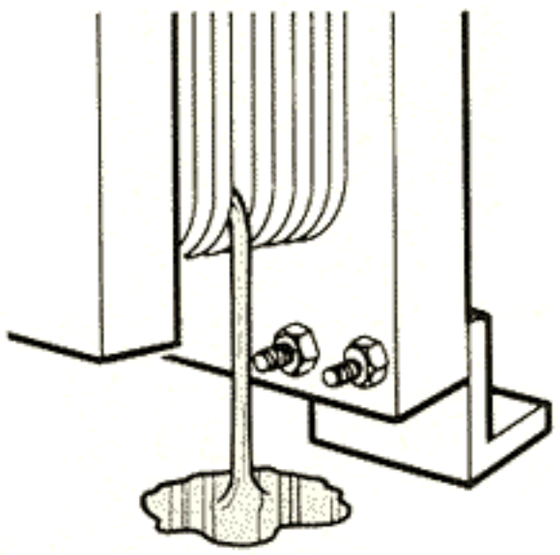


ACTION
Disconnect the flange, and look for misalignment between flange and connection, dislocated or damaged gasket, foreign objects on the surface of the gasket or the flange.

CORRECTION
- Rearrange the pipe in order to eliminate stress and to correct alignment.
- Relocate gasket.
- Replace damaged gasket.
- Replace connection lining if applicable.
- Remove foreign matter from flange and gasket.
- Reassemble, taking care to avoid misalignment.

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 equipment have stabilized.

SYMPTOM
LEAKAGE between plates to the outside.



ACTION
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.

Check for loose, dislocated or damaged gasket.

CORRECTION
- Relocate gasket.
- Recement loose gasket.
- Replace damaged gasket.

ACTION
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.

CORRECTION
- A damaged plate must in most cases be taken out for repair or replacement. If it is a regular plate with 4 holes: 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 not significant, at least not for a short period of time.
- Insufficient tightening must be corrected - see the drawing.

ACTION
Check hanger recess at both plate ends for deformations, which could cause misalignment between the plates.

CORRECTION
- Damaged hanger recesses must be repaired if possible, or the plate replaced.

ACTION
Make sure that the plates are hanging in the correct order A-B-A-B, etc.

CORRECTION
- Incorrect sequence of plates must be corrected (A-B-A-B-...). MAKE SURE THAT NO PLATE HAS BEEN DAMAGED, BEFORE REASSEMBLING THE PLATE PACK!

ACTION
Check for perforation of the plate (corrosion).

CORRECTION
- Perforated plates must be replaced.

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SYMPTOM
MIXING of media.

ACTION
Check that the piping is connected to the heat exchanger at correct locations.

CORRECTION
- Relocate piping to correct connections.

ACTION
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.

ACTION
If a leakage was detected, note the position of the leakage along the plate pack and then open the plate heat exchanger.

ACTION
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.

CORRECTION
- 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.

ACTION
If it has not been possible to locate the leakage as described above, it will be necessary to check each single plate for possible perforations, using any of the following methods:

— put a strong light behind the plate and watch for light coming through fine holes or cracks

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G. FAULT DETECTION (Cont'd)

— use a magnifying glass to check suspect area

— use a chemical penetrant, after having cleaned the plates well

CORRECTION
- Plates with holes are, generally speaking, destroyed and must be replaced. For temporary solution with reduced number of plates, see "LEAKAGE between plates to the outside".

SYMPTOM
PRESSURE DROP PROBLEMS.
Pressure drop has increased.

ACTION
Check that all valves are open including non return valves.

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.

Compare the pressure drop observed with the one specified for the actual flow rate. (See data print out).

ACTION
If the pressure drop is higher than specified, the temperature program should also be checked:

CORRECTION
- See next paragraph.

ACTION
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.

CORRECTION
- 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.

ACTION
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.

CORRECTION
- 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.

ACTION
If the pressure drop is corresponding to the specifications, there is no need for any action.

ACTION
If the pressure drop is lower than specified, the pump capacity is too small or the observation is wrong.

CORRECTION
- See pump instruction manual.

SYMPTOM
HEAT TRANSFER PROBLEMS.
The heat transfer capacity is dropping.

ACTION
Measure temperatures at inlets - 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. Check to see if the transferred amount of heat energy corresponds to the specifications.

CORRECTION
- 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.

ACTION
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 measurements.

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