QUALITY MANAGEMENT SYSTEM
CERTIFIED BY DNV
ISO 9001:2008

Installation, Operation and Maintenance Manual

COOLING WATER ISOLATION SKID (CWIS) 35, 80, and 140 GPM

SPD 8.1.12 Rev. 10 10/13

SENTRY EQUIPMENT CORP

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REVISION HISTORY

Rev. ID	Date	Notes
5	08/04	Added safety precautions to Rev. 4.
6	12/05	Updated to reflect Alfa Laval PHE.
7	12/08	Corrected Address, replaced P&ID figures with new versions, removed material lists, Corrected Drawing number chart
8	2/09	Miscellaneous text changes
9	2/10	Changed Programming document number in Procedures Section
10	10/13	Text changes to page 10

WARNING notices as used in this manual apply to hazards or unsafe practices, which could result in personal injury or death.

CAUTION notices apply to hazards or unsafe practices which could result in minor personal injury or property damage.

NOTES highlight procedures and contain information which assists the operator in understanding the information contained in this manual.

WARNING

Do not install, maintain, or operate this equipment without reading, understanding and following the proper Sentry Equipment Corp. instructions. Otherwise, injury or damage or both may result.

NOTICE

The information contained in this document is subject to change without notice.

Sentry Equipment Corp, its employees, agents, and the authors of and contributors to this document specifically disclaim all liabilities and warranties, express and implied (including warranties of merchantability and fitness for a particular purpose), for the accuracy, currency, completeness, and/or reliability of the information contained herein and/or for the fitness for any particular use and/or for the performance of any material and/or equipment selected in whole or part with the user of/or in reliance upon information contained herein. Selection of materials and/or equipment is at the sole risk of the user of this publication.

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Normal business hours: 7:00 a.m. to 4:30 p.m. CST (U.S. Central Time), Monday through Friday

SAFETY PRECAUTIONS

Please read the entire manual before attempting to unpack, set up or operate this product. Pay careful attention to all warnings, cautions and notes. Failure to do so could result in serious personal injury or equipment damage.

Use of Hazard Information

If multiple hazards exist, the signal word corresponding to the greatest hazard shall be used.

Definitions

Indicates an imminently hazardous situation, which if not avoided, will result in death or serious injury.

Indicates a potentially hazardous situation, which if not avoided, could result in death or serious injury.

Indicates a potentially hazardous situation, which if not avoided, may result in minor or moderate injury.

CAUTION used without the safety alert symbol indicates a potentially hazardous situation, which if not avoided, may result in property damage.

NOTE
Information that requires special emphasis

SHALL
This word understood to be mandatory

SHOULD
This word understood to be advisory

⚠WARNING

It is solely the responsibility of the user, through its own analysis and testing, to select products suitable for their specific application requirements, ensure they are properly installed, ensure that they are safely applied, ensure they are properly maintained, and limit their use to their intended purpose.

Improper selection, installation, or use can cause personal injury or property damage.

Sentry does not warrant against erosion and corrosion. Sentry makes no claims regarding suitability for specific use, and provides no warrantee regarding material compatibility of elastomers in specific services.

⚠WARNING

Hot Surfaces! This equipment may have very hot surfaces. If an operator contacts a hot surface, injury may occur. Use protective clothing to prevent injury. If other equipment comes in contact with a hot surface, damage to the equipment may occur. Ensure the area around this equipment is kept clear to prevent damage from occurring.

⚠WARNING

High Pressures! This equipment may contain fluids at very high pressures. Prior to installing, removing or maintaining this equipment, ensure that the equipment is isolated from all connecting piping, the equipment is de-pressurized, the contents have been drained and the equipment is cool.

1.0 General Information

The Sentry Cooling Water Isolation Skid (CWIS) is a compact, skidded heat exchange system. The CWIS is designed to provide a continuous flow of recirculating water at a specific temperature (generally 77°F) for process cooling applications. The CWIS controls the temperature of the recirculating water by exchanging heat with a secondary circuit of (generally) low quality service water. A centrifugal pump is sized to deliver the required flow of recirculating water to the process.

This manual covers 35, 80, and 140 GPM cooling water isolation skids. Consult Sentry for information on special features.

SPECIFICATIONS

CWIS - 35

- 500,000 BTU/hr of cooling
- Complete isolation from cooling water
- Loss of flow alarm
- Optional close temperature control
- Optional dual pump
- Optional dual plate heat exchanger

CWIS - 80

- 1,000,000 BTU/hr of cooling
- Complete isolation from cooling water
- Loss of flow alarm
- Optional close temperature control
- Optional dual pump
- Optional dual plate heat exchanger

CWIS – 140

- 1,800,000 BTU/hr of cooling
- Complete isolation from cooling water
- Loss of flow alarm
- Optional close temperature control
- Optional dual pump
- Optional dual plate heat exchanger

Pump Specifications

Centrifugal pump with direct connected 3 phase TEFC motor. Pumps are provided with inlet and outlet isolation valves and unions/flanges to facilitate pump maintenance.

Table 1

Model Number	Pump Horsepower	Supply	Full Load (KVA)	Recirculating Water (GPM) (1)	Cooling Water (GPM)
CWIS - 35	2.0 HP	480/3ø/60Hz or 380/3ø/50Hz	1.3	35	53
CWIS - 80	3.0 HP	480/3ø/60Hz or 380/3ø/50Hz	3.6	80	120
CWIS - 140	5.0 HP	480/3ø/60Hz or 380/3ø/50Hz	5.8	140	210

(1) Recirculating water flow based on 20 psid external pressure drop

Temperature Control
Temperature control is achieved by diverting flow around the plate heat exchanger using one of two methods; standard and close.

Standard Self-contained thermostatic element 3-way mixing valve
Close Electronically actuated 3-way ball valve.

Accuracy
Standard $\pm 4^{o}F$ ($\pm 2.2^{o}C$)
Close $\pm 1^{o}F$ ($\pm 0.5^{o}C$)

Heat Exchanger
Plate and frame type with 316 stainless steel plates. Isolation valves are standard on the recirculating water and external cooling water sides of the heat exchanger. Vent and drain fittings are provided for both sides of the heat exchanger.

Expansion Tank
Bladder type with relief valve

Make-Up Water
The CWIS includes a provision for make-up water to the recirculating water closed-loop. A pressure-reducing valve is installed which is designed for filling the chilled water closed-loop to a properly controlled pressure after CWIS installation or for system servicing. The pressure reducing valve is factory set at 45 PSIG (3.1 Bar-g); however, is easily adjusted if the make-up water supply pressure is less than the factory setting. The valve is adjustable from 25 to 60 PSIG (1.7 to 4.1 Bar-g). Refer to the ***Pressure Reducing Valve Pressure Setting*** section for adjustment. The pressure reducing valve is also equipped with a built-in strainer and low inlet pressure check valve.

Dimensions

Model Number	Approximate Overall Dimensions
CWIS - 35	60” L x 60” W x 44” H (152 cm L x 152 cm W x 91 cm H)
CWIS - 80	60” L x 60” W x 46” H (152 cm L x 152 cm W x 91 cm H)
CWIS - 140	80” L x 60” W x 60” H (203 cm L x 152 cm W x 152 cm H)

Cooling Water
Cooling water should be provided at a minimum flow rate of 1.5 times the recirculating water flow rate. At the minimum cooling water flow rate, the unit will maintain within $10^{o}F$ ($5.5^{o}C$) of the cooling water temperature.

Electrical
480VAC ± 10%, 3 phase, 60 Hz
380VAC ± 10%, 3 phase, 50 Hz
NEMA 4 enclosure with disconnect switch

Instrumentation
Pump Suction pressure gauge and recirculating water outlet temperature.

Options
- Close temperature control
- Dual pumps with automatic or manual switchover on loss of flow.
- Dual plate heat exchangers.

2.0 Principle of Operation

Figure 1 is a demonstration of a CWIS in use. The primary sections of the CWIS are the heat exchanger, temperature control, and the make-up water. Figure 2 is the process and instrumentation diagram of a Sentry designed CWIS. The component abbreviations in the following sections can be found in Fig. 2.

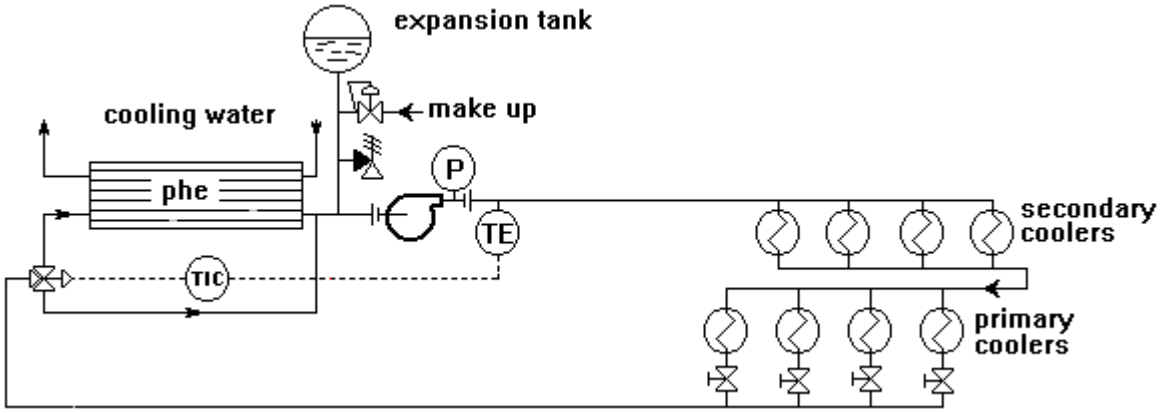


Figure 1 An example of a cooling water isolation skid in service.

NOTE

These systems are designed to provide recirculating water to a closed loop cooling system. If the cooling system is to be open loop (atmospheric), consult factory for evaluation.

Heat Exchange

The recirculating water is pumped to the process where it absorbs heat removed from the sample. The recirculating water enters the inlet side of the CWIS, passes through the mixing valve (TCV-1), and enters the inlet of the plate heat exchanger. The heat exchanger is a barrier between clean recirculating water and poor quality water used for cooling. The recirculating water is kept clean to reduce corrosion and clogging of components, extending their life. To size the plate heat exchanger, Sentry assumes a cooling water flow 1.5 times the recirculating water flow. When this condition is met, the recirculating water temperature can approach within $10^{o}F$ ($5.5^{o}C$) of the cooling water temperature. Isolation valves are provided for easy removal of the heat exchanger for periodic cleaning. An expansion tank accounts for temperature induced volume differences. The recirculating water piping has a 100 PSIG (6.9 Bar-g) relief valve for safety.

Temperature Control

Temperature control of the recirculating water is achieved by bypassing a portion of the inlet flow around the heat exchanger and remixing the hot water with the outlet flow. Two types temperature control are available; standard temperature control or close temperature control.

A self-contained thermostatic element 3-way mixing valve (TCV-1) is used for standard temperature control (see Figure 2). The valve utilizes a temperature dependent volume of wax to control the movement of a stainless steel sliding valve. Standard control holds the recirculating water within $\pm 4^{o}F$ of $77^{o}F$ ($\pm 3^{o}C$ of $25^{o}C$).

An electronically actuated 3-way ball valve (TCV-146 coupled with TIC-148) is used for close

temperature control (see Figure 3). Temperature sensor, TE-154, continuously monitors the temperature of the recirculating water. TIC-148 displays the temperature, and produces an analog output to control the mixing valve. The recirculating water will be within $\pm 1^{o}$F of the 77^{o}F ($\pm 0.5^{o}$C of 25^{o}C) setpoint. Temperature control is dependent on the temperature and cooling water flow.

Make-up Water

High quality make-up water must be supplied to the CWIS at a minimum of 45 psig. The make-up water passes through a pressure control valve filling the system at startup and keeping a constant volume of water in the closed loop. A plug valve is installed at the outlet of the heat exchanger for filling the heat exchanger after maintenance or replacement.

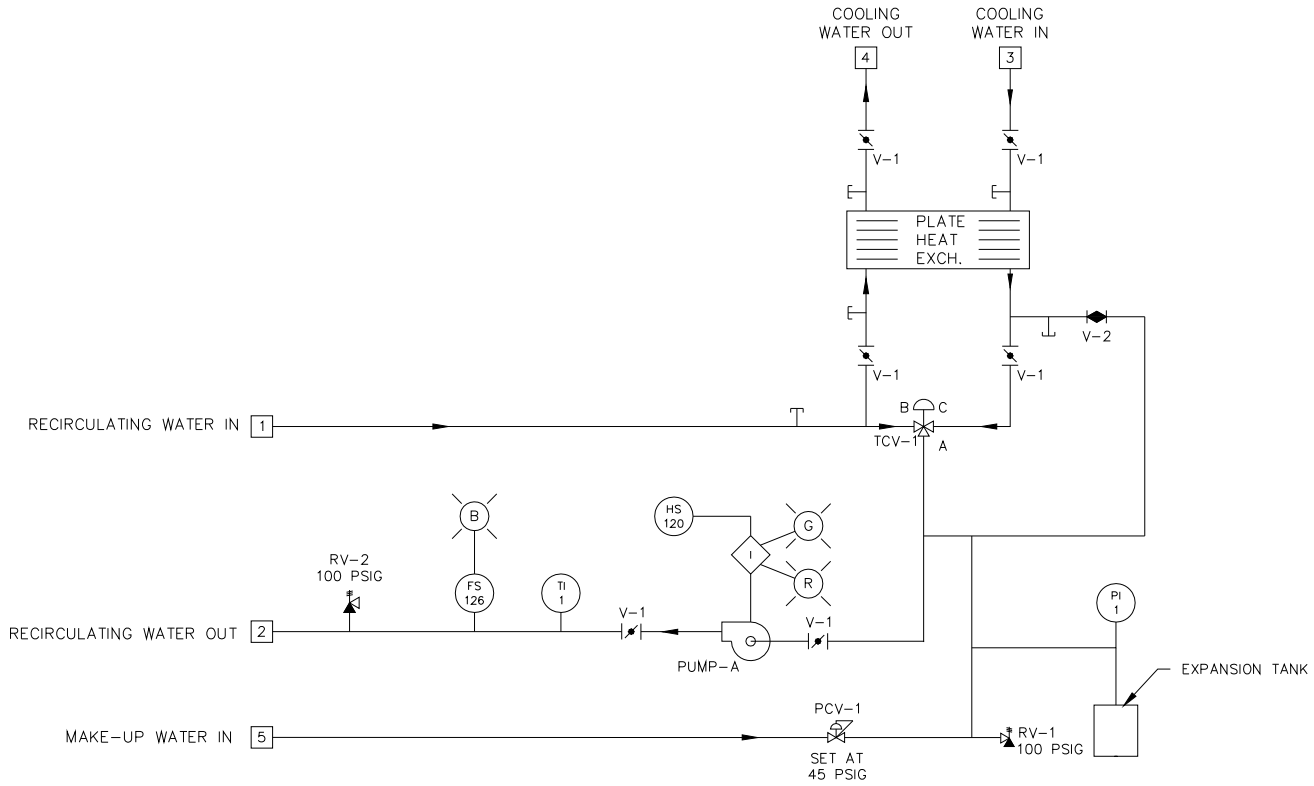


Figure 2 The process and instrumentation diagram for a single pump single heat exchanger cooling water isolation skid with standard temperature control.

Options

As options to the basic single pump/single heat exchanger CWIS, Sentry provides the ability to incorporate redundant pumps and heat exchangers. Figure 3 is a process and instrumentation diagram showing an optional dual pump and dual heat exchanger system. The dual heat exchanger configuration includes isolation valves. One heat exchanger may be removed and cleaned without interrupting operation. The dual pump configuration includes isolation valves for easy removal and service of one pump and check valves to eliminate back flow. An additional dual pump option is automatic or manual pump switchover. The pumps are controlled manually by a hand switch (HS-120). With manual switchover, a second hand switch (HS-121) selects which pump to operate. With automatic switchover, the flow switch (FS-126) senses low flow, shuts off online pump, and starts the offline pump. In the case of no flow after pump switchover, the CWIS will shut down.

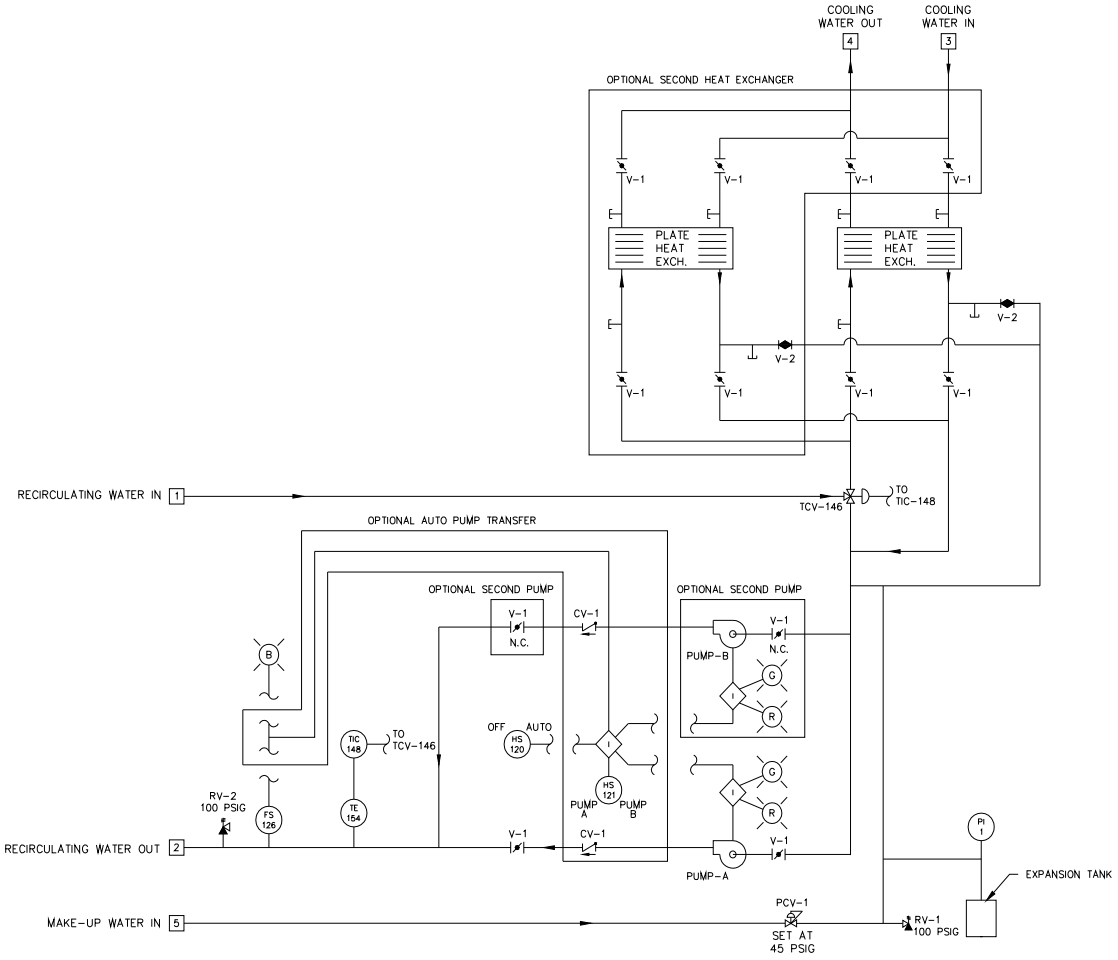


Figure 3 The process and instrumentation diagram for a dual pump dual heat exchanger cooling water isolation skid with close temperature control.

3.0 Installation

⚠WARNING

To ensure the protection provided by this equipment is not impaired, this equipment must not be installed or used in any manner other than that which is specified in this manual.

Receiving, Flushing and Mounting

a. Examine the crate for any shipping damage. If in doubt, take photographs of the suspect area(s). Remove the CWIS and examine for any visible damage. Report damages to the freight handler immediately. This is the consignee's responsibility.
b. Bolt the unit to the floor using ½" bolts, leave enough space around the unit for maintenance access.
c. Refer to general arrangement drawing for piping connection locations and sizes.

Piping

Connect recirculating and cooling water piping between the process application and CWIS with minimum pipe sizes in table 2. Provide a vent fitting at the high point of the recirculating water piping. It is important to minimize the pressure drop in the external loop (max. 20 psid) as much as possible. Connect a clean water source to the makeup water connection.

	35 GPM	80 GPM	140 GPM
Recirculating water	1½"	2"	2½"
Cooling water	1½"	2"	3"
Make-up water	½"	½"	½"

Table 2

Filling

a. Complete the piping. Vents, make-up water isolation valve, and any valves in the recirculating water piping must be opened. The CWIS skid includes a provision for make-up water to the recirculating water closed-loop. A pressure reducing valve (PCV-1) is installed which is designed for filling the recirculating water closed-loop to a properly controlled pressure after CWIS installation or for system servicing. The pressure reducing valve is factory set at 45 PSIG (3.16 kg/cm^2); however, is easily adjusted if the make-up water supply pressure is less than the factory setting. Refer to the ***Pressure Reducing Valve Pressure Setting*** section that follows for adjustment. The pressure reducing valve is also equipped with a built-in strainer and low inlet pressure check valve.
b. When water starts to come out of the cooler rack vent, close it. (This assumes the cooler rack vent is higher than the CWIS vent).

Pressure Reducing Valve Pressure Setting

The pressure setting of the pressure reducing valve **must be** adjusted when the make-up water supply pressure is less than 45 PSIG (3.16 kg/cm^2). The valve is adjustable from 25 to 60 PSIG (1.76 to 4.22 kg/cm^2). The pressure setting can be changed by conducting the following steps:

1. Turn the CWIS selector switch to the "OFF" position, which will de-energize the chilled water circulating pump (MOT-107).

2. Vent any high points in the chilled water closed-loop.

3. Ensure that the make-up water isolation valve (customer supplied) is open.

4. The pressure setting can be raised or lowered by loosening the jam nut on top of the pressure reducing valve and turning the slotted adjusting screw counterclockwise to lower the set pressure (clockwise to increase the set pressure). Turn the slotted adjusting screw counterclockwise until make-up water is passing through the valve.

5. Verify that make-up water is filling the system. The pressure reducing valve is passing make-up water if the copper tubing downstream is cold to the touch. Fill the chilled water closed-loop until water appears at the vents.

6. Close any high points in the chilled water closed-loop.

7. The pressure reducing valve set pressure can be observed on the pump discharge pressure gauge. Turn the slotted adjusting screw slowly to the desired pressure set point.

   NOTE: Do not adjust pressure to less than 10 PSIG.

8. A screwdriver should be used to hold the adjusting screw stationary while the jam nut is tightened.

9. Once the chilled water closed-loop has been filled, properly vented, and the make-up water supply pressure has been set, close the make-up water isolation valve (customer supplied).

⚠CAUTION

Corrosion and eventual failure of system components can result from the constant addition of fresh make-up water. After the recirculating water closed-loop has been filled, the make-up water isolation valve (customer supplied) must be closed. This will prevent system leaks from being undetected by the constant replacement of lost water in the closed-loop. Failure to follow these instructions could result in property damage and/or moderate personal injury.

10. The CWIS is now ready for service.

Pressure Reducing Valve Service Instructions

If the pressure reducing valve fails to fill to the set cold fill pressure, the built-in strainer may be clogged. The strainer can be serviced by conducting the following steps:

1. Ensure that the make-up water isolation valve (customer supplied) is closed.

2. Remove the pipe plug installed in the pipe tee upstream of the pressure reducing valve. Removal of the pipe plug will depressurize and drain the trapped volume of water between the make-up water isolation ball valve and the inlet portion of the pressure reducing valve. Remove the strainer nut located on the bottom of the pressure reducing valve. This valve is designed with low inlet pressure check valve which allows the operator to remove the strainer nut while the chilled water circulating pump (MOT-107) is operating.

3. Remove and clean or replace the strainer.

4. Reinstall the strainer nut with O-ring into the reducing valve and tighten to a torque of 10 in-lbs. Min. to 100 in-lbs. Max. Replace the strainer nut with O-ring if it is damaged.

Open the make-up water isolation valve (customer supplied). Ensure that all air is purged from the system

Wiring

NOTE

Make all wiring connections in accordance with the National Electrical Code and all local regulations. Use copper conductors only. Do not exceed the equipments electrical rating.

a. Check to be sure the available power supply voltage and frequency agrees within 10% of CWIS electrical rating.

CAUTION

Use Copper Conductors Only! Unit terminals are not designed to accept other types of conductors. Failure to use copper conductors may result in equipment damage.

b. Bring properly sized power leads from the customer supplied fused disconnect to the control box. Cut a cable hole at a convenient location in the control box. Route power leads to terminals L1, L2, L3 in the upper right corner. Dual element time delay fuse sizes recommended for different CWISs are in Table 3.

c. The recirculating water pump must rotate in the proper direction (counterclockwise). If the pump is rotating in the wrong direction (clockwise), a low flow alarm will occur because the flow switch was not activated. Ensure the system is properly filled, vented, and initially pressurized to around 45 psig.

d. Connect the ground wire to the lug in upper right corner of control panel.

CWIS Model Number	Fuse Size 480V/60 Hz	Fuse Size 380V/50 Hz	Pump Size
CWIS -35	6 Amp	8 Amp	1 HP
CWIS -80	8 Amp	10 Amp	3 HP
CWIS -140	10 Amp	15 Amp	5 HP

Table 3 Recommended Fuse Sizes

⚠WARNING

Potential Fire Hazard! Replace fuses only with the same fuse type and ratings.

4.0 Operation

⚠WARNING

Live Electrical Components! It may be necessary to work with live electrical components when installing, testing, servicing, and troubleshooting this product. Have a qualified licensed electrician or other properly trained individual perform these tasks. Failure to follow all electrical safety precautions when exposed to live electrical components can result in death or serious injury.

Controls and Indicators

a. The selector switches and light on the control panel are:

Selector Switch:	OFF / AUTO or OFF / ON Pump A / Pump B
Lights:	Pump A ON (Red) Pump A OFF (Green) Pump B ON (Red) Pump B OFF (Green) Power ON (White) Alarm (Blue)

b. Instruments on the CWIS are:

Digital LED display/temp controller:	Recirculating water temperature (close control)
Analog Gauges:	System Pressure
	Temperature Gauge (standard control)

Start-up

a. Open all shutoff valves in the cooling water circuit and in the recirculating water circuit.

b. Start the pump. Ensure there is not a flow alarm and check for leaks in the piping. Vent air from the high points in the system, such as the heat exchanger return port.

⚠WARNING

Drawing-in Hazard! The centrifugal pump has a rotating shaft that may create a drawing-in hazard of loose articles of clothing or maintenance equipment. The expanded metal cage and cover shall remain in place during operation of the equipment. Failure to keep the expanded metal cage and cover in place during operation of the equipment can result in death or serious injury.

c. **Close temperature control only**. The temperature controller is mounted on the enclosure door. Control parameters are set at the factory. The temperature is factory set at 76.6°F (24.4°C). If the temperature setpoint needs to be adjusted, press the up or down arrow keys to change the setpoint. The temperature setpoint cannot be lower than the temperature of the cooling water.

Features

a. A CWIS with close temperature control utilizes a solid state controller to modulate recirculating water flow through or around the heat exchanger. The controller monitors the recirculating water outlet with thermal sensors. A PID control signal modulates the position of the mixing valve (TCV-146), and regulates the recirculating water flow through the heat exchanger.

b. Flow switch (FS-1) is located in the recirculating water outlet piping. If recirculating water flow is lost, the flow switch closes turning on a time delay relay. After approximately six seconds, the time delay relay energizes, turning the pump off. After the time delay relay has energized, a local alarm light and customer alarm is activated. The unit then requires a manual restart.

c. The heat exchangers and pump have isolation valves for easy maintenance and cleaning. A dual pump system can be purchased with either manual or automatic switchover. The automatic switchover option provides automatic pump switching with the loss of flow.

5.0 Maintenance

⚠WARNING

Live Electrical Components! It may be necessary to work with live electrical components when installing, testing, servicing, and troubleshooting this product. Have a qualified licensed electrician or other properly trained individual perform these tasks. Failure to follow all electrical safety precautions when exposed to live electrical components can result in death or serious injury.

⚠WARNING

Hazardous Voltage! Disconnect all electric power, including remote disconnects before servicing. Follow proper lockout/tagout procedures to ensure power cannot be inadvertently energized. Failure to disconnect power before servicing can result in death or serious injury.

The plate heat exchanger needs to be cleaned periodically. Periodic cleaning of the heat exchanger in place by back flushing can prevent serious fouling. If the heat exchanger cannot maintain temperature or the pressure drop becomes too high after back flushing, it may be necessary to dismantle the heat exchanger for cleaning. The document "Alfa Laval Plate Exchanger Operational and Maintenance Manual" included at the end of this manual describes cleaning in place and dismantling the heat exchanger.

Troubleshooting Checklist

Condition	Cause	Correction
1. Cannot maintain temperature	a. Fouled heat exchanger	Follow the cleaning instructions in the manual
	b. Excessive cooling water temperature	Verify the temperature of the cooling water is 5°F below set point.
	c. Low cooling water flow	Check the pressure drop in the cooling water circuit. Clean the heat exchanger.
2. Excessive pump pressure (~70 psig)	a. Restricted water flow	Check for partially closed valves Be sure all lines are properly sized.
	b. PCV-1 setpoint too high	Adjust setpoint of PCV-1 to a maximum of 45 psig.

System Component Data

Component	Description	Set-Point	Comments
P-A/B	Pump		TEFC motor. Flow rate based on an external 20 psig drop.
FS-126	Flow switch	approx 10 GPM	Low flow cutout. Factory set
TIC-148	Solid-State temperature controller	Variable	Available with close temperature control. Set controller 1^{o}F less than desired sample temperature.
TE-154	Temperature sensor		Monitors recirculating water out. Provides temperature input to controller.
HS-120	Hand switch		OFF/AUTO
PI-1	Pressure gauge		Displays inlet system pressure.
TCV-146	Temperature controlled valve	Variable	Bypasses flow around the heat exchanger. Amount of mixing is controlled by analog signal from controller.
PCV-1	Pressure control valve	45 psig	
RV-1/RV-2	Relief valve	100 psig/100 psig	
TDR-126	Time delay relay	6 seconds	Eliminates false flow alarm preventing pump cycling.
TDR-128	Time delay relay	6.2 seconds	Used in a dual pump auto switchover configuration.
TDR-134	Time delay relay, Switchover	2 seconds	Used in a dual pump auto switchover configuration.
PHE	Plate heat exchanger		Provides a physical barrier between cooling water and process water.

6.0 Warranty

Seller warrants products manufactured by it and supplied hereunder to be free from defects in materials and workmanship for a period of eighteen months from date of shipment or twelve months from start up (which ever occurs first). If within such period any such products shall be proved to Seller's satisfaction to be defective, such products shall be repaired or replaced at Seller's option. Seller's obligation and Buyer's exclusive remedy hereunder shall be limited to such repair and replacement and shall be conditioned upon Seller's receiving written notice of any alleged defect within 10 days after its discovery and, at Seller's option, return of such product to Seller, ex-works Sentry's factory.

The foregoing warranties are exclusive and in lieu of all other express and implied warranties except in title, including but not limited to implied warranties of merchantability and fitness for purpose. Seller shall not be subject to any other obligations or liabilities whatsoever with respect to products manufactured or furnished by it, or any undertakings, acts or omissions relating thereto.

Warranty Conditions & Limitations
This Warranty shall not apply to any Sentry product which, in the opinion of Sentry Equipment Corp, has been (a) altered or repaired in a manner affecting the efficiency of performance of the unit or (b) incorrectly installed or operated or (c) damaged in shipment or (d) damaged by flood or fire or (e) if the serial number is missing, altered or defaced.

Any materials proposed to be used by Sentry Equipment Corp. ("Seller") are based on published reference literature and/or customer recommendations, and customer assumes sole responsibility for the selection of such materials. Any references are based on third-party studies, and may not correlate directly with the end user's intended usage or process (i.e. chemical composition, concentrations, temperatures, etc.).
EXCEPT FOR THE LIMITED WARRANTIES SET FORTH HEREIN, SELLER HEREBY DISCLAIMS ANY AND ALL WARRANTIES AND REPRESENTATIONS (EXPRESS OR IMPLIED, ORAL OR WRITTEN), INCLUDING ANY AND ALL IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR ANY PURPOSE WHETHER OR NOT SELLER KNOWS, OR HAS REASON TO KNOW, HAS BEEN ADVISED, OR IS OTHERWISE IN FACT AWARE OF ANY SUCH PURPOSE, WHETHER ALLEGED TO ARISE BY LAW, BY REASON OF CUSTOM OR USAGE IN THE TRADE, OR BY COURSE OF DEALING OR PERFORMANCE. Without limiting the generality of the foregoing, Seller makes no warranty regarding ability of products sold hereunder to withstand erosion or corrosion, or regarding material compatibility of elastomers in specific services, and no warranty made hereunder shall apply to products which have been subjected to adverse storage

The owner shall be responsible for maintenance of his equipment. Wear or damage caused by lack of normal maintenance or by misuse of the equipment shall not be considered as defective workmanship and material.

Sentry reserves the right to make product design changes or improvements without notice and without imposing any obligation upon itself to install these changes or improvements on its products previously manufactured.

This warranty is for the sole benefit of the original purchaser and is not transferable unless agreed to in writing by Sentry Equipment Corp.

Receiving Shipments (including loss or damage by transportation)
It is the customer's responsibility to check for missing cartons and sign of damage to cartons. If found, customer should note missing and/or damaged cartons on the delivery receipt and have delivery receipt signed by the representative of the transportation company. If unpacking discloses concealed damage from rough handling, the customer should request a concealed damage inspection from the transportation company.

The Sentry Customer Service Department will aid your organization in any claim proceeding for shortages or damages in shipment, but it is the receiver's responsibility to file claim with the carrier for damage or loss.

Customer Actions For Claims on Products During the Warranty Period

1. Contact the Customer Service Department, Sentry Equipment Corp., Oconomowoc, WI, Telephone: 262-567-7256, to obtain a Return Material Authorization (RMA) number.
2. You will be sent an "RMA" and a "Decontamination Statement" that is required to be filled out and **returned with the equipment**.
3. The following information must appear on the outside of the package:
   a. RMA number marked on outside of box.
   b. Decontamination Statement filled out and attached to outside of box.
4. Return defective equipment **FREIGHT PREPAID.** Collect shipments will be refused.
5. The factory will not process warranty claims until the customer has properly accomplished the above items.
6. The Sentry factory may accept the entire claim, a part of the claim or none of the claim if our inspection of returned parts proves the failure was for reasons other than defective material or factory workmanship.

Important Notes:
1. Sentry will not be responsible for damage incurred during the return shipment.
2. All returns subject to inspection and a minimum $100.00 evaluation fee.
3. This RMA is not authorization for credit. Credits and/or replacements will be issued upon evaluation of returned goods.
4. RMA is valid for thirty (30) days from issue date.

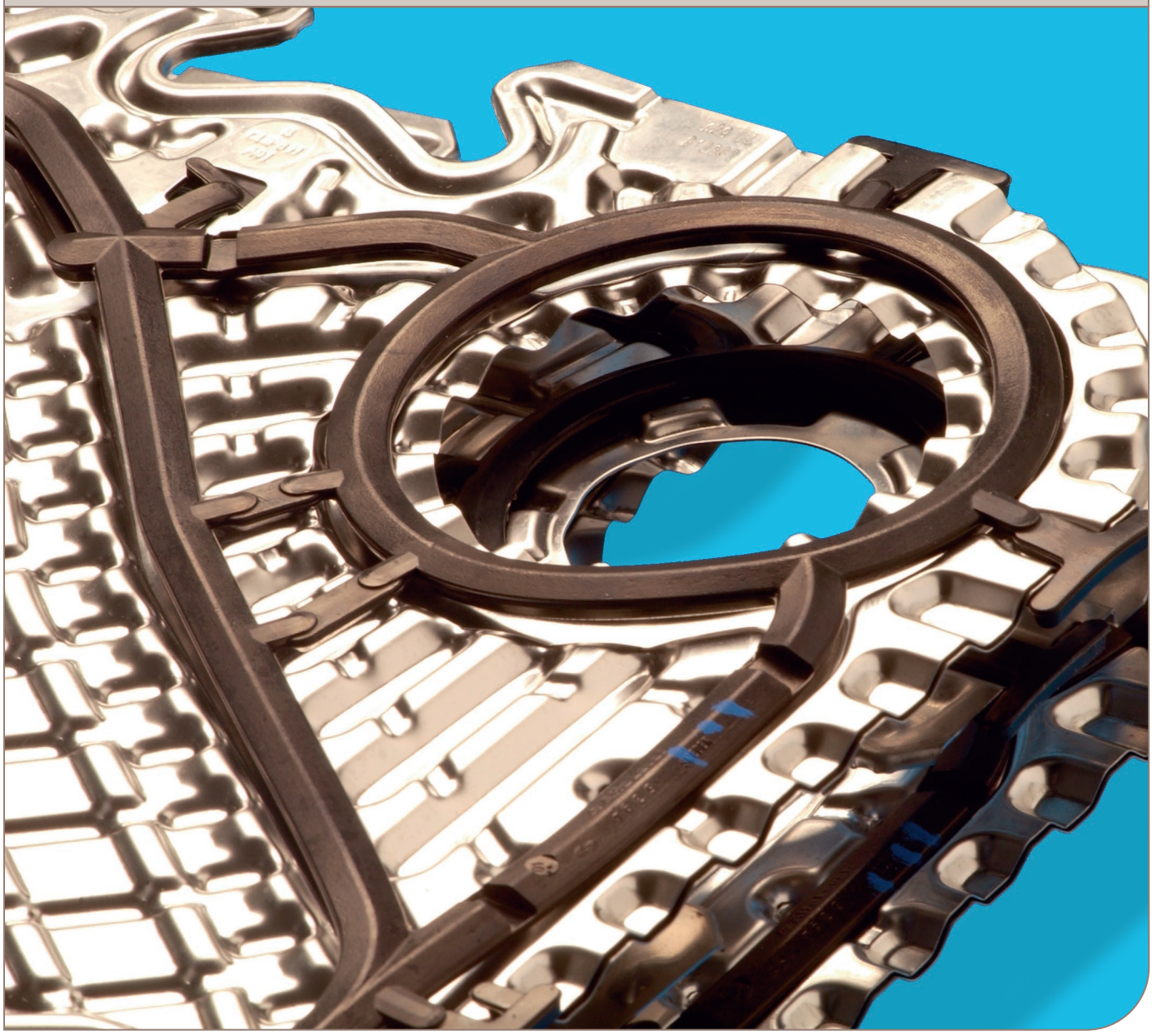
7.0 Procedures

"Alfa Laval Plate Exchanger Operational and Maintenance Manual"

Configuration of a Watlow EZ-Zone PM Controller for use in Sentry Cooling Water Skids (CWIS/CWMS) (Document No. 16-05072A).

Plate Heat Exchanger

Operational and Maintenance Manual



NOTICE

TO AVOID HAND INJURIES, PROTECTIVE GLOVES SHOULD ALWAYS BE WORN WHEN HANDLING PLATES.

PROTECTIVE SHROUDS

IT IS THE RESPONSIBILITY OF EACH PERSON OPERATING OR REPAIRING EQUIPMENT TO TAKE THE NECESSARY PRECAUTIONS TO COMPLY WITH ALL APPLICABLE SAFETY REGULATIONS.

ALFA LAVAL PROVIDES PROTECTIVE SHROUDS FOR ALL OUR PLATE HEAT EXCHANGERS. THESE SHROUDS WILL PREVENT POSSIBLE INJURIES AND/OR DAMAGE AS A RESULT OF SUDDEN LEAKAGE FROM THE PLATE PACKAGE.

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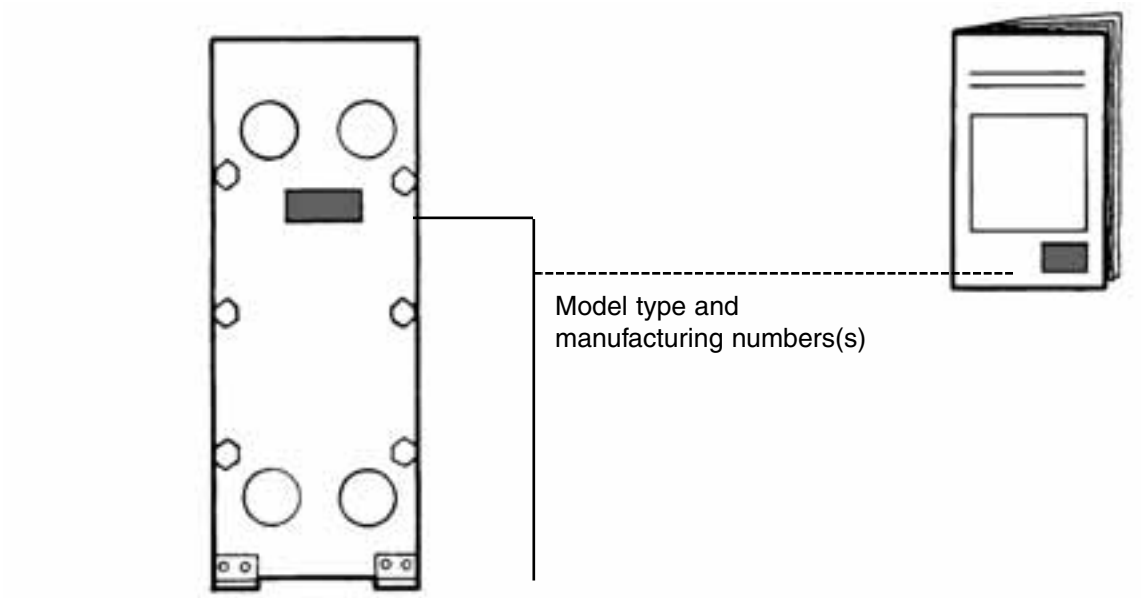
List of contents

To our valued customer:

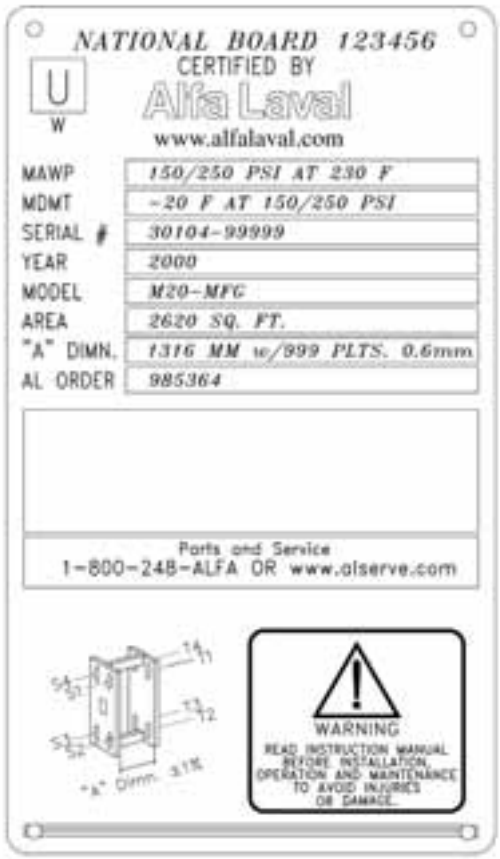
Thank you for purchasing an Alfa Laval Plate Heat Exchanger. As the world's largest manufacturer of Heat Exchangers, we are very proud of our products and services. We value you as our customer and wish to assure your satisfaction. We have prepared this Instruction Manual to assist you with your Alfa Laval Plate Heat Exchanger in various situations. We suggest that you look through it carefully, and, above all, make it readily available to any personnel who may need it for reference.

2

The name plate - and the identification of the equipment



A name plate like the one shown below is fixed to the apparatus as shown above and it gives the following information



The name plate
- and the identification of the equipment

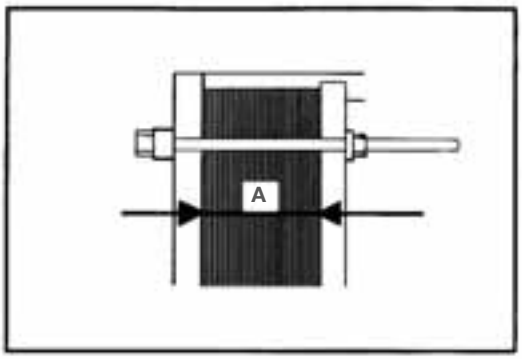
This instruction manual has been issued for many different models of Alfa Laval *industrial* PHEs. There are separate manuals for *industrial, sanitary*, *spiral*, *alfa rex, brazed & evaporator/condensor* heat exchangers.

- WHENEVER USING THE MANUAL, CHECK FIRST THAT THE SERIAL NUMBER ON THE FRONT COVER IS IDENTICAL TO THAT ON THE NAME PLATE OF THE EQUIPMENT.
- IN ALL CORRESPONDENCE WITH ALFA LAVAL, PLEASE REFER TO THE MANUFACTURING SERIAL NUMBER, FOR TRUE IDENTIFICATION OF THE EQUIPMENT.
- WHENEVER CONTACTING ALFA LAVAL ABOUT A PART FOR YOUR PLATE HEAT EXCHANGER, BE SURE TO STATE THE MANUFACTURING SERIAL NO.(S), AND MODEL TYPE.

3 General

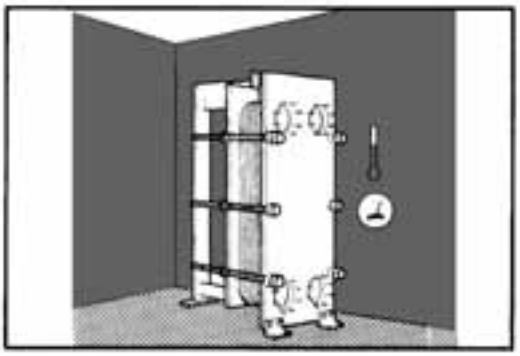
STORAGE

In this section, names of heat exchanger parts are mentioned for the first time. For your information, see Chapters 4A or 4B FUNCTION.



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 equipment for a longer period (1 month or more) before, certain precautions should be made in order to prevent unnecessary wear of the equipment:

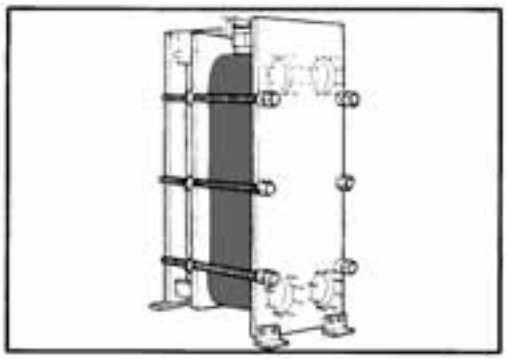


2. Preferably, the heat exchanger should be stored inside, in a room with a temperature around 15 to 20 degrees Celsius (60 to 70 degrees Fahrenheit) and humidity around 70%

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).

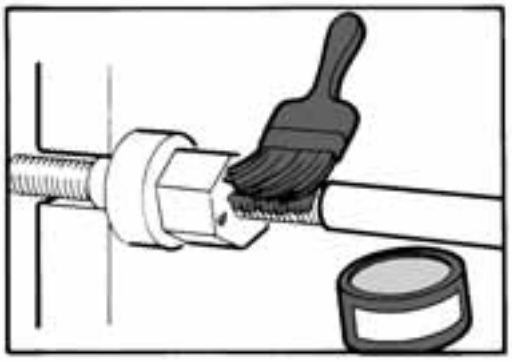
Do not store organic solvents or acids in the room.

Avoid heat or ultraviolet radiation.



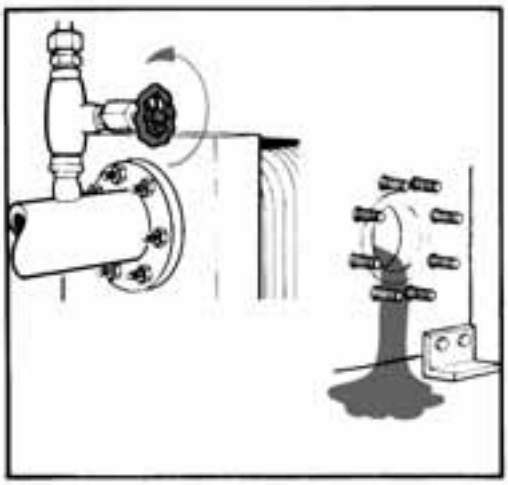
3. Wrapping the PHE with a non-transparent plastic film is a good precaution. Use of transparent film can alter paint color if unit is stored in direct sunlight.

STORAGE



4. The tightening bolts should be well covered with good rust preventing coating, suitable types (LUBRIPLATE FGL-2 or Equivalent) and if not connected to the pipe system, the connections should be covered.

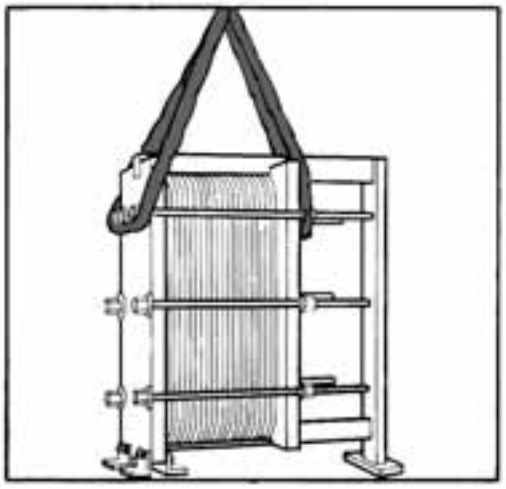
   If the heat exchanger must be stored outdoors, the precautions mentioned above should be taken as far as practical. The need for protection against the climate etc. is of course even more important in this case.



5. If for any reason the heat exchanger is removed from service for a long period, it is advantageous to follow the advice above, even if the equipment is not moved from the location.

   The heat exchanger should be VENTED AND DRAINED, and depending on the media processed, it is recommended to RINSE AND DRY it, before it is stored.

LIFTING



1. Whenever the heat exchanger is lifted, straps should be placed around tightening bolts on both sides of the unit, as shown in picture. If lifting lugs or lifting eyes are provided, always use chains or lifting cables rated above the published weight of the heat exchanger.

NEVER LIFT BY THE CONNECTIONS OR THE STUDS AROUND THEM!

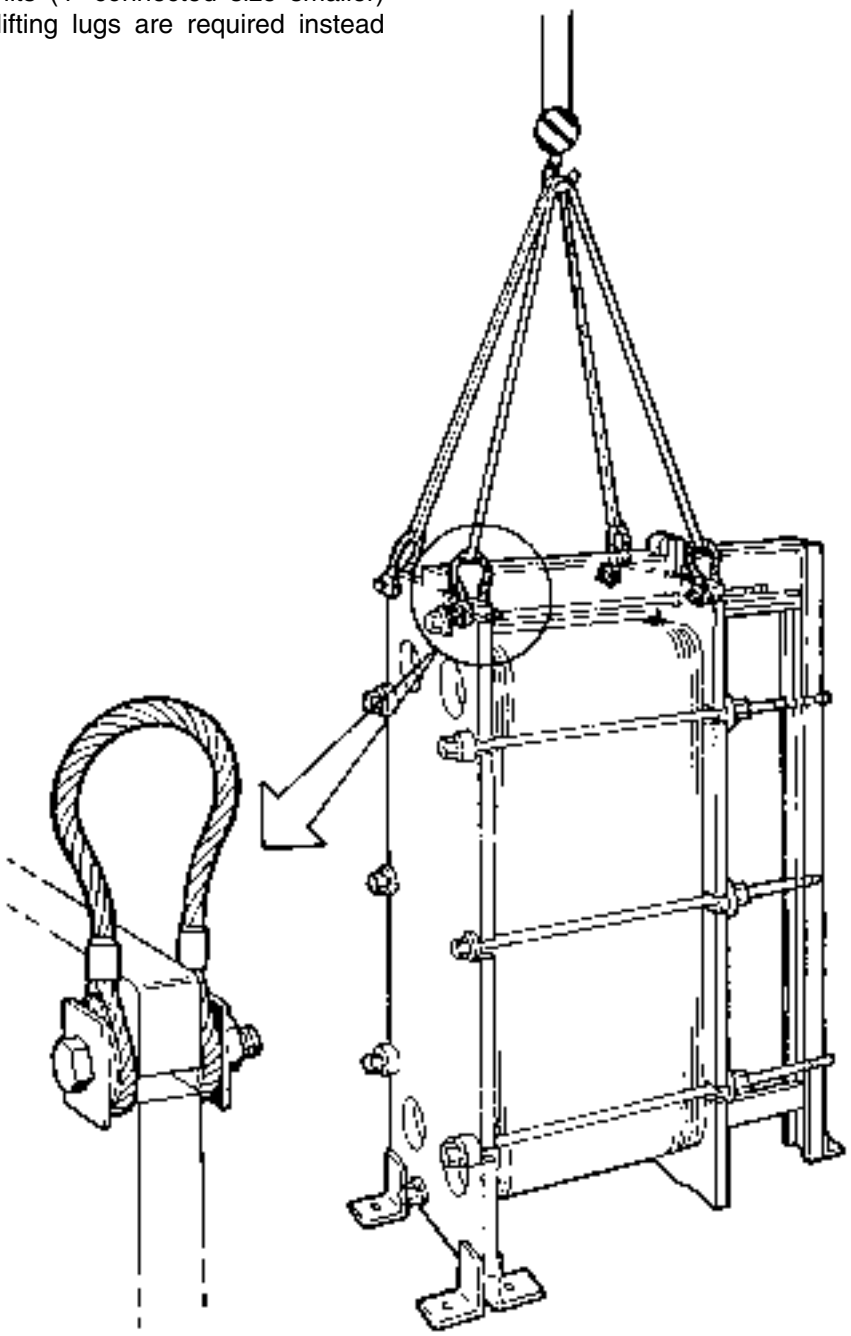
LIFTING CONTINUED

If Lifting Lugs are provided

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

On smaller units (4” connected size smaller) typically two lifting lugs are required instead of four.

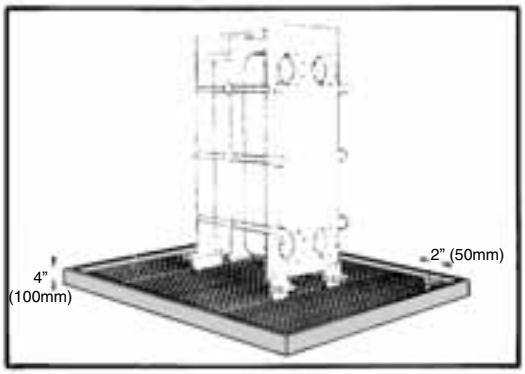
WARNING!
Never lift by the connections or the studs around them.



General

FOUNDATIONS.

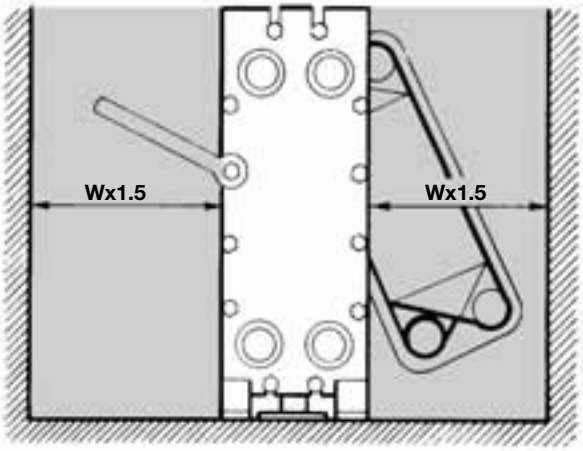
All information necessary for the preparation of the foundation appears on the data sheet provided by ALFA LAVAL.



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

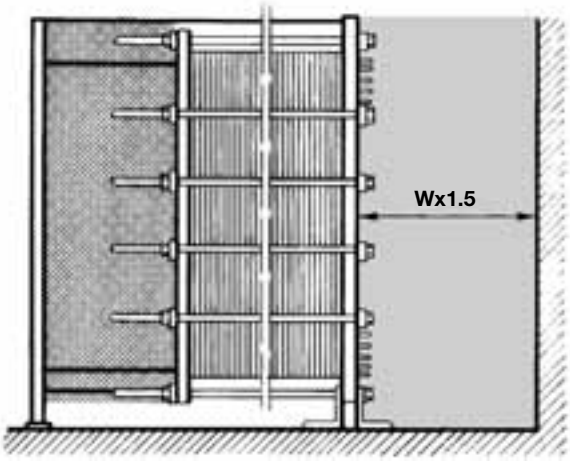
INSTALLATION.

BEFORE connecting any piping to the heat exchanger, MAKE SURE THAT ALL FOREIGN OBJECTS HAVE BEEN FLUSHED OUT OF THE SYSTEM!



PLEASE OBSERVE THAT

The measurements given in the picture above are recommended by ALFA LAVAL, it is necessary to leave free space around the equipment, to provide 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 PHE.



PLEASE OBSERVE THAT

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, the dimensions suggested can be reduced. It is left to the purchaser to decide just how much access space is required.

This field should be kept free from fixed installations.

Recommended free space for opening and closing.

General

PIPES

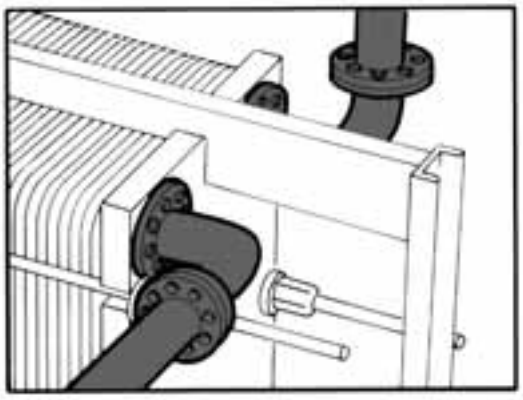
Always ensure that no measurable stress is placed on the heat exchanger by the piping system.

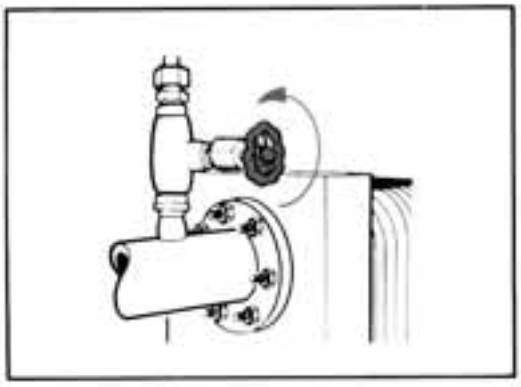
SHUT OFF VALVES

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

PRESSURE RELIEF DEVICES

It is the responsibility of the user to ensure that the required pressure relief devices are properly installed prior to initial operation. Refer to the applicable Code(s) and corresponding Standard(s) for proper size requirements of these pressure relief devices.





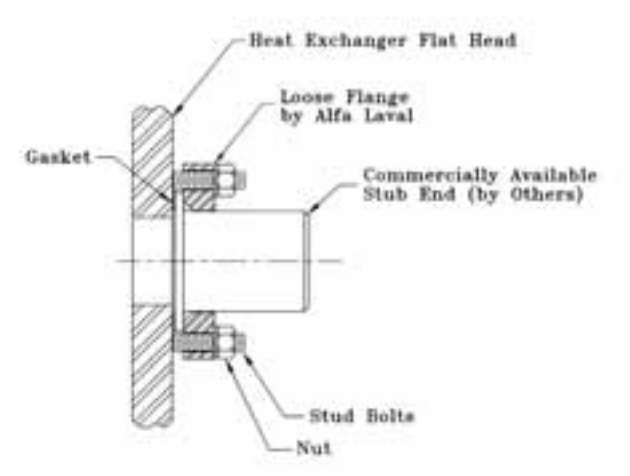
CONNECTIONS ON THE PRESSURE PLATE (REAR COVER)

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

Whenever piping is connected to the pressure plate, a short 90° spool piece shall be installed between the heat exchanger and the piping. These should be directed upwards or sideways. This simplifies pressure plate removal during servicing.

Venting of both sides of the heat exchanger must be provided. This is important and enables air to be drawn from the system during start-up. It also enables air or gas to be removed during operation, and it enables faster drainage.

Special Loose Flange Connections



Loose Flanges are provided on certain model types due to interference. When provided these flanges shall be incorporated into the piping.

MODELS WITH BOTH "S" AND "T" PORT CONNECTIONS

M6-FD, M6-MFD, M6-MWFD, M10-BFD, M10-MFD, M10-BWFD, M10-BDFD, M20-MFD*, M20-MWFD*

MODEL TYPES WITH LOOSE FLANGE ON T PORT CONNECTIONS ONLY:

M6-FG, M6-MFG, M6-MWFG, M10-BFG, M10-MFG, M10-BWFG, M10-BDFG, V28-FD*, V45-FD*, M20-MFG, M20-MWFG

* Loose flange only when design pressures above 230 psi.

Notes:
1) Sports connections on these model types utilized industry standard flanges.
2) Not all exchangers require T port connections.

PIPING CONNECTION

The loose flange is connected to piping by use of a commercially available stub end of same material as the piping.

The stub end is installed as shown and then butt weld to the piping.

4A LIST OF PARALLEL FLOW UNITS

"A" SERIES UNITS:

AM10-FG; AM10-FS

A15-BFL; A15-BFG; A15-BFD; A15-BWFG; A15-BWFD

A20-BFL; A20-BFG; A20-BFD

AM20-FG; AM20-BFG; AM20-WFG; AM20-SFG; AM20-DWFG

AK20-FG; AK20-FD; T200-FG; T200-FD

AX30-BFG; AX30-BFD; AX30-BWFG; AX30-BWFD

A35-HA

"M" SERIES UNITS:

M3-VG

M6-FG; M6-FD; M6-MFG; M6-MFD; M6-MWFD/FG/FDR/FGR

M10-BFM; M10-BFG; M10-BFD; M10-MFG; M10-MFD;

M10-BWFG; M10-BWFD; M10-BWFGR, M10-BWFDR

M15-BFG; M15-BFD; M15-BFS; M15-MFG;

M15-MFD; M15-MFS; MK15-BWFD; MK15-BWFG

M20-MFG; M20-MFM; M20-MFD; M20-MWFG; M20-MWFD

M30-FM; M30-FG; M30-FD

MA30-FD; MA30-FG; MA30-WFG; MA30-WFD

MX25-BFG; MX25-BFD; MX25-BFS

EC500-WTFE; EC500-WTFL

"V" SERIES UNITS:

V8-VG, V13-FG, V13-FD, V20-FG, V20-FD

Function

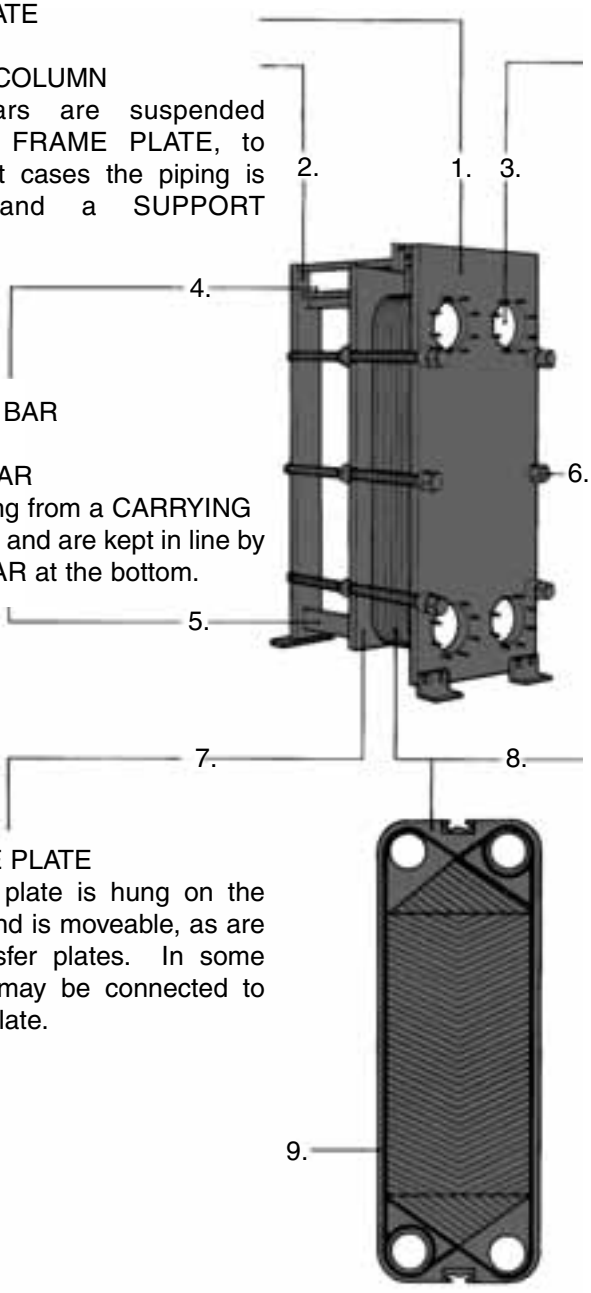
THE MAIN COMPONENTS OF THE PLATE HEAT EXCHANGER AND THEIR FUNCTIONS.

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

1. FRAME PLATE

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

3. 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 equipment. Depending on the application, metallic or rubber-type LININGS may protect the edges of the holes against corrosion.



4. CARRYING BAR

5. GUIDING BAR
The plates hang from a CARRYING BAR at the top and are kept in line by a GUIDING BAR at the bottom.

6. 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, bringing them into metallic contact, and to compress the gaskets, enough to seal off the narrow passages which have now been formed between the plates.

7. PRESSURE PLATE
The pressure plate is hung on the carrying bar and is moveable, as are the heat transfer plates. In some cases piping may be connected to the pressure plate.

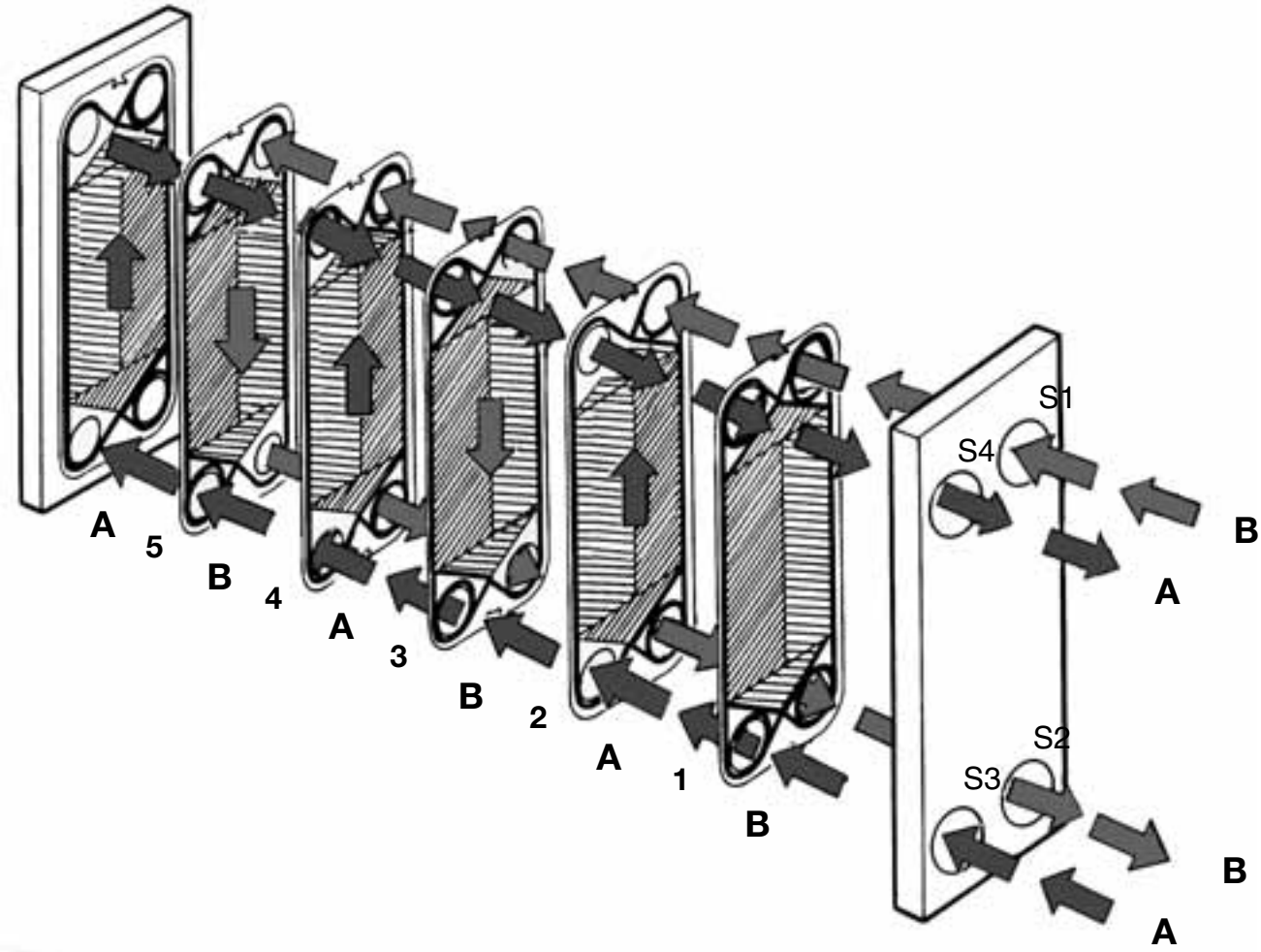
8. CHANNEL PLATES

9. 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 your heat exchanger is determined by the size of the heat transfer surface required.

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 pack, where they are distributed in 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 even number passages, and cold liquid between odd 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 equipment, 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 equipment is to transfer heat from one medium to another. Heat passes very easily through the thin wall separating the two media.

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; however, 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 in the chapter on 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 PHE 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 equipment.

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

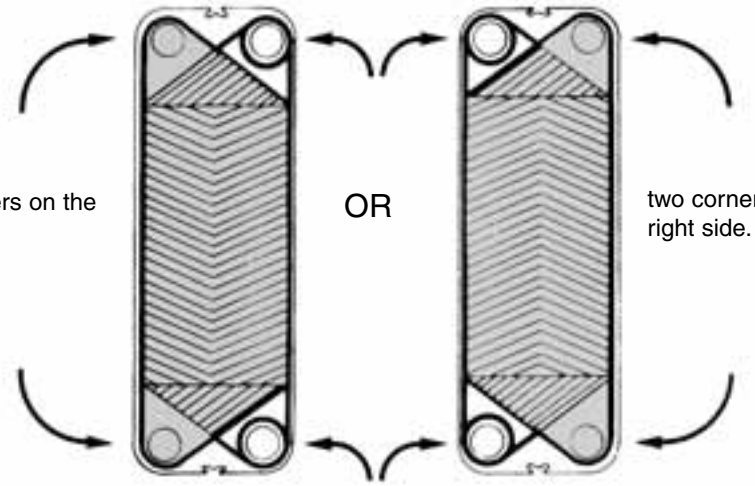
Larger particles and fibers may also be drawn into the heat exchanger and clog the passage ways if strainers or other means of protection have not been provided for.

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, see MAINTENANCE and CLEANING.

PARALLEL FLOW UNITS

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 two corners on the left side.

OR

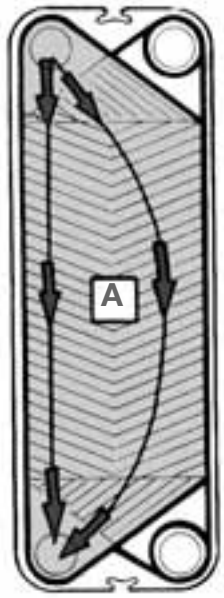
two corners on the right side.

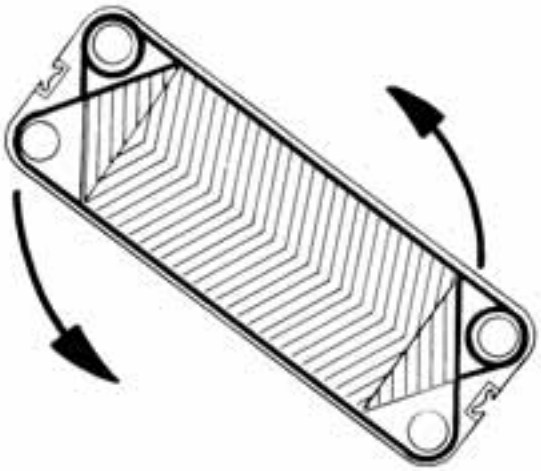
Smaller rings surround the two remaining corners.

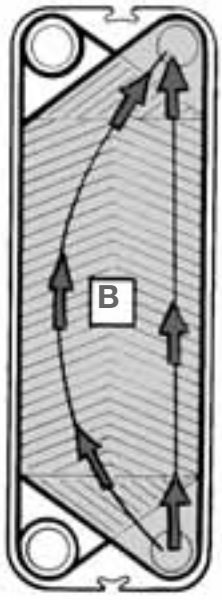
We decide that we will name the plates after these two situations.

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

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



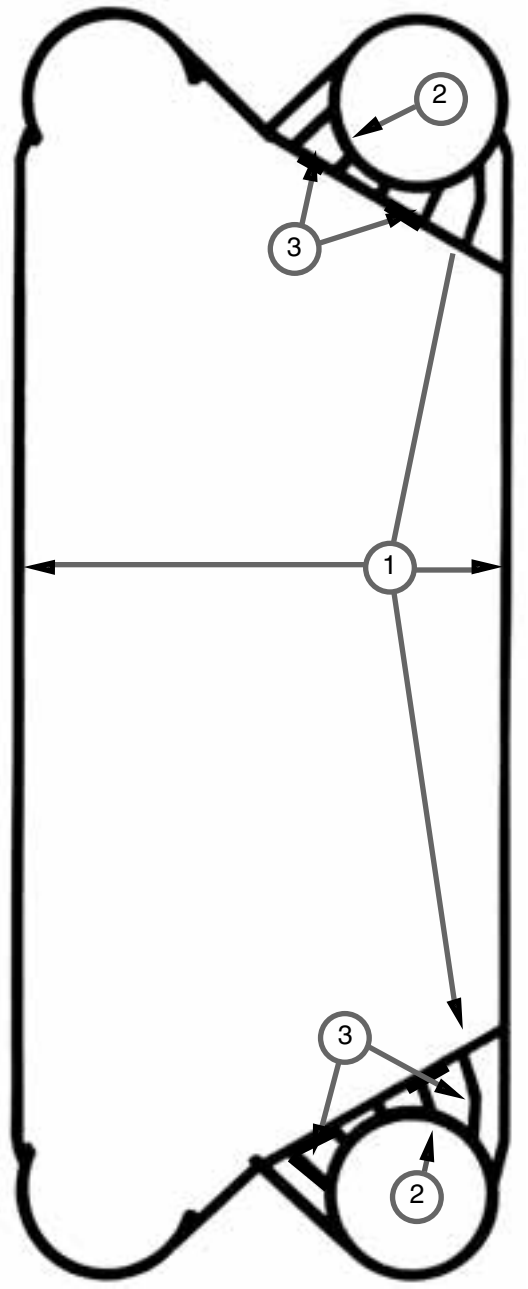




If we turn an A-plate upside down we will have a B-plate:

Gaskets

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



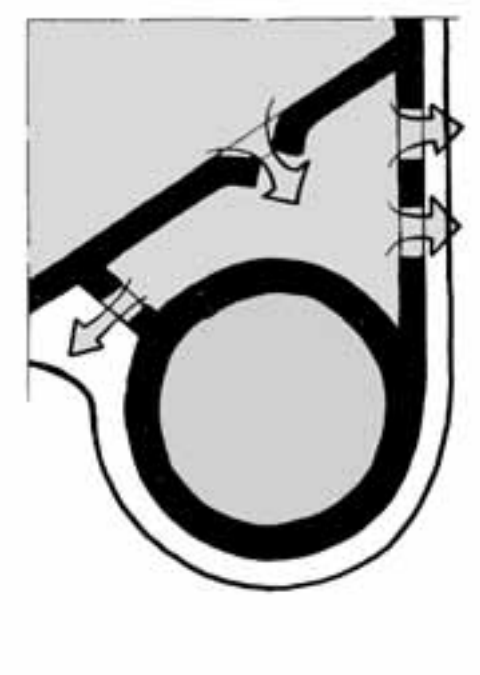
The one-piece gasket consists of:
1. One field gasket
2. Two ring gaskets
3. Links

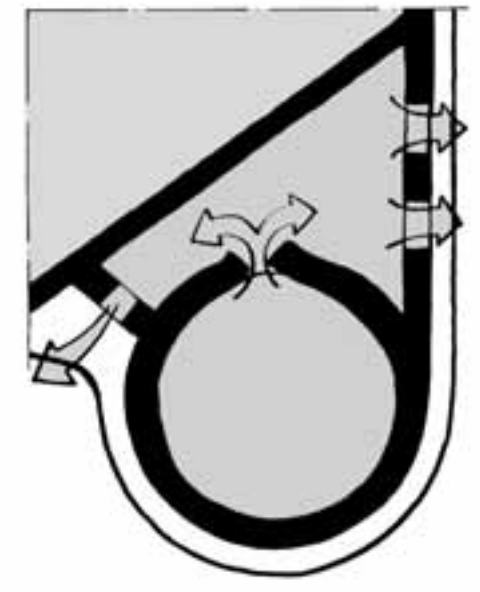
The field gasket is by far the larger part containing the whole heat transfer area and the two corners connected to it. The ring gaskets seal off the remaining two corners.

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. On some plate heat exchangers, the gasket is held in place on the plate by means of a suitable cement or glue.

PARALLEL FLOW UNITS

Gaskets



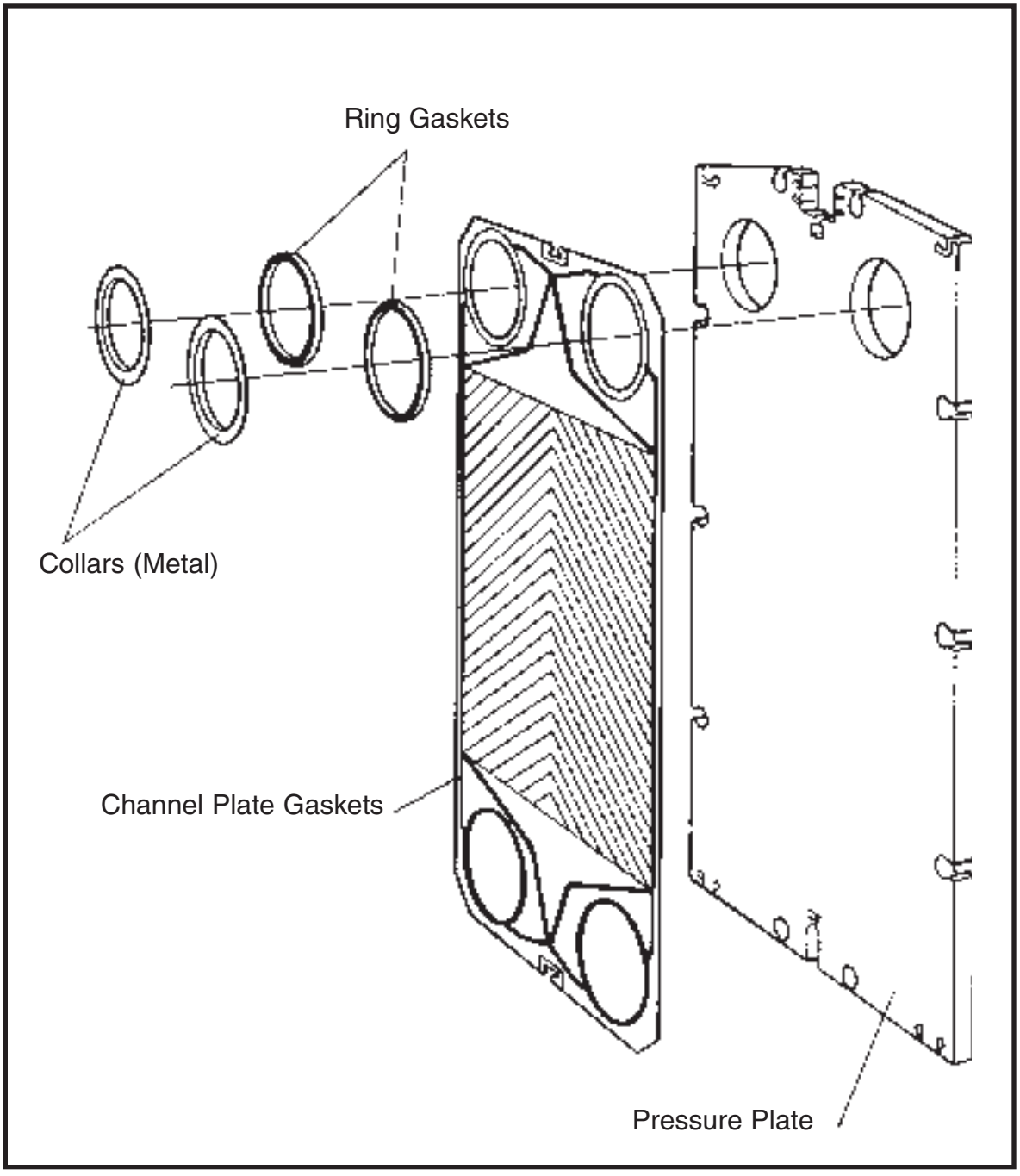


As already demonstrated, the two media are effectively kept apart by the ring and field gaskets. To prevent intermixing of the media in the corner areas where field and ring gaskets are very close to each other, the link pieces have a number of slots which opens the area between the field and ring gaskets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

It is important that these openings are kept clear. If they are not, there is a risk that should a leak occur in that region of the plate, there might be a local pressure build-up, which could allow one medium to mix with the other.

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

TRANSITION PLATE
M30, MX25, A20-B, AM20, AK20, T200, A15-B, M15, M10, M6



4B List of Diagonal Flow Units

“A” SERIES UNITS:
A10-BFG; A10-BFD
AX35-FG
A45-FG

“P” SERIES UNITS:
P2-FG; P2-VLCH; P2-DWFG
P3-E;P3-EH

“M” SERIES UNITS:
M3-XVG

“V” SERIES UNITS:
V28-FG, V28-FD, V45-FG, V45-FD, V110-FG, V110-FD, V170-FG, V170-FD, V280-FG, V280-FD

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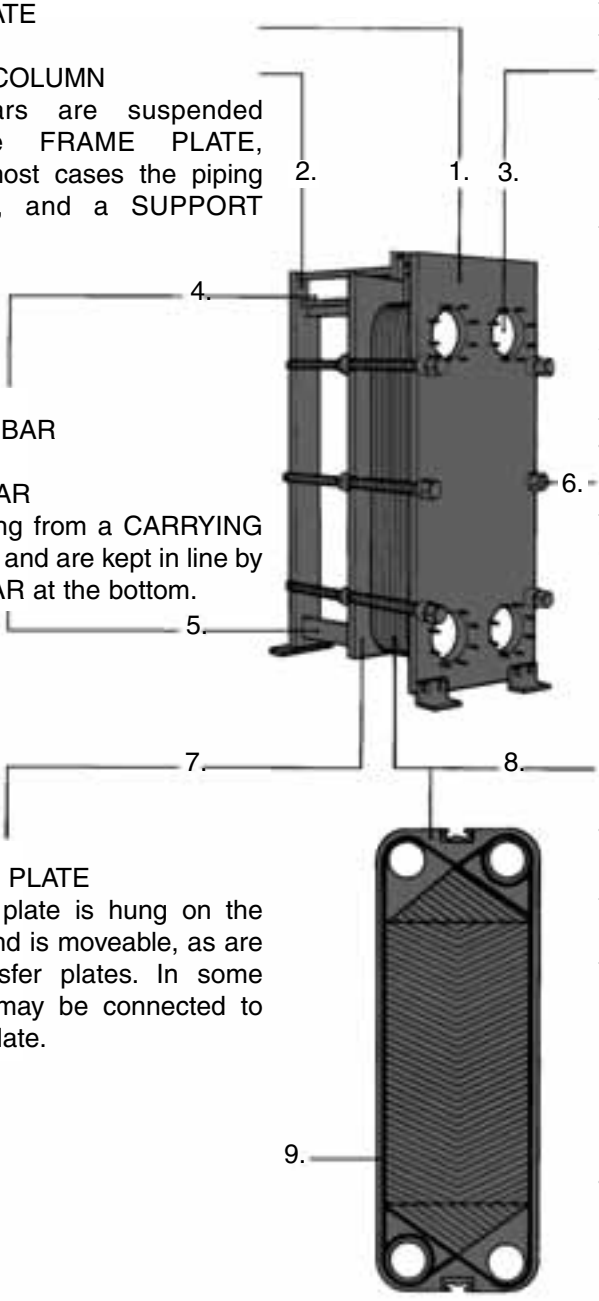

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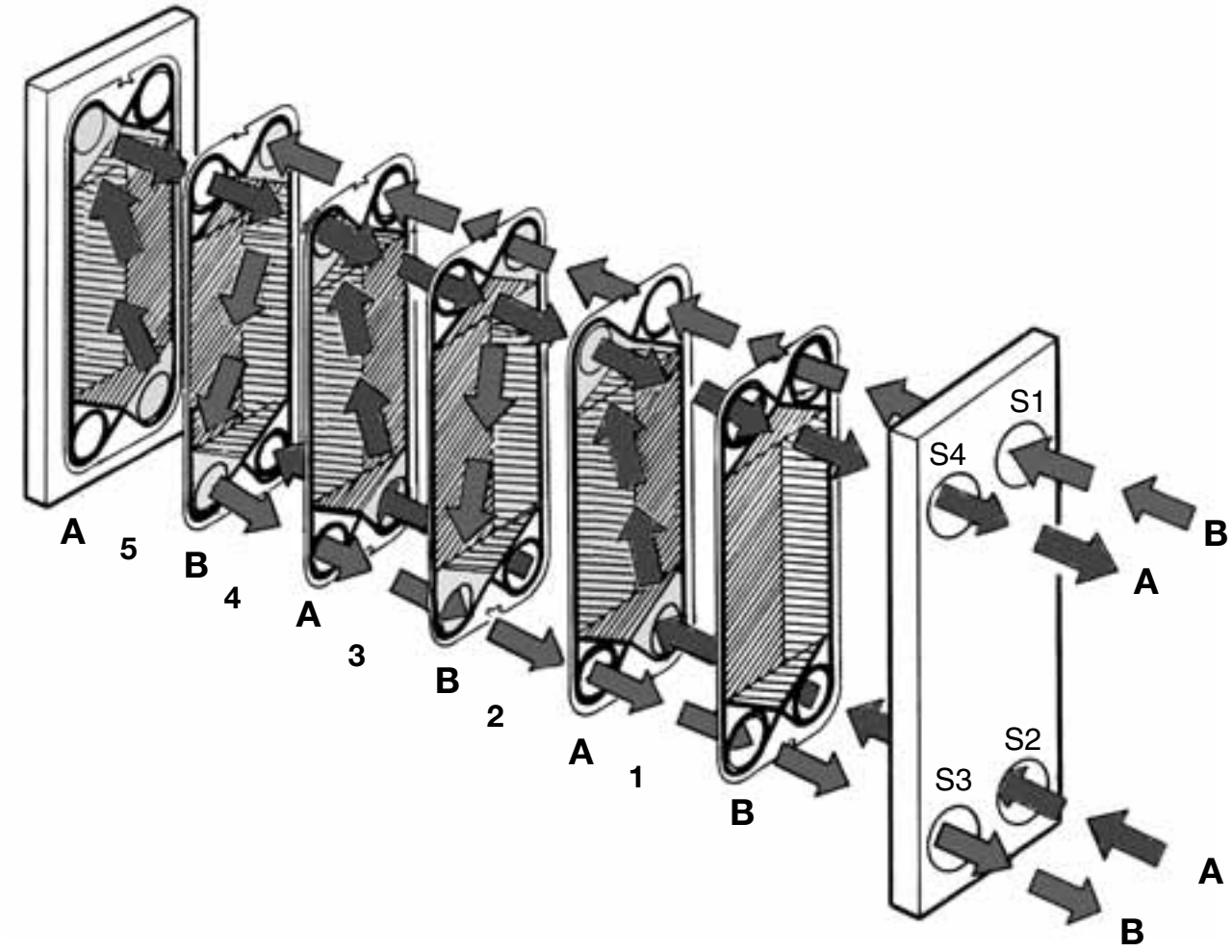
4B DIAGONAL FLOW UNITS

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 pack, where they are distributed in 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 even number passages, and cold liquid between odd number passages.

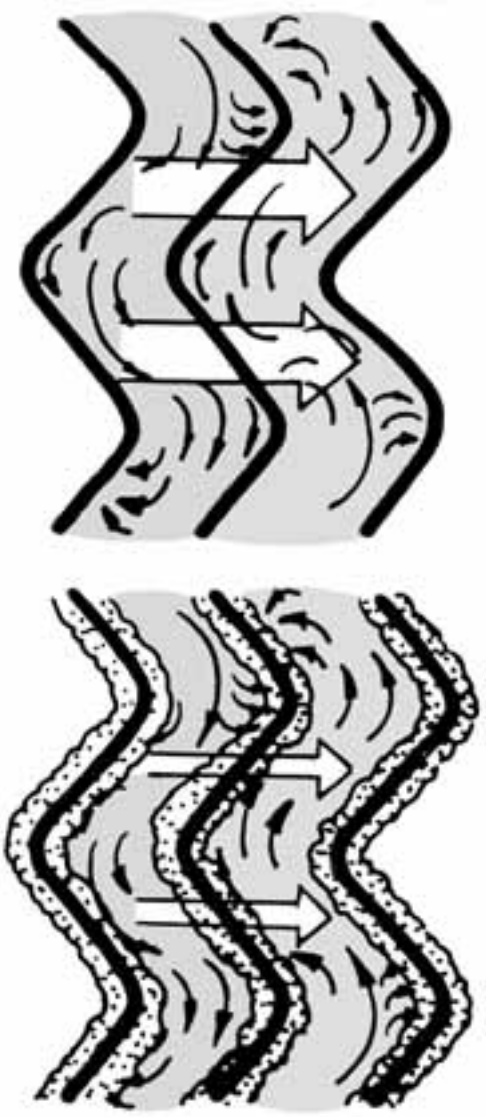
Thus the media are separated by a thin metal wall. In most cases the liquids flow in opposite directions.

During the passage through the PHE, 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 equipment is to transfer heat from one medium to another, and heat passes very easily through the thin wall separating the two media.

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; however, 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 in the chapter on 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 PHE 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 equipment.

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

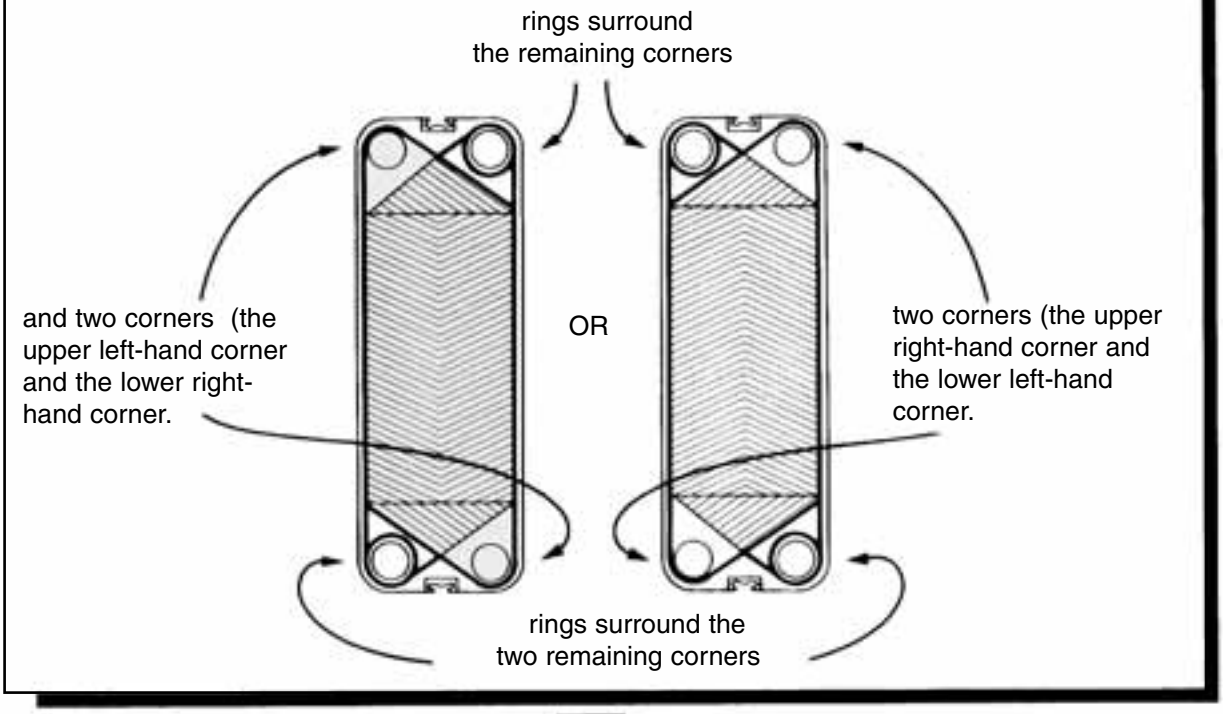
Larger particles and fibers may also be drawn into the heat exchanger and clog the passage ways if strainers or other means of protection have not been provided for.

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, see MAINTENANCE and CLEANING.

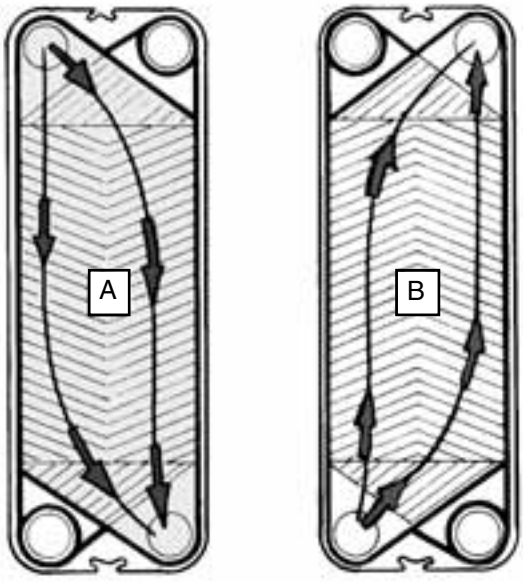
Plates

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



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

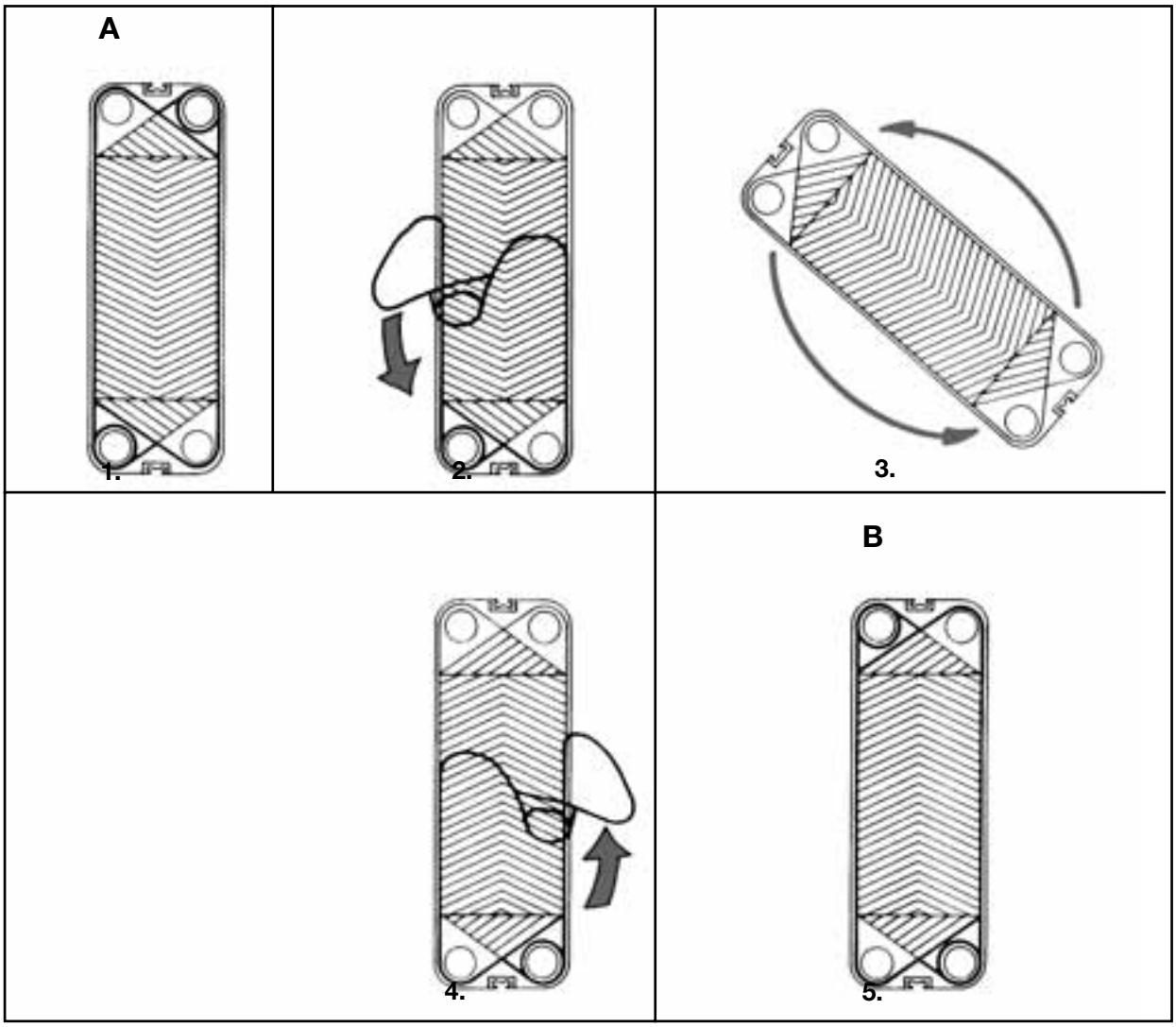
An A-plate is a plate hanging with the chevron pointing downwards.



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

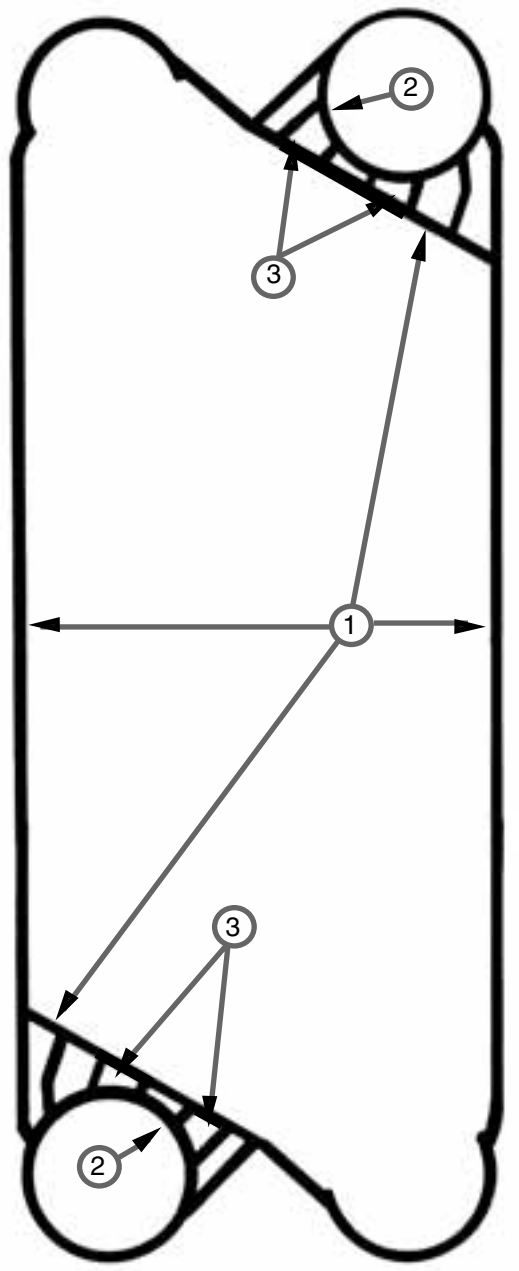
Plates

We can make a B-Plate from an A-plate or the opposite,
by changing the gasket and turning the plate upside down.



Gaskets

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

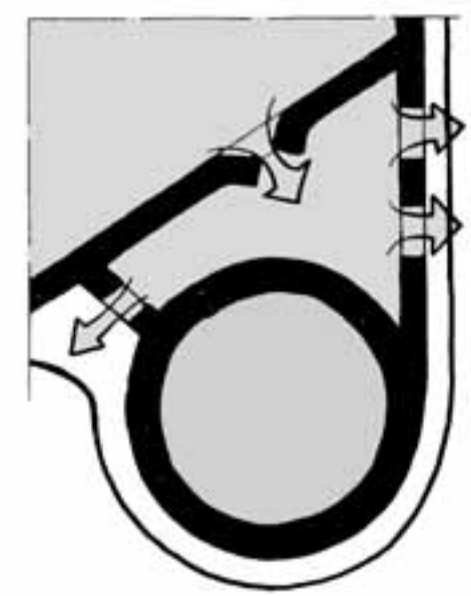


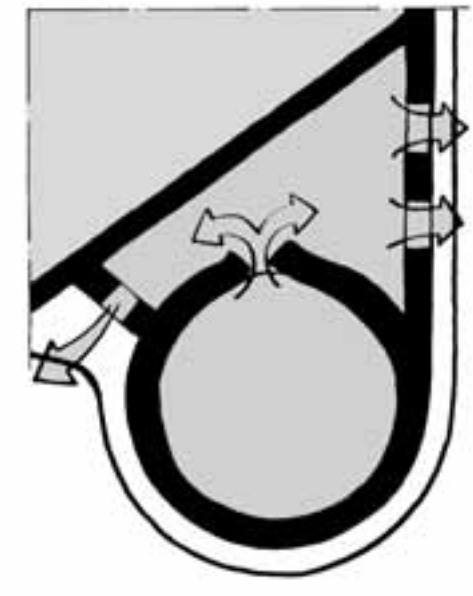
The one-piece gasket consists of:
1. One field gasket
2. Two ring gaskets
3. Links

The field gasket is by far the larger part containing the whole heat transfer area and the two corners connected to it. 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. On some plate heat exchangers, the gasket is held in place on the plate by means of a suitable cement or glue.

Gaskets



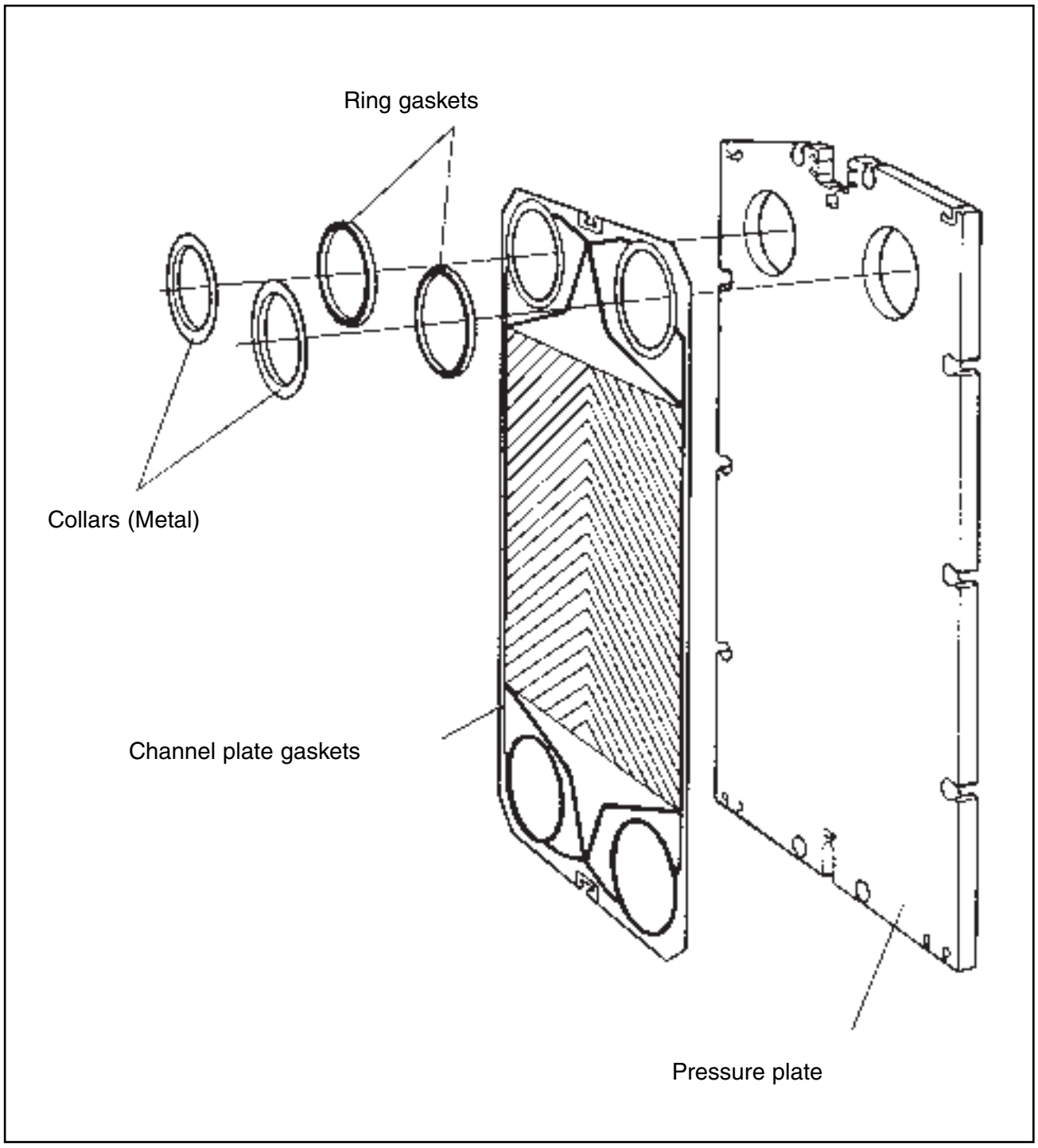


As already demonstrated, the two media are effectively kept apart by the ring and field gaskets. To prevent intermixing of the media in the corner areas where field and ring gaskets are very close to each other, the link pieces have a number of slots which open the area between the field and ring gaskets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

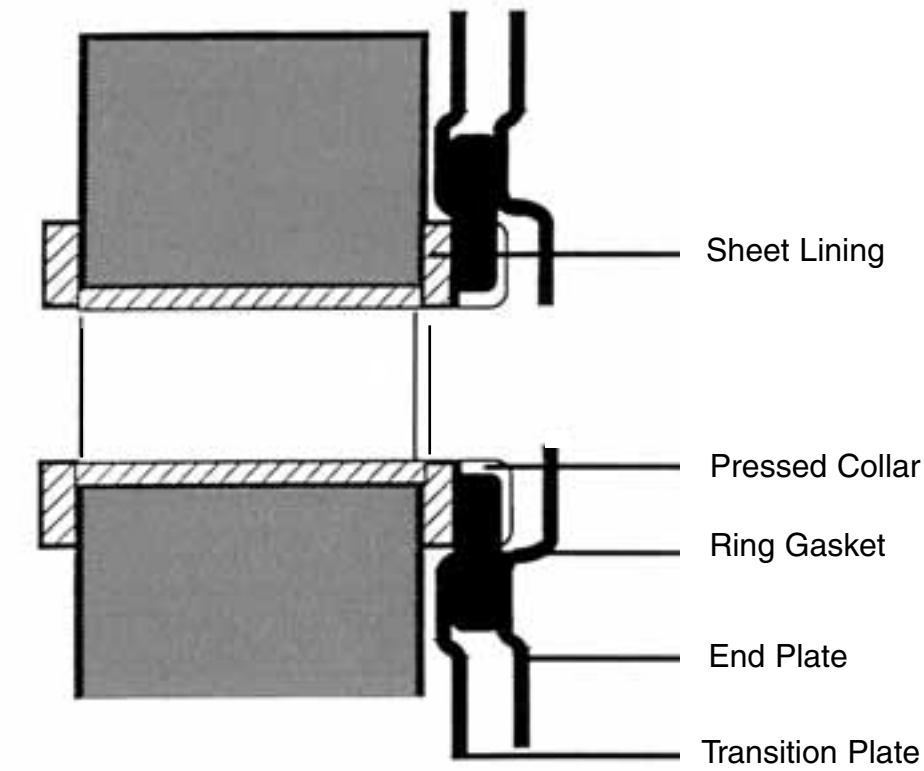
It is important that these openings are kept clear. If they are not, there is a risk that should a leak occur in that region of the plate, there might be a local pressure build-up, which could allow one medium to mix with the other.

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

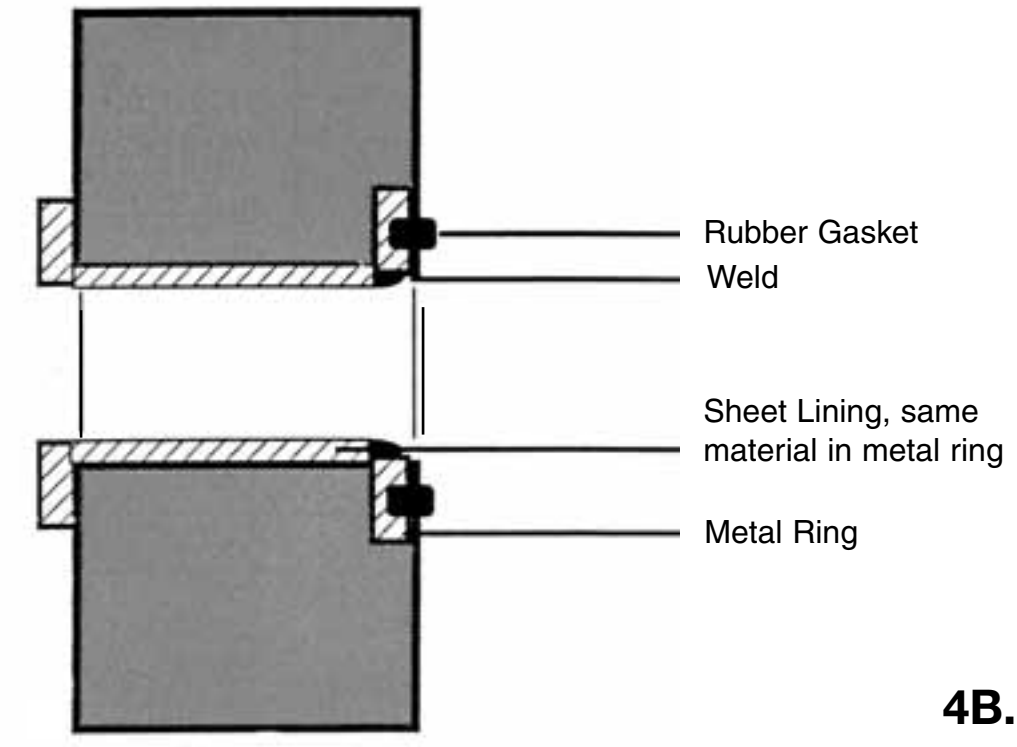
TRANSITION PLATE
M30, MX25, A20-B, AM20, AK20, T200, A15-B, M15, M10, M6



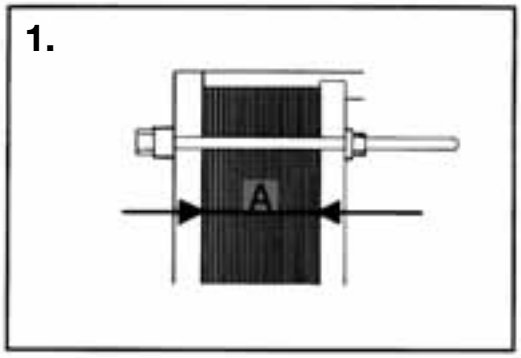
NON MACHINED PRESSURE PLATE

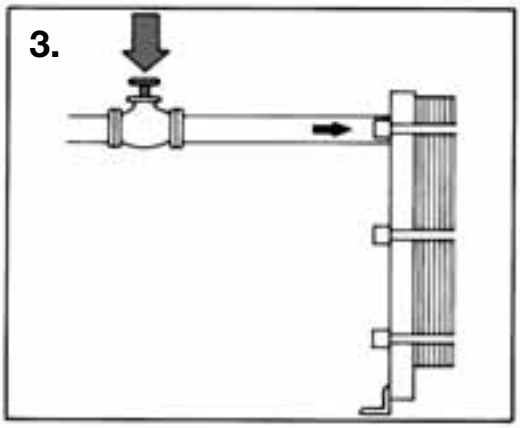


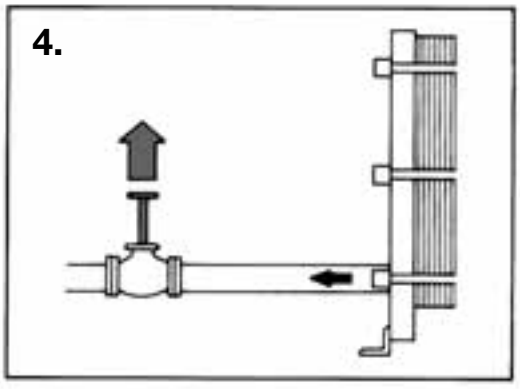
MACHINED PRESSURE PLATE (AX30, AM20 AND OBSOLETE FRAMES)



5 Operation







START UP

1. BEFORE STARTING UP FOR THE FIRST TIME OR AFTER A LONG TIME IN STORAGE: MAKE SURE THAT THE PLATE PACK IS COMPRESSED TO THE CORRECT MEASUREMENT A! Check with the Drawing or Nameplate, which is provided with each heat exchanger.

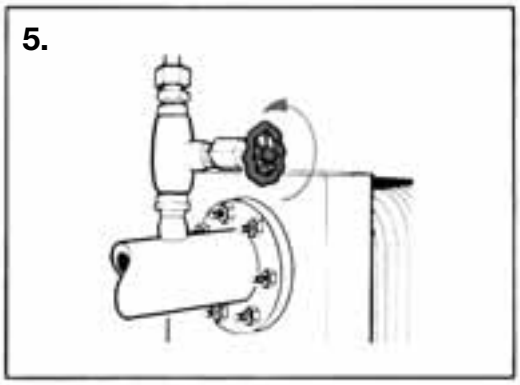
It is very important that the system to which the heat exchanger is connected, is protected against sudden and extreme variations of temperature and pressure. This is not only for the heat exchanger but also for the pipe system itself and every piece of equipment included in it.

This should be kept in mind whenever a maneuver 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.

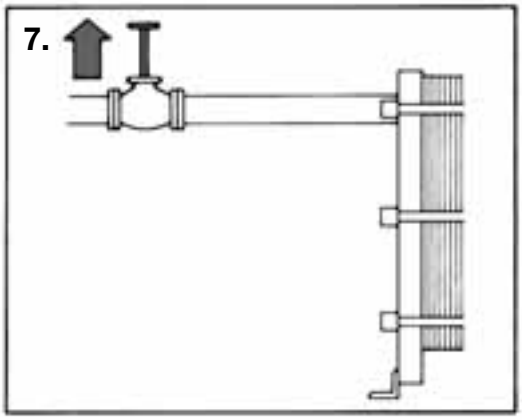
3. Check that the valve between the pump and the equipment, controlling the flow rate of the system which you are about to start up is closed.

4. Check that the valve at the exit, if there is one, is fully open.

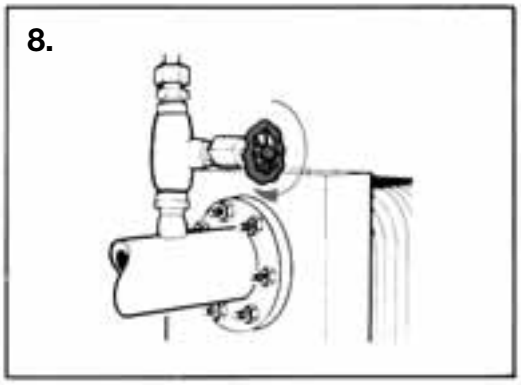


5. Open the vent.

6. Start the Pump.



7. Open the valve slowly.



8. When all air is out, close the vent.

9. Repeat the procedure for the other media.

5 Operation

UNIT IN OPERATION

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

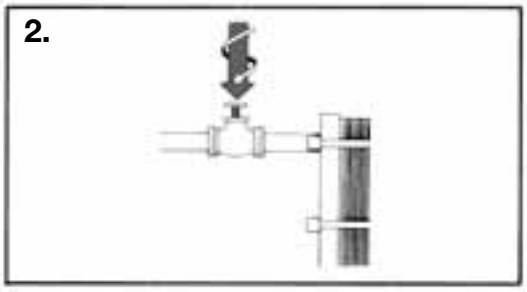
Problems in keeping up the performance of the heat exchanger may be caused by a change in some of the temperature conditions, the heat load or by fouling.

As long as the PHE 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 the pumps are to be stopped - the following procedure should be followed:

1. First establish whether instructions exist that specify 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.

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

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

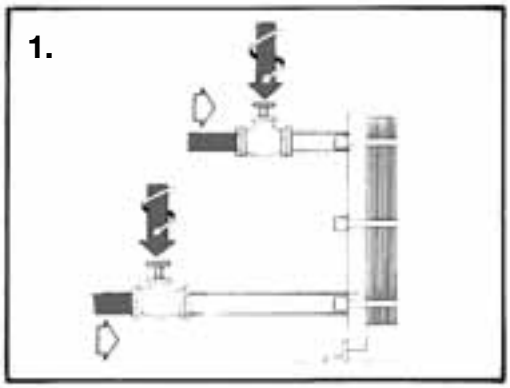
WATER HAMMER is the name given to a short duration pressure peak, traveling along the pipe as a wave at the speed of sound, and resulting from a sudden deceleration of the motion of the fluid in a closed system.

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.

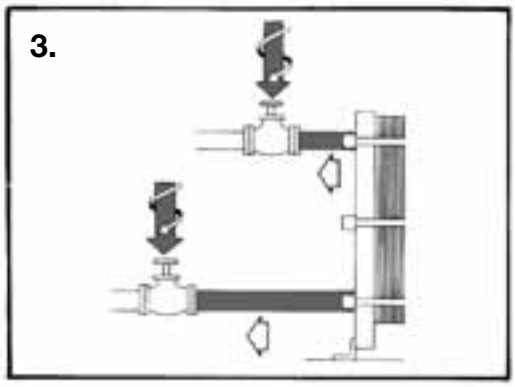
Therefore it is very important for the protection of the whole installation that start-ups and close-downs are carried out with great care.

6 Opening

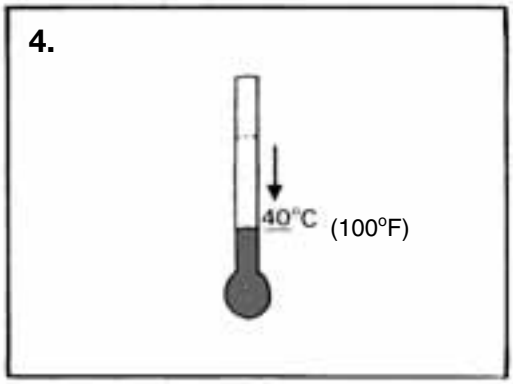


1. Slowly close the valves on the inlets. Shut off the inlet side, closing the highest pressure first.

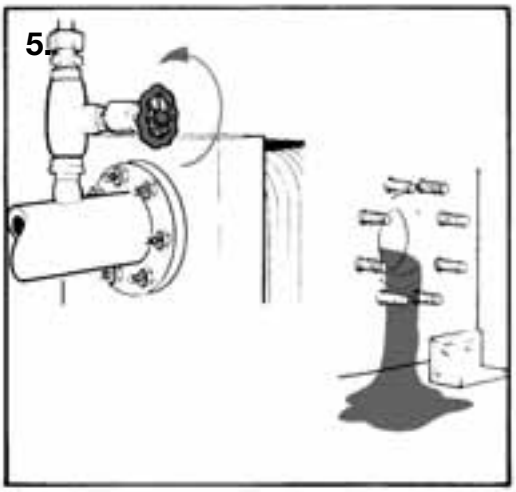
2. Switch off pumps.



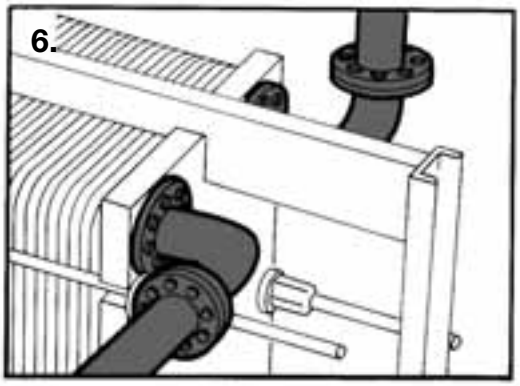
3. Close the valves on both outlets.



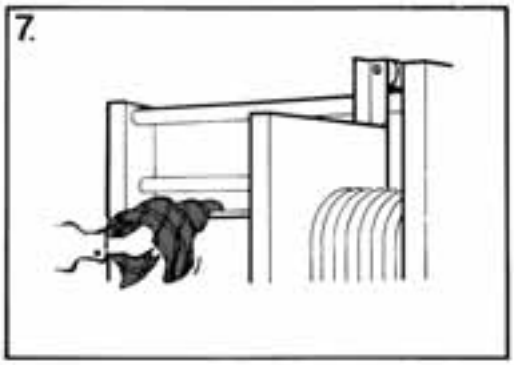
4. If the heat exchanger is hot, wait until it has cooled down to about 40°C (100°F).



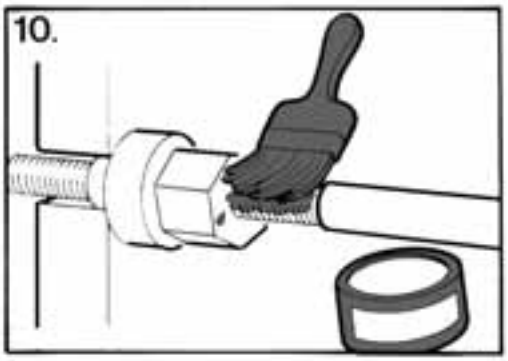
5. Drain



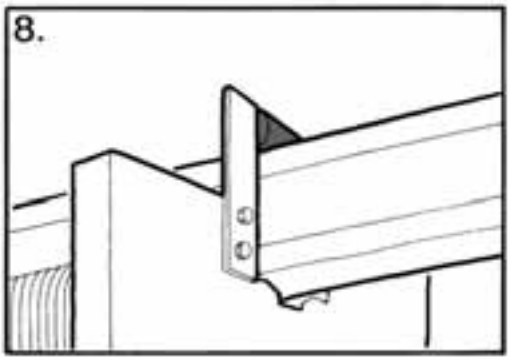
6. Dismantle any pipe bends connected to the pressure plate, so that it can be moved freely along the carrying bar.



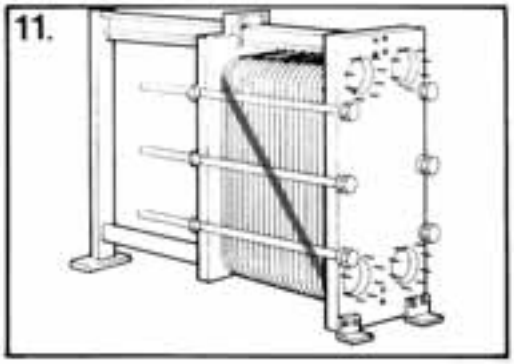
7. Inspect the sliding surfaces of the carrying bar and wipe clean



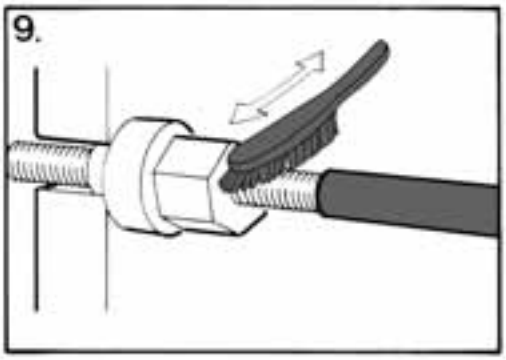
10. Lubricate the threads with a thin layer of grease, e.g LUBRIPLATE FGL-2 or equivalent.



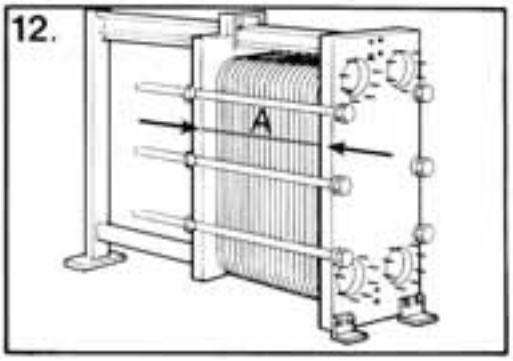
8. Inspect pressure plate roller.



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



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



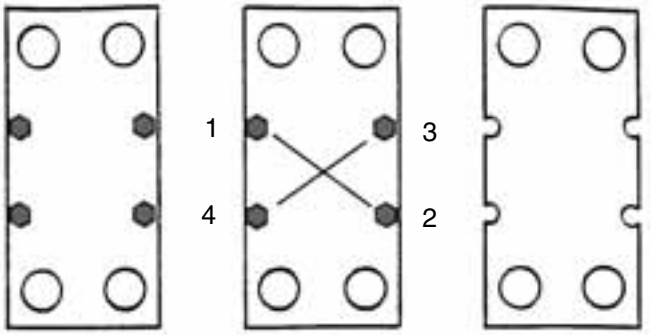
12. Measure and note the dimension A. Compare with code plate and PHE documentation for this same serial number.

6

Opening

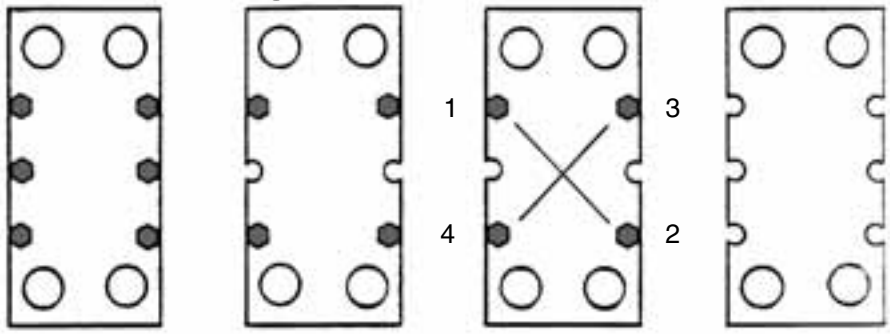
(13) (See page 6.5) (14)

	P2	A10B	TS6-M	AM10	M10B M10M
FG	X	X	X	X	
FM					X
FD			X		



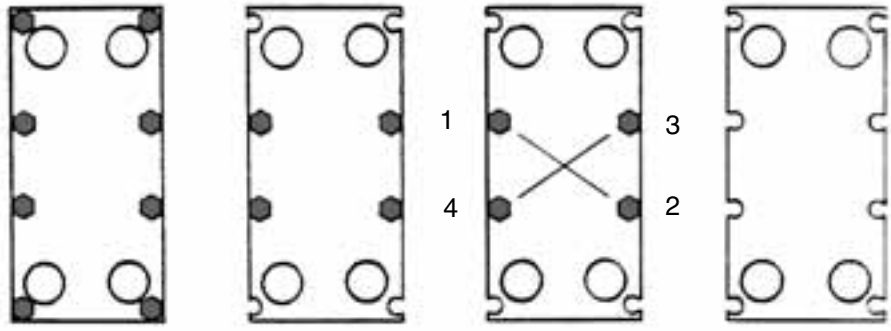
(13) (See page 6.5) (14)

	V8	P3	V13 V20	V28	M10B M10M	M10BW M10DW	M20-M
E		X					
FD			X				
FG			X	X	X	X	
FM							X
VG	X						



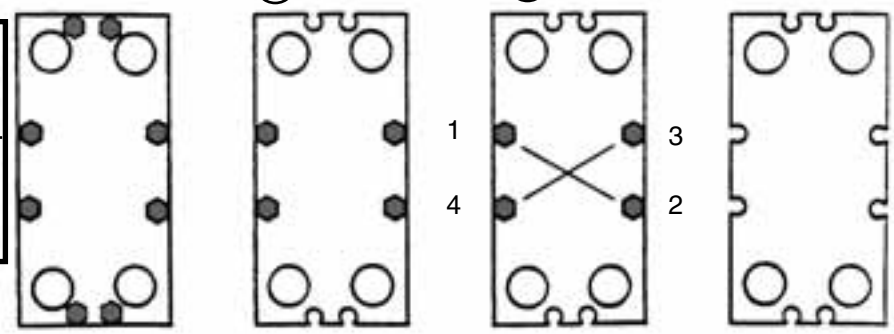
(13) (See page 6.5) (14)

	M3	P2	P3	V28	V45
EH			X		
VG	X				
VLCH		X			
FG				X	X
FD				X	X



(13) (See page 6.5) (14)

	MX25B	A15BWA	15B	TS20-M	AM20 AM20B AM20W AM20S AM20DW	M6 M6M	M15M
FG		X	X	X	X	X	X
FD		X	X				X
FL			X				
FM	X			X			X
FS				X			



M6/M6-MFG & MX25-BFM ONLY HAS ONE BOLT TOP AND BOTTOM

Opening

	M20-M			
FG				

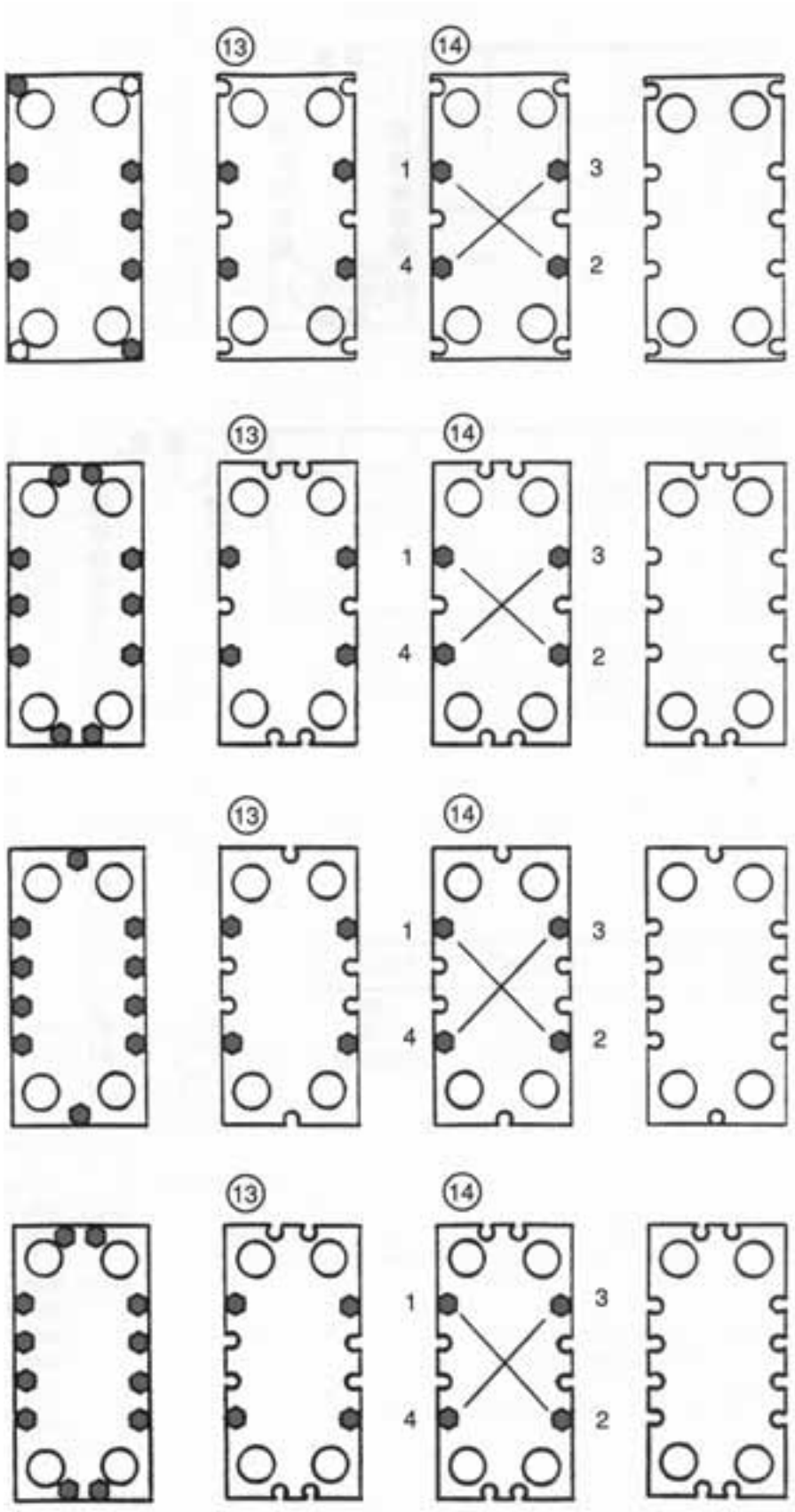
M20-MFG ONLY HAS ONE BOLT TOP AND BOTTOM

	M15B M15F	A20B	T200	M6 AK20 M6DW	M6M M30
FG		X	X		
FD				X	
FM					X
FS	X				

M6/M6-MFG ONLY HAS ONE BOLT TOP AND BOTTOM

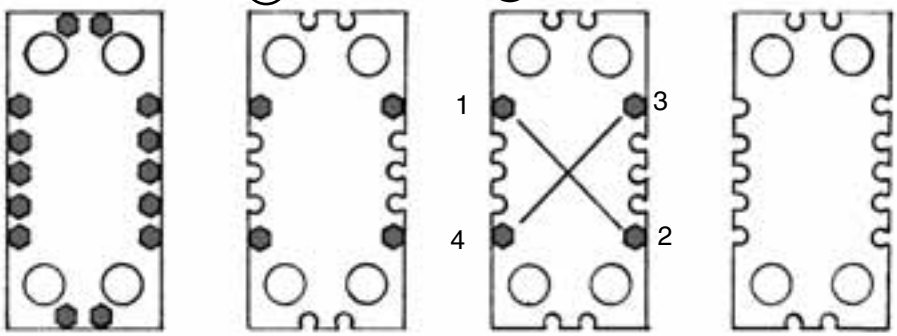
	M10B M10M	M10BW		
FD	X	X		

	A20B	AK20 T200	MX25B	V110
FD	X	X		
FL	X			
FG			X	X



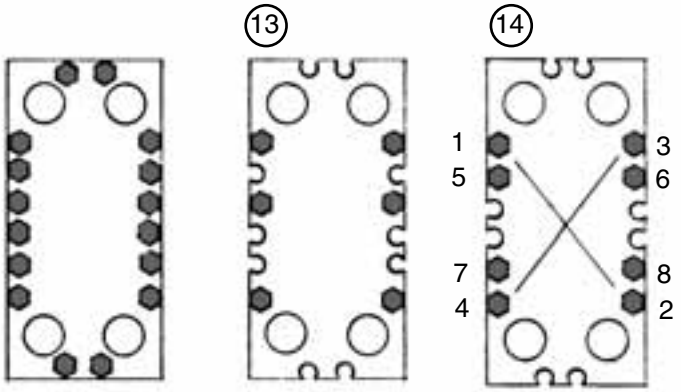
6 Opening

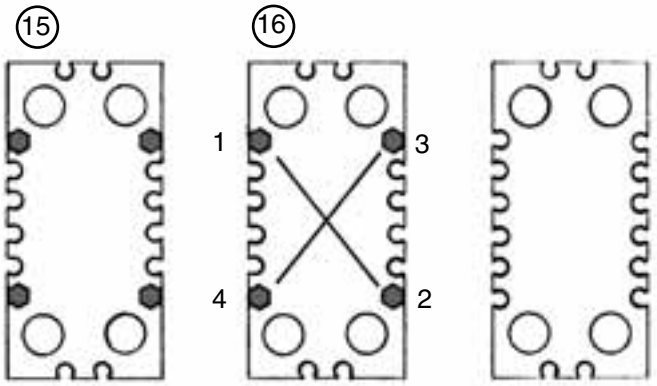
	AX30B AX30BW	V110		
FG FD	X	X		



	AX30B AX30BW	A35 A45	AX35	M20M	M30	MX25B	V170 V280
FG			X		X		X
FD	X			X	X	X	X
HA		X					
FS						X	

NOTE: M30-FD, MA30-FG/FD, MX25-BFS, V280-FG/FD and V170-FD have a twenty bolt or larger pattern, use this picture only as a guide. Start sequence numbers 5 and 6 at the fourth bolt down on both sides.





ORDER	BOLT NO.	TO DIM.
1	1-2-3-4-5-6	1.05A
2	1-2-3-4	1.10A
3	1-2 OR 3-4	OPENING

(13) If bolts are fitted with bearing boxes loosen and remove them. If not fitted with bearing boxes, then follow the pictures above.

(14) Loosen the remaining bolts, alternately and diagonally, to bring length to 1.05A.

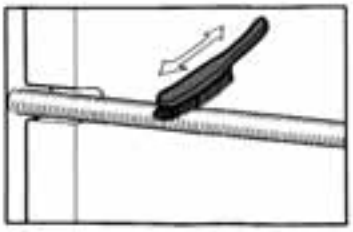
(15) Remove bolts 5 and 6 completely.

(16) Continue opening, alternately and diagonally.

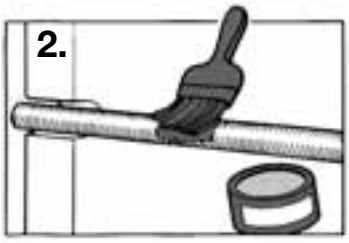
Note: Skewing of the Pressure Plate during opening must not exceed 10 mm (2 turns per bolts) across the width and 25 mm (5 turns per bolts) vertically.

Removal and insertion of plates

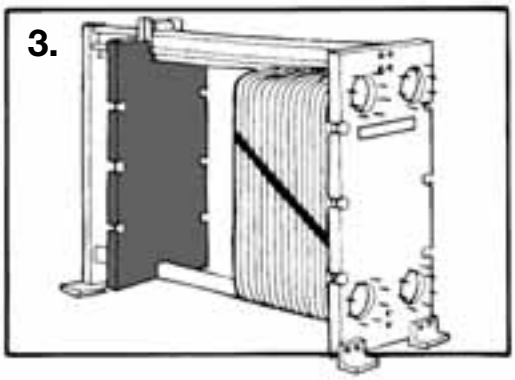
1.

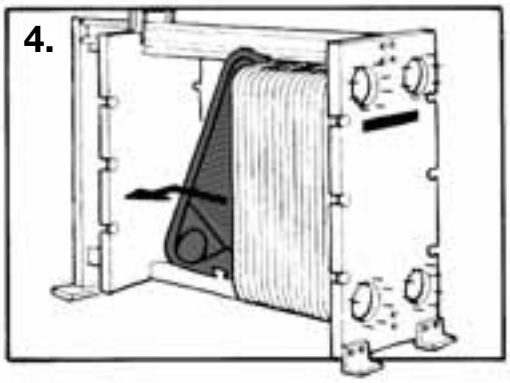


Brush the threads of the bolts clean, using a steel wire brush



Lubricate the threads with a thin layer of grease, e.g. LUBRIPLATE FGL-2 or equivalent.

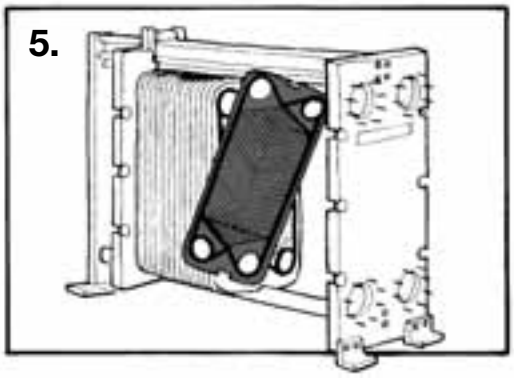




REMOVAL OF PLATES

3. Push the pressure plate against the support column.

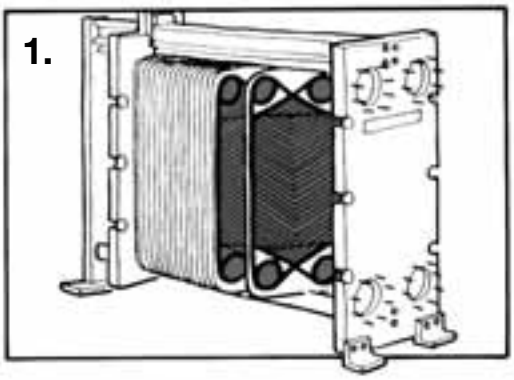
4. Remove the plates. Stack them neatly on a skid or pallet for easy transporting.



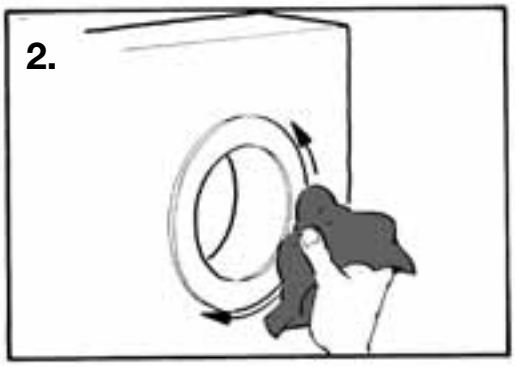
INSERTION OF PLATES

5. Hang the plates with their backs towards the pressure plate (the side without gasket).

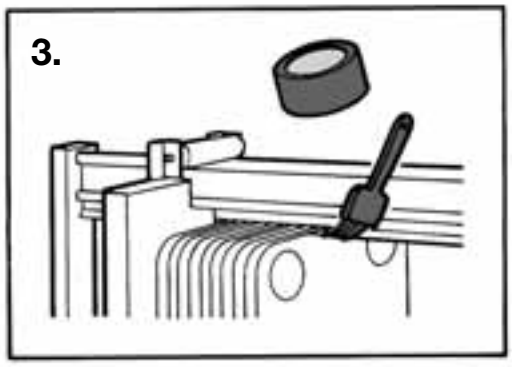
6 Closing



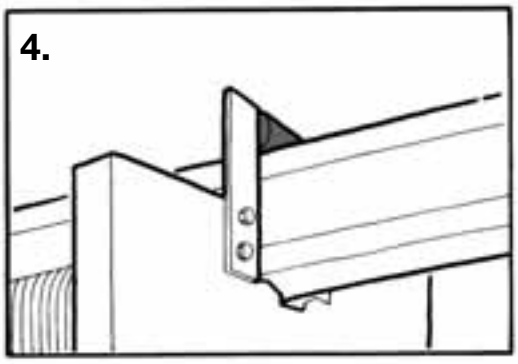
1. Check that all the sealing surfaces (i.e. surfaces in contact with the heat transfer medium) are clean.



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

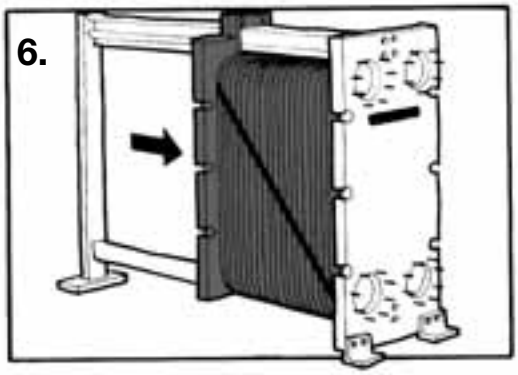


3. Clean and lubricate the sliding surfaces of the carrying bar.

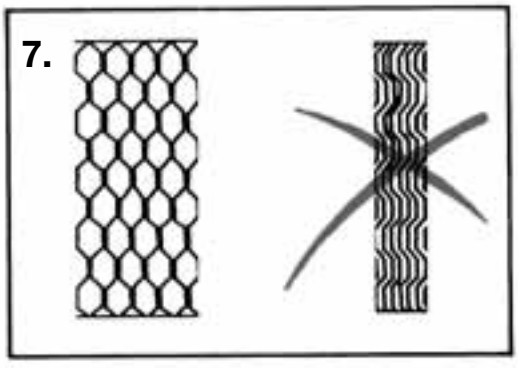


4. Inspect the pressure plate roller. Remove any debris from top surface of carrying bar.

5. Check against the drawing or flow sheet (provided with each heat exchanger) to make sure that the plates are hanging in the correct order.



6. Press the plate assembly together.

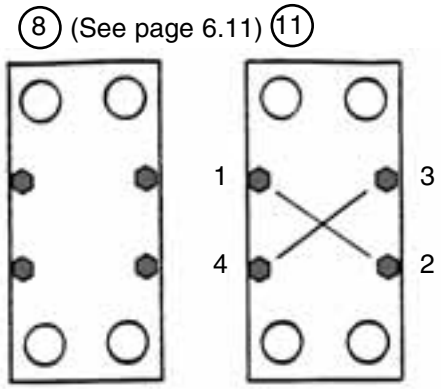


7. If the plates are correctly assembled, the edges form a “honeycomb” pattern.

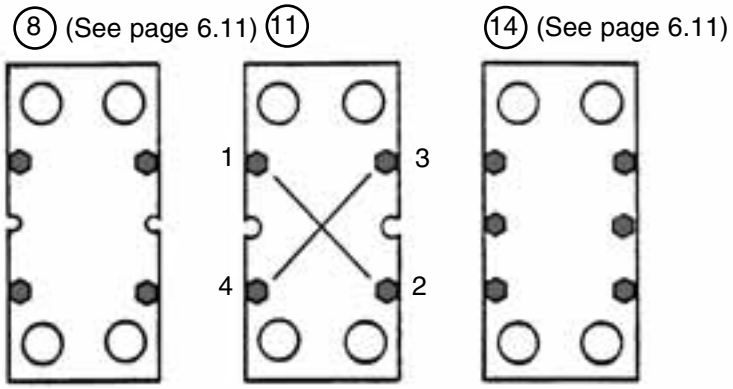
   If the plate pack has been marked on the outside (fig. 6) check this.

Closing

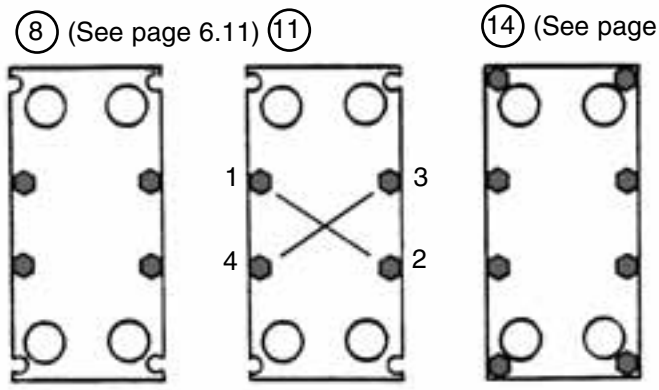
	P2	A10B	TS6-M	AM10	M10B M10M
FG	X	X	X	X	
FM					X
FD			X		



	V8	P3	V13 V20	V28	M10B M10M	M10BW M10DW	M20-M
E		X					
FD			X				
FG			X	X	X	X	
FM							X
VG	X						

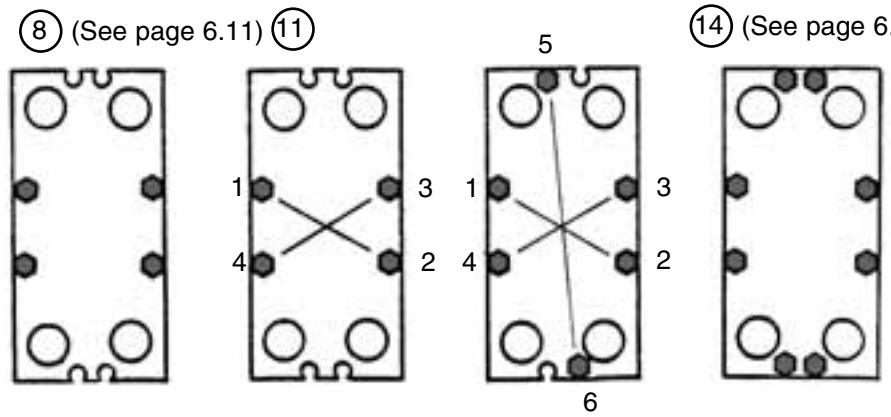


	M3	P2	P3	V28	V45
EH			X		
VG	X				
VLCH		X			
FG					X
FD				X	X



	MX25B	A15BW	A15B	TS20-M	AM20 AM20B AM20W AM20S AM20DW	M6 M6M	M15M
FG		X	X	X	X	X	X
FD		X	X				X
FL			X				
FM	X			X			X
FS				X			

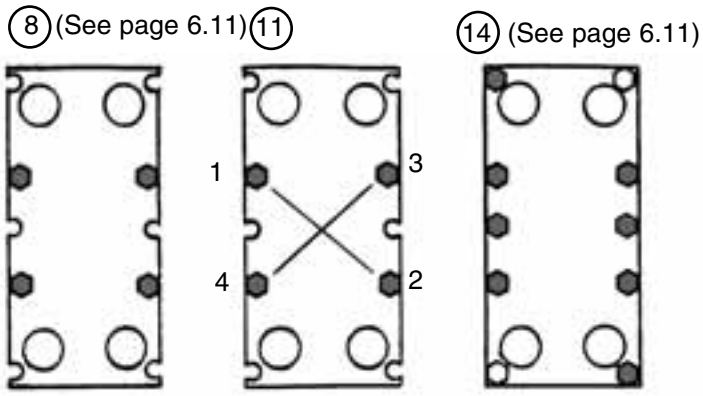
M6/M6-MFG & MX25-BFM ONLY HAS ONE BOLT TOP AND BOTTOM



Closing

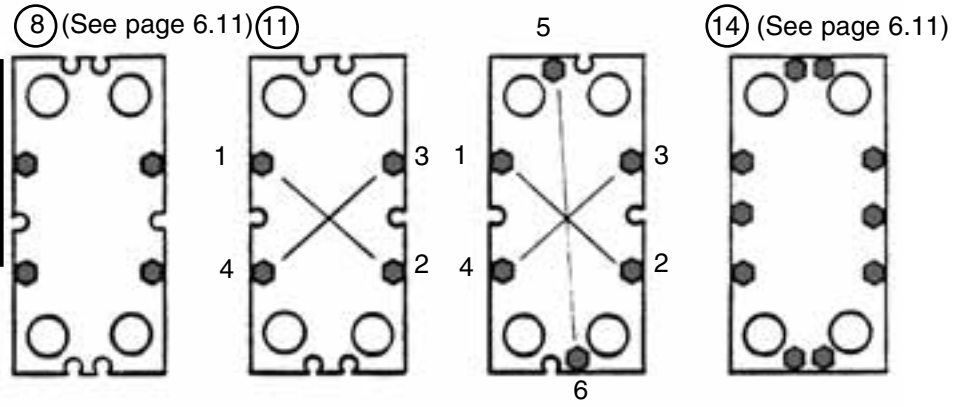
	M20-M			
FG				

M20-MFG ONLY HAS ONE BOLT TOP AND BOTTOM

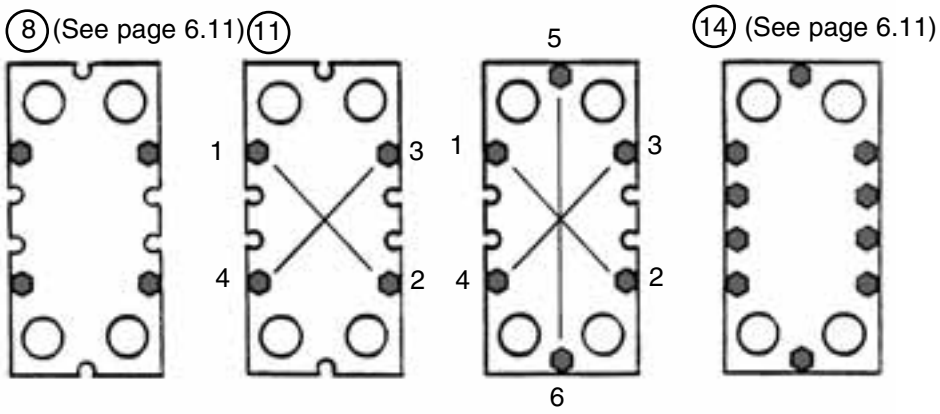


	M15B M15F	A20B	T200	M6 AK20 M6DW	M6M M30
FG		X	X		
FD				X	
FM					X
FS	X				

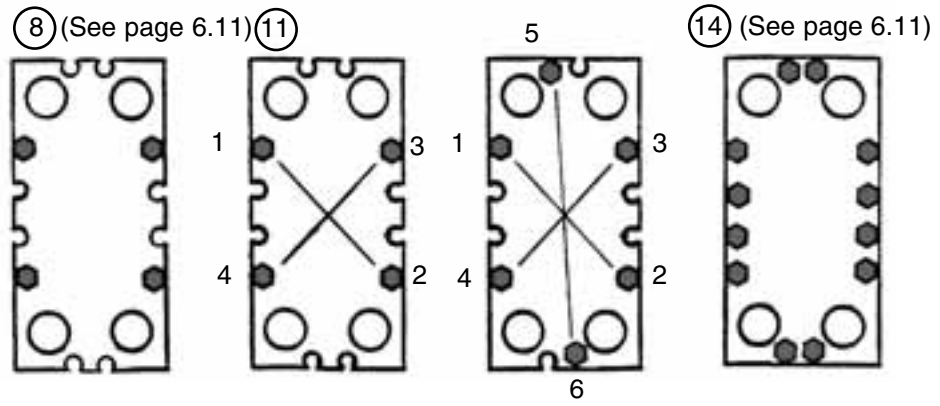
M6/M6-MFG ONLY HAS ONE BOLT TOP AND BOTTOM



	M10B M10M	M10BW		
FD	X	X		

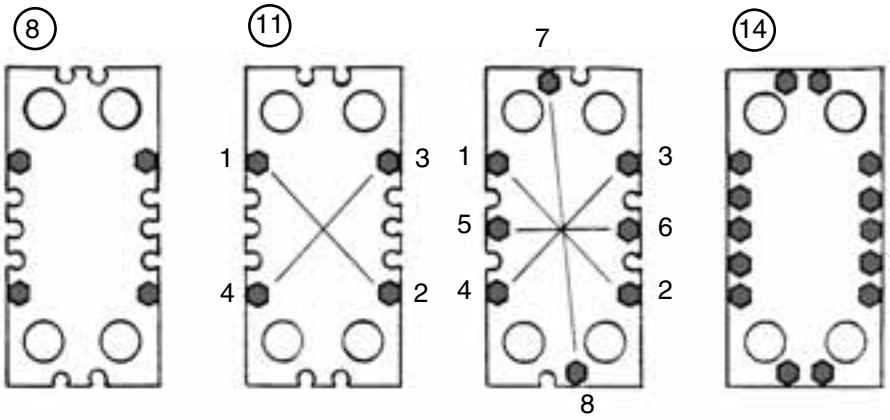


	A20B	AK20 T200	MX25B	V110
FD	X	X		
FL	X			
FG			X	X



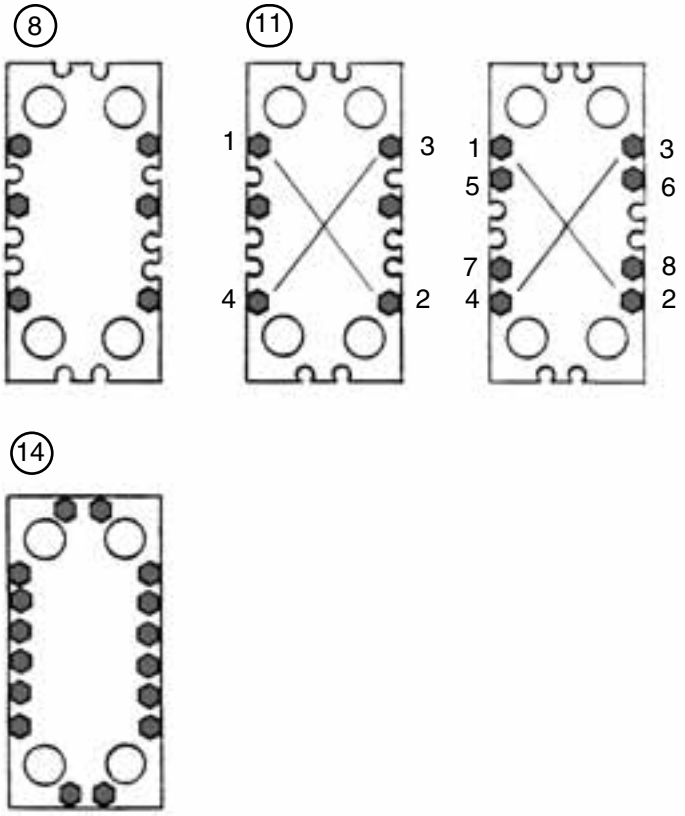
Closing

	AX30B AX30BW	V110		
FG FD	X	X		



	AX30B AX30BW	A35 A45	AX35	M20M	M30	MX25B	V170 V280
FG			X		X		X
FD	X			X	X	X	X
HA		X					
FS						X	

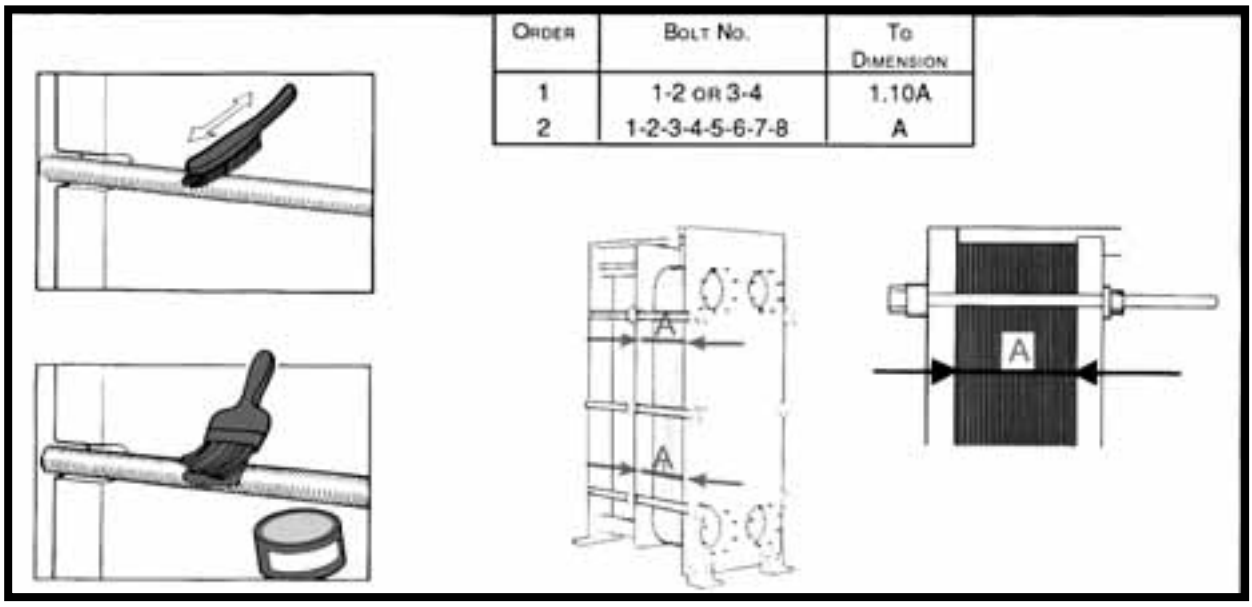
NOTE: M30-FD, MA30-FG/FD, MX25-BFS, V280-FG/FD and V170-FD have a twenty bolt or larger pattern, use this picture only as a guide. Start sequence numbers 5 and 6 at the fourth bolt down on both sides.



ORDER	BOLT NO.	TO DIM.
1	1-2-3-4-5-6	1.05A
2	1-2-3-4	1.10A
3	1-2 OR 3-4	OPENING

Note: See next page for closing instructions for all the models

6 Closing



Order	Bolt No.	To Dimension
1	1-2 or 3-4	1.10A
2	1-2-3-4-5-6-7-8	A

8. Place all the bolts that are fitted with bearing boxes in position. If not fitted with bearing boxes then follow the pictures for your specific model.

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. LUBRIPLATE FGL-2 or equivalent.

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

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 10mm (2 turns per bolt) across the width and 25 mm (5 turns per bolt) vertically.

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

Plate pack length/plat	Plate pack length
> 4 mm	A + 1%
> 3mm, < 4mm	A + 1.5%

14. 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:

  2mm when dimension A is < 1000mm

  4mm when dimension A is > 1000mm
- The plate pack length at all bolts must not differ by more than 1%
- If the unit does not seal fully, it can be tightened to the dimension A-1%.

IF DIMENSION A IS NOT REACHED WITH APPLICATION OF THE ABOVE STEPS:

- 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.

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 must be consulted.

Contact the following address:
ALFA LAVAL
Heat Transfer Center
5400 International Trade Drive
Richmond, VA 23231
Phone (804) 222-5300
Fax (804) 236-3276

NOTE! Titanium is not affected by chlorine.

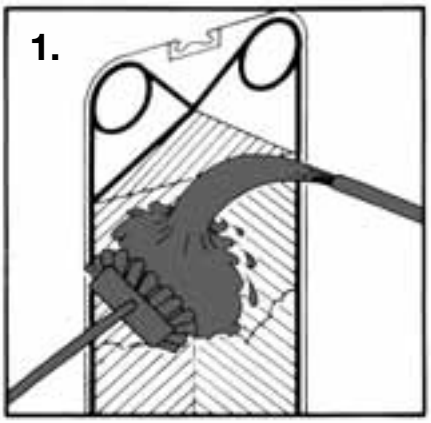
7 Cleaning

INCRUSTATION - SCALING

- Calcium carbonate
- Calcium sulphate
- Silicates

CLEANING

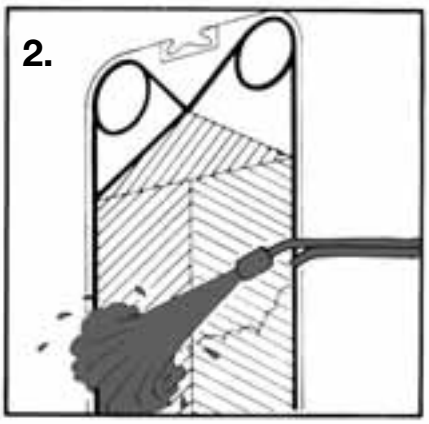
Mechanical cleaning after opening.



1. Soft brush and running water.
   NOTE! Avoid gasket damage.

3. Chemical cleaning of opened unit by using:
   - Nitric acid
   - Sulfamic acid
   - Citric Acid
   - Phosphoric acid
   - Complexing agents (EDTA, NTA)
   - Sodium polyphosphates

Concentration max 4% by wt%
Temperature max 140° F

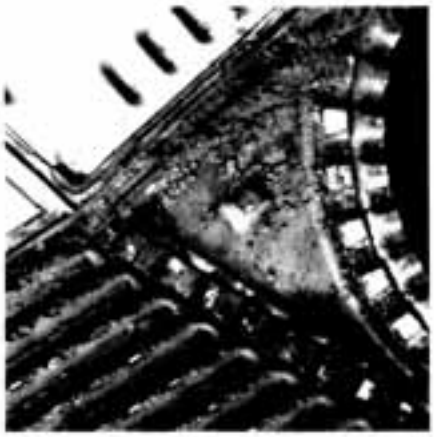


2. High pressure hose.

NOTE!
Under no circumstances should HYDROCHLORIC ACID be used with STAINLESS STEEL PLATES and under no circumstances should HYDROFLUORIC ACID be used with TITANIUM PLATES. Water of more than 300 ppm Chlorine may not be used for the preparation of cleaning solutions.

It is very important that carrying bars and support columns made of aluminum are protected against chemicals.

Cleaning

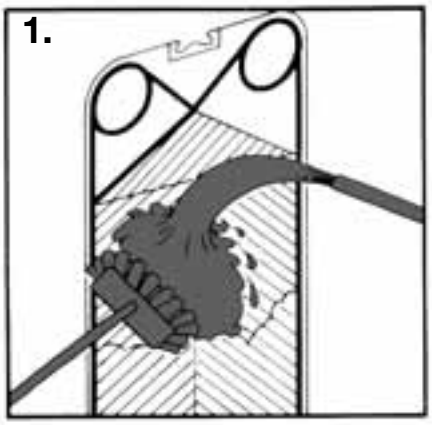


SEDIMENT

- Corrosion products
- Metal Oxides
- Silt
- Alumina
- Diatomic organisms and their excrement of various colors.

CLEANING

Mechanical cleaning after opening.

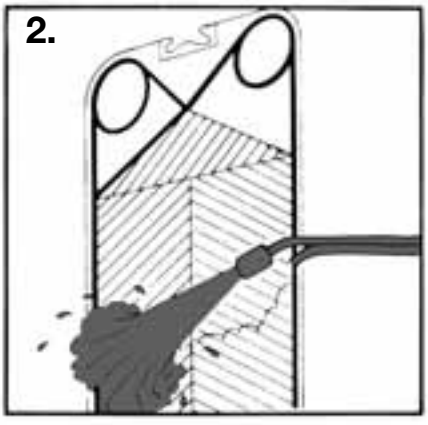


1. Soft brush and running water.
   NOTE! Avoid gasket damage.

3. Chemical cleaning of opened unit by using:

   - Nitric acid
   - Sulfamic acid
   - Citric Acid
   - Phosphoric acid
   - Complexing agents (EDTA, NTA)
   - Sodium polyphosphates

Concentration max 4% by wt%
Temperature max 140° F



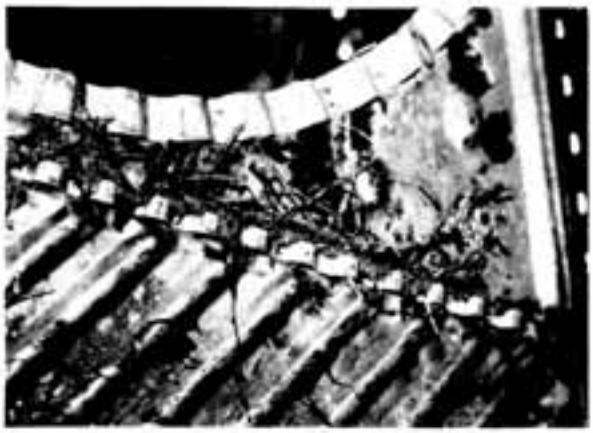
2. High pressure hose.

4. The addition of surfactants can improve cleaning effect.

NOTE!
Under no circumstances should HYDROCHLORIC ACID be used with STAINLESS STEEL PLATES and under no circumstances should HYDROFLUORIC ACID be used with TITANIUM PLATES. Water of more than 300 ppm Chlorine may not be used for the preparation of cleaning solutions.

It is very important that carrying bars and support columns made of aluminum are protected against chemicals.

7 Cleaning

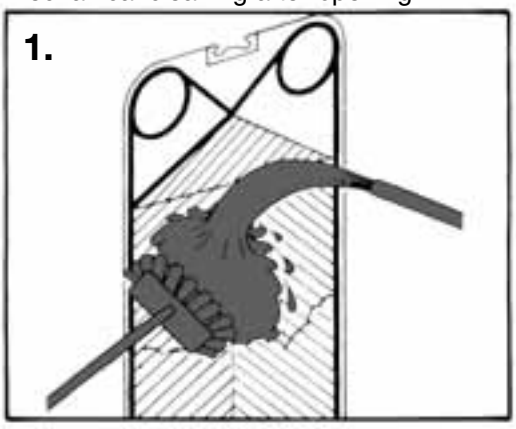


GROSS FOULING

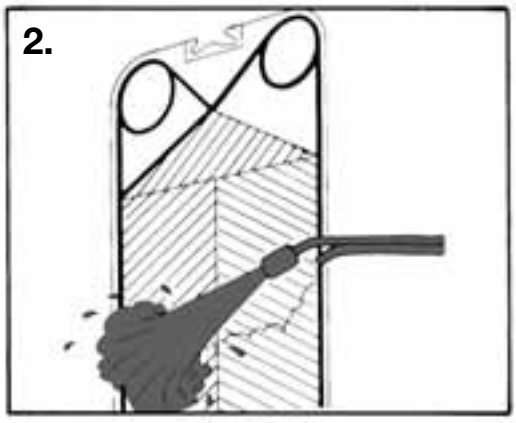
- Seaweeds
- Wood chips/fibers
- Mussels
- Barnacles

CLEANING: NOTE: BACKFLUSHING OF THE UNOPENED HEAT EXCHANGER CAN SOMETIMES BE SUFFICIENTLY EFFECTIVE.

Mechanical cleaning after opening.



1. Soft brush and running water.
   NOTE! Avoid gasket damage.



2. High pressure hose.

NOTE!
Under no circumstances should HYDROCHLORIC ACID be used with STAINLESS STEEL PLATES and under no circumstances should HYDROFLUORIC ACID be used with TITANIUM PLATES. Water of more than 300 ppm Chlorine may not be used for the preparation of cleaning solutions.

It is very important that carrying bars and support columns made of aluminum are protected against chemicals.

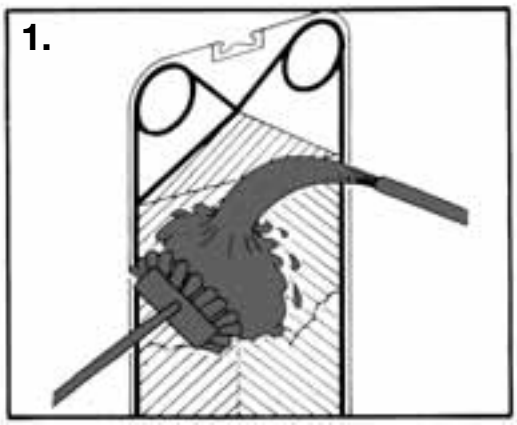
Cleaning

BIOLOGICAL GROWTH - SLIME

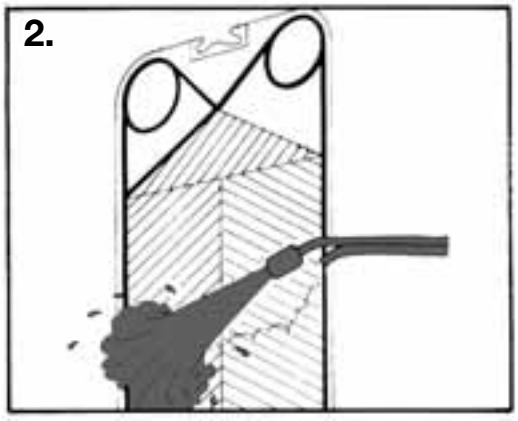
- Bacteria
- Nematodes
- Protozoa

CLEANING

Mechanical cleaning after opening.



1. Soft brush and running water.
   NOTE! Avoid gasket damage.



2. High pressure hose.

3. Chemical cleaning of opened unit by using:

   - Nitric acid
   - Sulfamic acid
   - Citric Acid
   - Phosphoric acid
   - Complexing agents (EDTA, NTA)
   - Sodium polyphosphates

Concentration max 4% by wt%
Temperature max 140° F

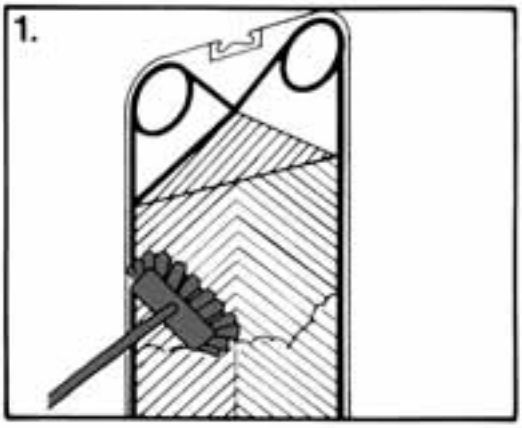
NOTE!
Under no circumstances should HYDROCHLORIC ACID be used with STAINLESS STEEL PLATES and under no circumstances should HYDROFLUORIC ACID be used with TITANIUM PLATES. Water of more than 300 ppm Chlorine may not be used for the preparation of cleaning solutions.

It is very important that carrying bars and support columns made of aluminum are protected against chemicals.

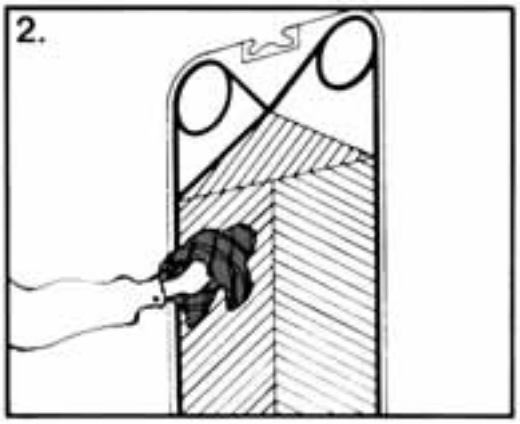
- Oil residues
- Asphalt
- Fats

CLEANING

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).



2. Dry with a cloth or rinse with water.

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

Regasketing

ALFA LAVAL has two types of glue for field repairs - 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. 1 year when stored at room temperature but can be prolonged when kept in a refrigerator.

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 200 F
- For operating temperatures above 200° F and oil coolers/heaters, the glued joints should be cured at 200° F 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.

SEPARATE GLUING INSTRUCTIONS WILL BE DELIVERED TOGETHER WITH THE GLUE.

ALFA LAVAL RECONDITIONING SERVICE

In addition to supplying genuine gaskets for your plate heat exchangers, we are able to provide a "SPECIALIZED PLATE RECONDITIONING SERVICE" to quickly and efficiently meet your service requirements.

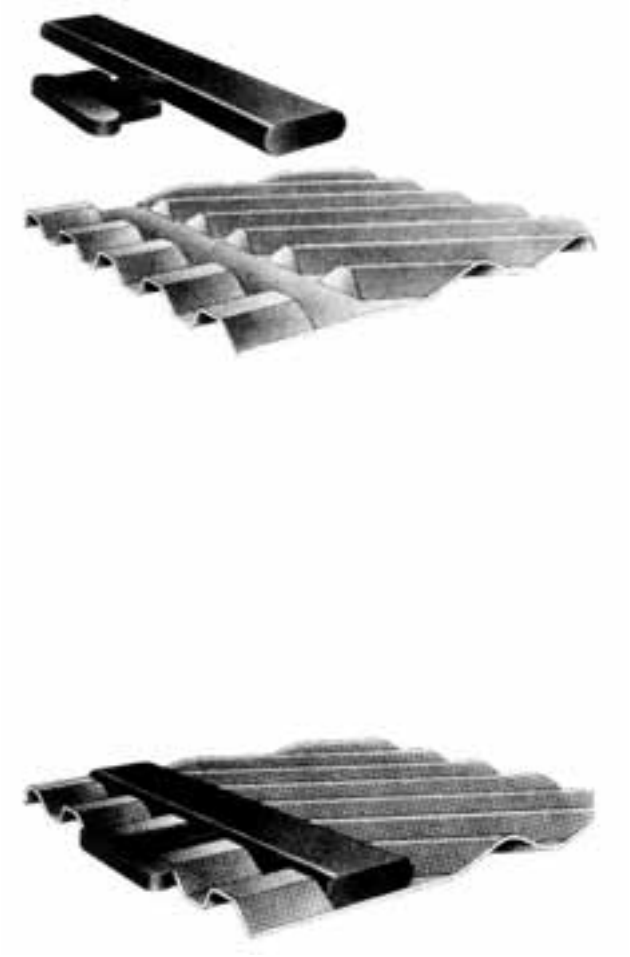
Our reconditioning service includes a liquid nitrogen debonding process with chemical cleaning, crack detection and regasketing using a special epoxy/phenolic resin adhesive.

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 reconditioning 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.
(See Section 1)

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.

The Clip-on gasket in the gasket groove.

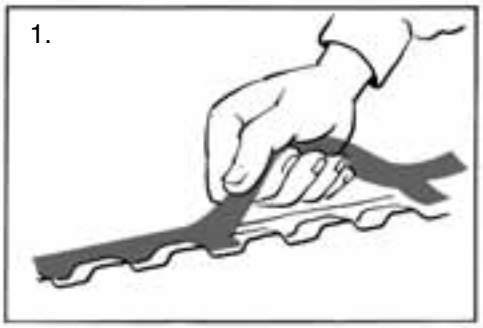
NOTE!

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

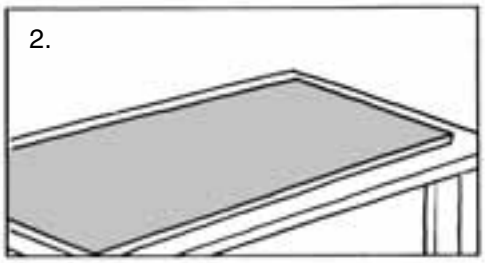
Regasketing of Snap-On Gaskets 7

THE PROCEDURES (2-7) ARE NOT NECESSARY FOR DOING A SMALL QUANTITY OF PLATES. THESE PROCEDURES WILL INCREASE SPEED OF REGASKETING OF LARGE QUANTITIES OF PLATES.

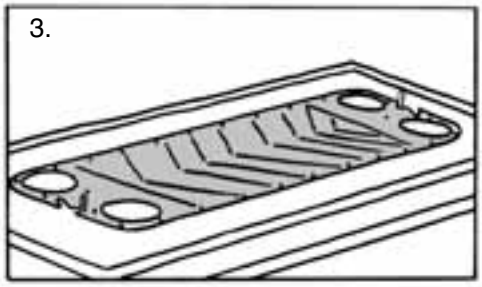
PREPARATORY PROCEDURES



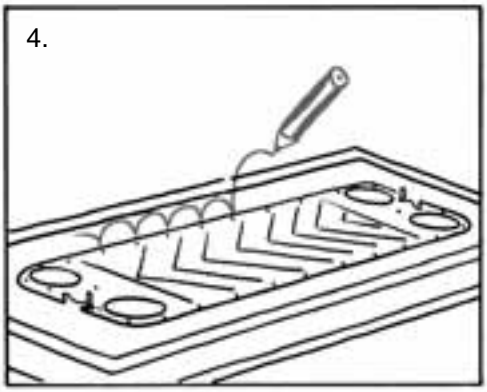
1. Pull the old gasket off the plate and clean the groove, if necessary.



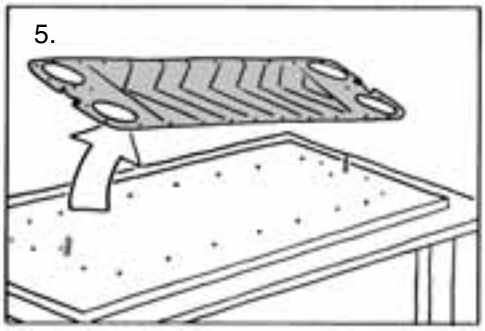
2. Place a flat sheet of plywood (somewhat larger than the PHE plate) on the table.



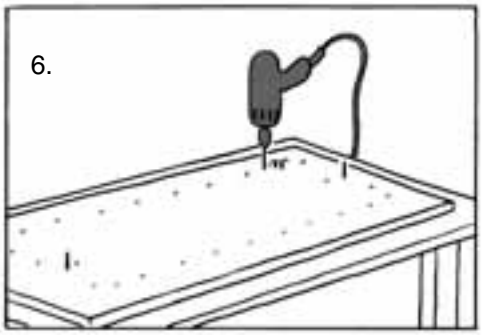
3. Place the PHE plate on the board with gasket groove upwards and fix firmly. Placing cylindrical pins in the plank at the carrying bar slots.



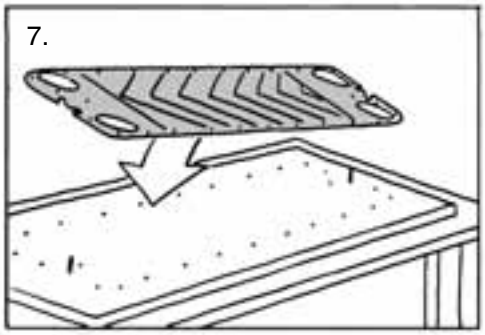
4. Make marks in the plank at all locations for gasket “snap-on”.



5. Remove the plate.



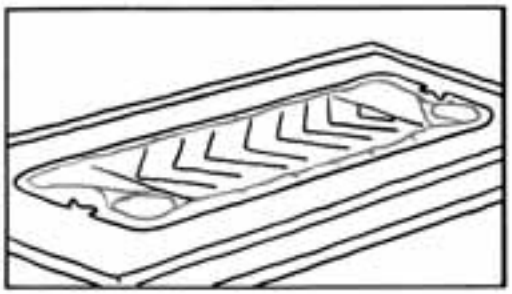
6. Drill holes approx. 7mm dia and 10 mm deep in the plank at the marked spots. The plank is now a practical tool for regasketing of larger numbers of plates.



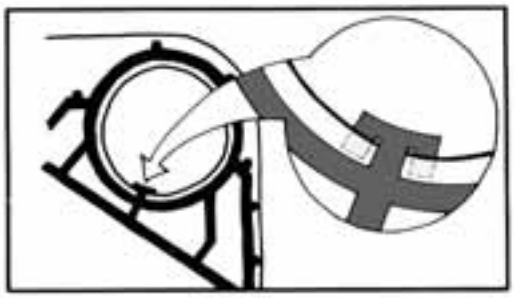
7. Replace PHE plate on the board in exactly the same location as at 3 above.

7 Regasketing of Snap-On Gaskets

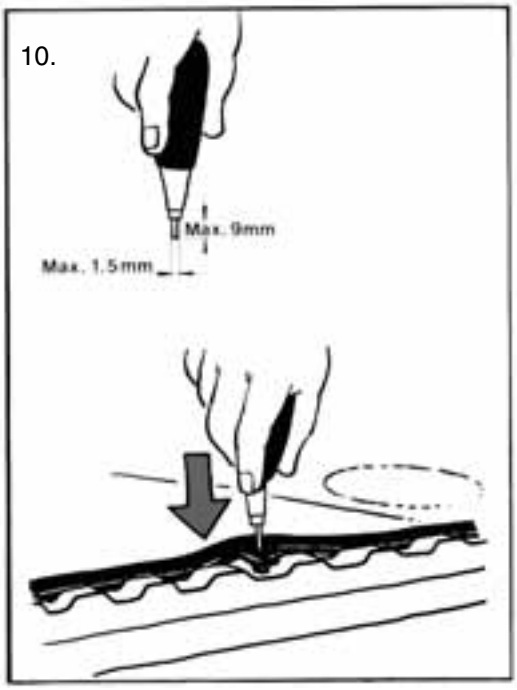
FASTENING OF THE "SNAP-ON" GASKET



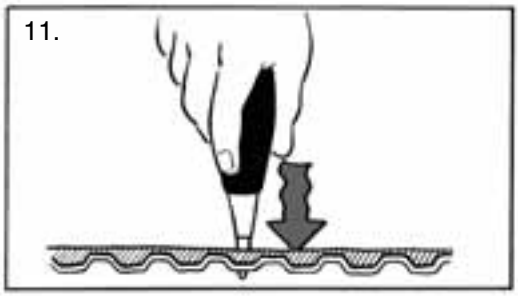
8. Place the gasket, with the "snap-on" projections downwards, in the gasket groove.



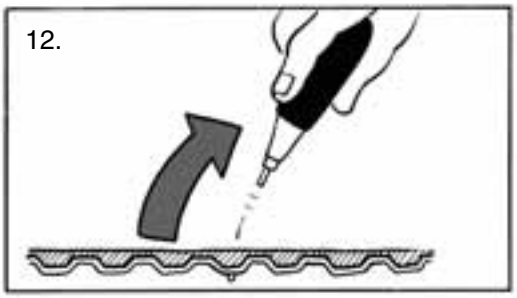
9. Place the ring gaskets in the groove and fix them with the T-flap.



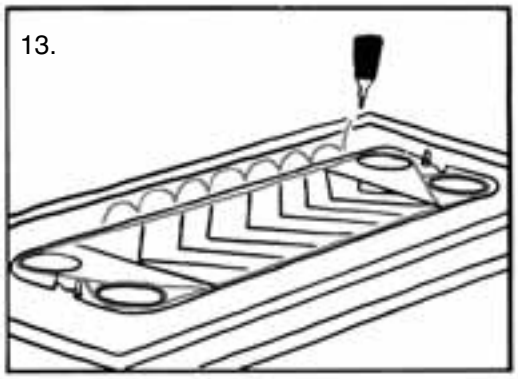
10. Insert the tool point into the recess in the projection.



11. Push the projection through the hole in the plate.



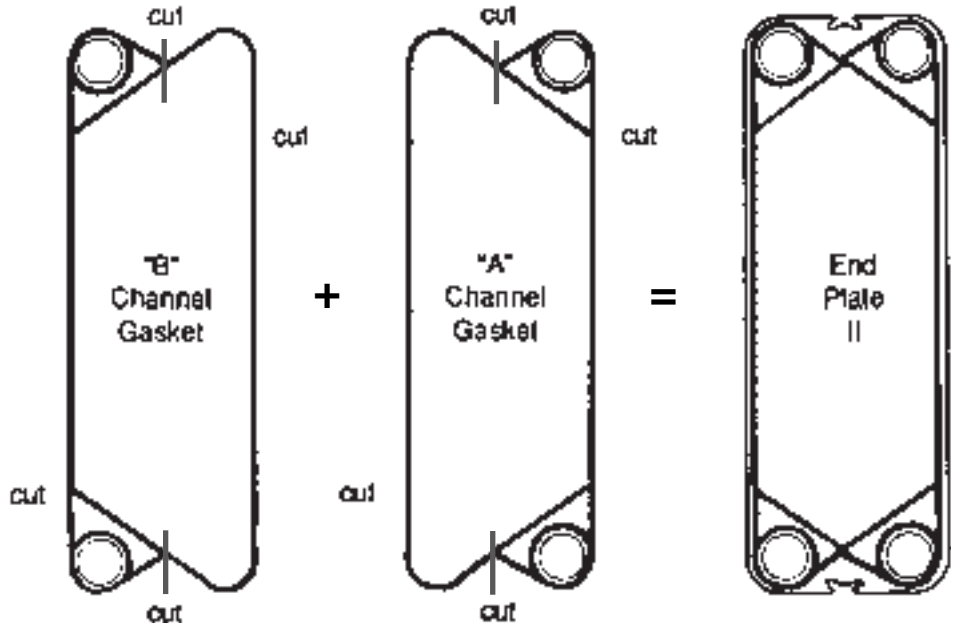
12. Remove the tool point, and the projection is now "snapped on".



13. Repeat for all projections, and the gasket is "snapped on".

NOTE!
BEFORE CLOSING OF THE EQUIPMENT: CHECK THAT THE T-FLAPS ARE IN CORRECT POSITION.

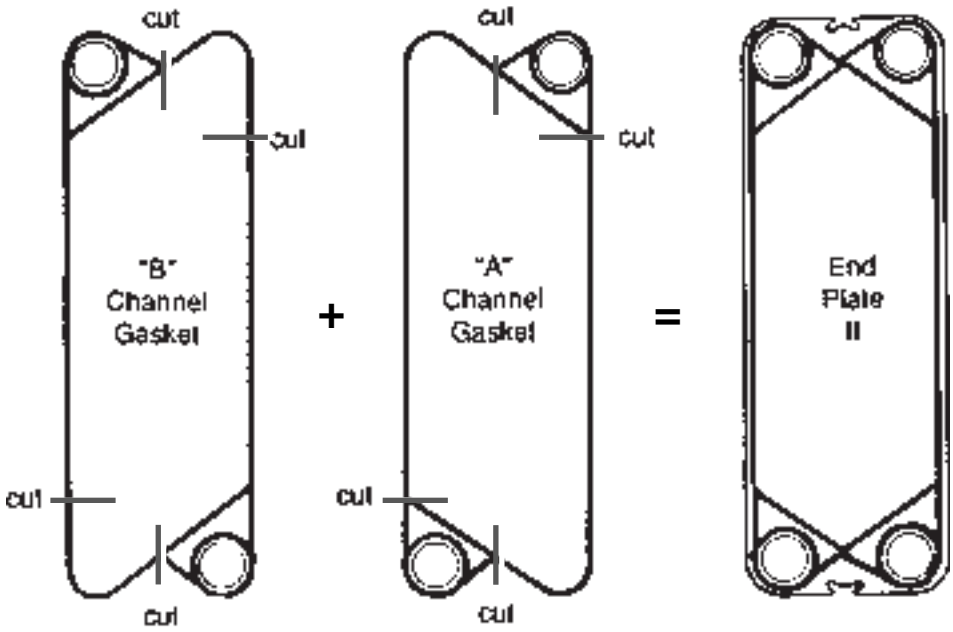
The End Plate II Gasket is formed by cutting (2) channel gaskets (as shown below) and gluing the gaskets to the first plate.



The (2) half channel gaskets should be glued to the end plate with GC-8 glue: or double sided tape (GC-1). The (4) port gasket areas are critical because these gaskets will be in contact with the process fluids.

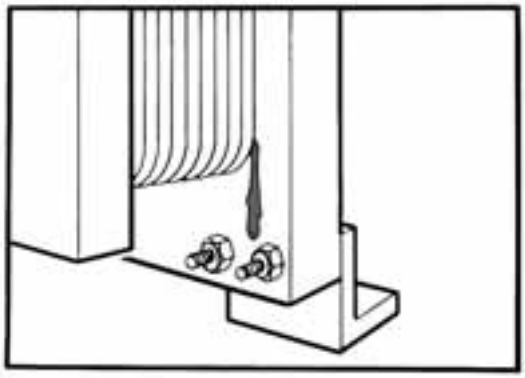
DIAGONAL FLOW UNITS

The End Plate II Gasket is formed by cutting (2) channel gaskets (as shown below) and gluing the gaskets to the first plate.



The (4) parts of the channel gaskets should be glued to the end plate with GC-8 glue: or double sided tape (GC-1). The (4) port gasket areas are critical because these gaskets will be in contact with the process fluids.

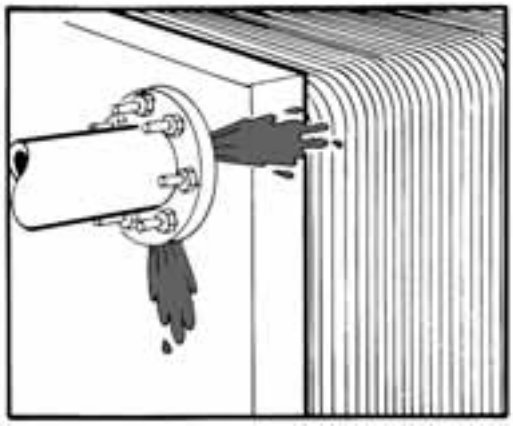
Fault detection



SYMPTOM

LEAKAGE between plates and frame.

ACTION	CORRECTIONS
Mark with a felt tip or similar marker, mark the area where the leakage seems to be, and open the heat exchanger	1. • Relocate gasket. • remove foreign matter. • replace connection lining if applicable. Remove anything disturbing the joint between gasket and pressure plate surface. A perforated end plate must be replaced.
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.	
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.	
3. Check the plate itself for cracks or holes.	



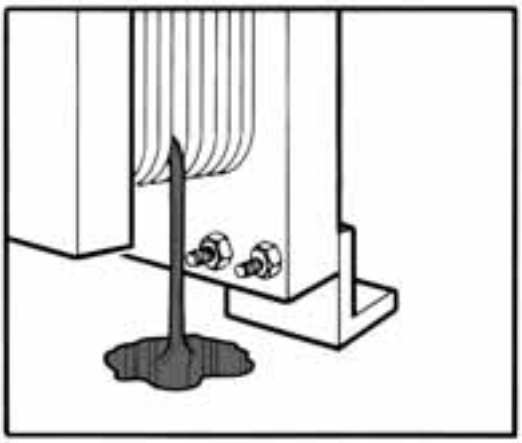
SYMPTOM

LEAKAGE between flange and frame.

ACTION	CORRECTIONS
1. 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.	1. • 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

8 Fault detection

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	CORRECTIONS
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.	
1. Check for loose, dislocated or damaged gasket.	1. • Relocate gasket. • Re-cement loose gasket, if applicable. • Replace damaged gasket.
2. Check for plate damage in the area, and also check plate pack length against the drawing to see if possible plate or gasket damage could be caused by overtightening of the plate pack, or if the leakage itself may simply be caused by insufficient tightening.	2. 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. CONTACT ALFA LAVAL FOR ASSISTANCE IN THE RECALCULATION IF NECESSARY. The small reduction of the heat transfer area is normally of no importance, at least not for a short period of time. • Insufficient tightening must be corrected - see the drawing.
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 4A or 4B).	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.

SYMPTOM

LEAKAGE between plates.

ACTION	CORRECTIONS
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 par. 2 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. • use a magnifying glass to check suspect area. • use a chemical penetrant, after having cleaned the plates well.	5. Plates with holes must be replaced. The PHE may be temporarily operated with a reduced number of plates. See “LEAKAGE between plates to the outside”.

SYMPTOM

PRESSURE DROP PROBLEMS,

Pressure drop has increased

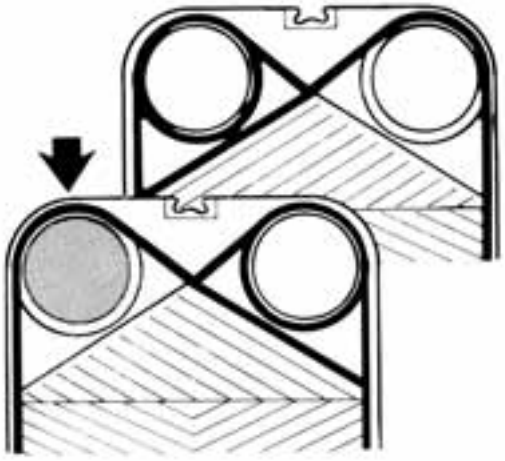
ACTION	CORRECTIONS
Check that all valves are open including non return valves.	
Measure the pressure just before and just after the heat exchanger, and the flow rate. For viscous media a membrane manometer with a diameter of at least 30 millimeters should be used. Measure or estimate the flow rate if 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 plate print out)	
1. If the pressure drop is higher than specified, the temperature program should also be checked:	1. See next paragraph.
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.	1.1 Open the PHE and take out whatever is clogging the passage, or use the back-flush system - if there is one - to rinse out the cloggings.
1.2 If the thermometer readings are NOT corresponding to those 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.	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 PHE and clean the plates.
2. If the pressure drop corresponds to the specifications, there is no need for any action.	2. See pump instruction manual.
3. If the pressure drop is lower than specified, the pump capacity is too small or the observation is wrong.	

SYMPTOM: HEAT TRANSFER PROBLEMS

The heat transfer capacity is dropping

ACTION	CORRECTIONS
Measure temperatures at inlet 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. If great precision is important, it will be necessary to use laboratory thermometers with an accuracy of 0.2 degrees Fahrenheit, and also to use the best equipment available for flow measurements.	If the heat transfer capacity of the equipment has dropped below specified values, the heat transfer surface must be cleaned. Either use the “cleaning-in-place” arrangement if provided or open the heat exchanger for visual inspection and manual cleaning. NOTE: Contact the Alfa Laval Sales & Service Division for CIP recommendations (See Section 1).

9 Supplementary Parts



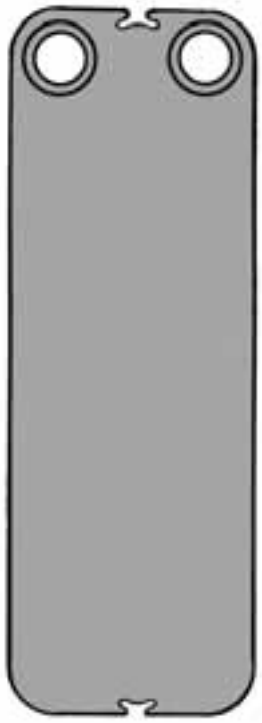
THE PARTITION PLATE - for special cases only.

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

To prevent the thin metal collapsing under the differential pressure, un-punched corners require extra support.

The extra support is provided by a partition plate - approximately the size of a channel plate - made of about 1/4" - 3/4" thick plate material with lined holes where a free passage is required.

The partition plate is suspended from the carrying bar. Where partition plates are required, in units with 8" ports or larger, there will be one at every turning point in a multi-grouped plate package.



Example only

ENSR00006 0207

Operation Description: Programming

Part Description: **Configuration of a Watlow EZ-Zone PM Controller for use in Sentry Cooling Water Skids (CWIS/CWMS)**

Written By: KMK Origin Date: **2/5/2010** Rev# 1

Approvals: (initials & date)

BW	*KMK 12/03/12*	*MLJ*	
Manufacturing	**Engineering**	**QA**	

IMPORTANT **ALL INSTRUCTIONS BELOW MUST BE COMPLETED PER THE ENGINEERING PRINTS SPECIFIED ON THE SHOP ORDER BILL OF MATERIALS.**

MINIMUM OPERATOR QUALIFICATIONS

Assembler "C"

REQUIRED EQUIPMENT

1. None

REQUIRED MATERIALS

1. None

SAFETY EQUIPMENT

1. Safety Glasses
2. Safety Shoes

OPERATION

This work instruction is used to program the PID controller of a Sentry cooling water skid. The controller is a Watlow PM6C3FA-AAFAAAA, Sentry part number 4-05610D.

SETUP PAGE

1. Initiate power to the controller. Press the Up▲ and Down▼ keys simultaneously for six (6) seconds. The controller will enter the Setup page. **Ai** will appear in the upper display and **SEt** in the lower display.

2. Press the Up ▲ or Down▼ keys to view available menus. Press the Advance Key (circle arrows) to enter and view available prompts within a menu. Press the Up ▲ or Down▼ keys to view available menu prompts. Press the Infinity key ∞ to move backwards through levels: parameter to submenu; submenu to menu; menu to Home Page. Press the Infinity key ∞ for two (2) seconds to return to the Home Page.

3. Change the following Setup Parameters as listed. Leave all other Parameters at their default value:

Ai Menu

Display	Parameter Name	Setting
SEn	Analog Input 1: Sensor Type	**r0.1H** = RTD 100 Ω
dEC	Analog Input 1: Display Precision	**0.0** = tenths

LooP Menu

Display	Parameter Name	Setting
h.A9	Heat Algorithm	**oFF** = Off
C.A9	Cool Algorithm	**Pid** = PID

otPt Menu

Display	Parameter Name	Setting
o.ty (for Output 1)	Output **1** Type	**MA** = 4-20 mA
Fn (for Output 1)	Output **1** Function	**CooL** = Cool Function
S.Lo (for Output 1)	Output **1** Scale Low	**4.0**
S.hi (for Output 1)	Output **1** Scale High	**20.0**
o.ty (for Output 3)	Output **3** Type	**MA** = 4-20 mA
Fn (for Output 3)	Output **3** Function	**rMt** = Retransmit
r.Sr (for Output 3)	Output **3** Retransmit Source	**Ai** = Analog Input
S.Lo (for Output 3)	Output **3** Scale Low	**4.0**
S.hi (for Output 3)	Output **3** Scale High	**20.0**
r.Lo (for Output 3)	Output **3** Range Low	**32.0**°F for US customers **or** **0.0**°C for International customers
r.hi (for Output 3)	Output **3** Range High	**200.0**

gLbL Menu

Display	Parameter Name	Setting
C_F	Display Units	**F** = °F for US customers **or** **C** = °C for International customers
AC.LF	AC Line Frequency	**60** = 60 Hz for US customers **or** **50** = 50 Hz for International customers

4. Press the Infinity key ∞ for two (2) seconds to return to the Home Page.

5. Press the Up▲ and Down▼ keys simultaneously for three (3) seconds. The controller will enter the Operations page. **Ai** will appear in the upper display and **oPEr** in the lower display.

6. Change the following Operation Parameters as listed. Leave all other Parameters at their default value:

LooP Menu

Display	Parameter Name	Setting
C.SP	Closed Loop Set Point	**76.6°F** for US customers **or** **24.8°C** for International customers
C.Pb	Cool Proportional Band	**4** °F
ti	Time Integral	**147** seconds/repeat
td	Time Derivative	**27** seconds

7. Press the Infinity key ∞ for two (2) seconds to return to the Home Page.

Revisions

Rev. No.	Description	Date	By
0	Created	02/05/10	KMK
1	Added S.Lo, S.hi for Outputs 1 & 3, r.Lo, r.hi for Output 3, Changed values for C.Pb (3.6 to 4), ti (2.45 to 147) and td (0.45 to 27)	12/03/12	KMK

8.0 Drawings

CWIS-35

Temperature control	Pump/Heat Exchanger	P&ID	GA	EWD
Standard	Single/Single	10-01304A	10-01312P	10-01304M
	Single/Dual	10-01304A	10-01312Q	10-01304M
	Dual/Single	10-01304A	10-01312M	10-01304P (Manual Transfer) 10-01304V (Auto Transfer)
	Dual/Dual	10-01304A	10-01312N	10-01304Q (Manual Transfer) 10-01304V (Auto Transfer)
Close	Single/Single	10-01304G	10-01312V	10-01304N
	Single/Dual	10-01304G	10-01312W	10-01304N
	Dual/Single	10-01304G	10-01312R	10-01304Q (Manual Transfer) 10-01304S (Auto Transfer)
	Dual/Dual	10-01304G	10-01312T	10-01304Q (Manual Transfer) 10-01304S (Auto Transfer)

CWIS-80

Temperature control	Pump/Heat Exchanger	P&ID	GA	EWD
Standard	Single/Single	10-01304A	10-01313E	10-01304M
	Single/Dual	10-01304A	10-01313F	10-01304M
	Dual/Single	10-01304A	10-01313C	10-01304P (Manual Transfer) 10-01304V (Auto Transfer)
	Dual/Dual	10-01304A	10-01313D	10-01304P (Manual Transfer) 10-01304V (Auto Transfer)
Close	Single/Single	10-01304G	10-01313K	10-01304N
	Single/Dual	10-01304G	10-01313L	10-01304N
	Dual/Single	10-01304G	10-01313H	10-01304Q (Manual Transfer) 10-01304S (Auto Transfer)
	Dual/Dual	10-01304G	10-01313J	10-01304Q (Manual Transfer) 10-01304S (Auto Transfer)

CWIS-140

Temperature control	Pump/Heat Exchanger	P&ID	GA	EWD
Standard	Single/Single	10-01304A	10-01304E	10-01304M
	Single/Dual	10-01304A	10-01304F	10-01304M
	Dual/Single	10-01304A	10-01304C (Manual Transfer) 10-01304W (Auto Transfer)	10-01304P (Manual Transfer) 10-01304V (Auto Transfer)
	Dual/Dual	10-01304A	10-01304D (Manual Transfer) 10-01304X (Auto Transfer)	10-01304P (Manual Transfer) 10-01304V (Auto Transfer)
Close	Single/Single	10-01304G	10-01304K	10-01304N
	Single/Dual	10-01304G	10-01304L	10-01304N
	Dual/Single	10-01304G	10-01304H (Manual Transfer) 10-01304Y (Auto Transfer)	10-01304Q (Manual Transfer) 10-01304S (Auto Transfer)
	Dual/Dual	10-01304G	10-01304J (Manual Transfer) 10-01304Z (Auto Transfer)	10-01304Q (Manual Transfer) 10-01304S (Auto Transfer)