

**ARES PHE**

**OPERATION AND MAINTENANCE MANUAL**

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## INTRODUCTION

This instruction manual is a guide for installation, operation, maintenance for ARES plate heat exchanger. It is meant for those who are responsible for the installation, use and maintenance of the heat exchangers. ARES PHE strongly recommends that you read this instruction manual carefully before starting any work.

This manual is applicable to all heat exchangers produced by ARES. Our company is not responsible for any damage due to incorrect installation, use or maintenance of our heat exchangers as well as not complying with our instruction manual.

Please note that ARES plate heat exchangers are specially designed and built for the operating conditions according to the information provided by the customer. Sudden pressure increase above the normal operating pressure, which can occur during start-up or stopping of the system can severely damage the equipment. ARES is not responsible for any damage as a result of any operation deviating from the original design conditions.

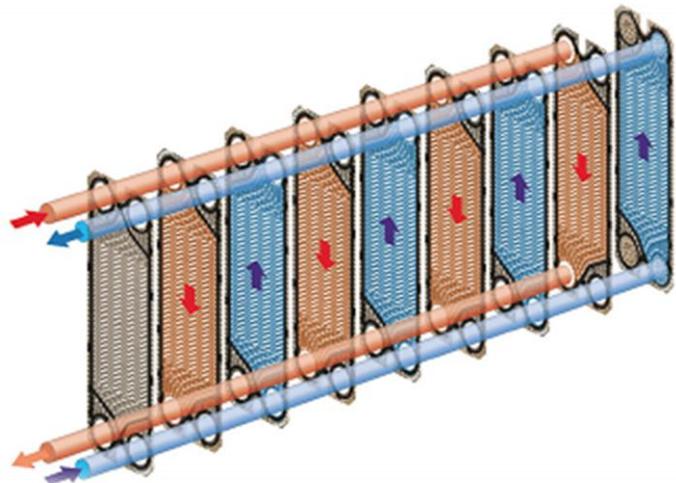
If you would like to contact ARES about any plate heat exchanger, then please have the plate type, serial number ready as mentioned on the name plate of our product.

## PRINCIPLE OF PLATE HEAT EXCHANGER

A plate heat exchanger consists of a frame, which consists of a head plate, pressure plate, support column, carrying bar, guiding bar, and tie bolts. The plates are placed between head and pressure plate and tighten by tie bolts to form a pressure resistant equipment.

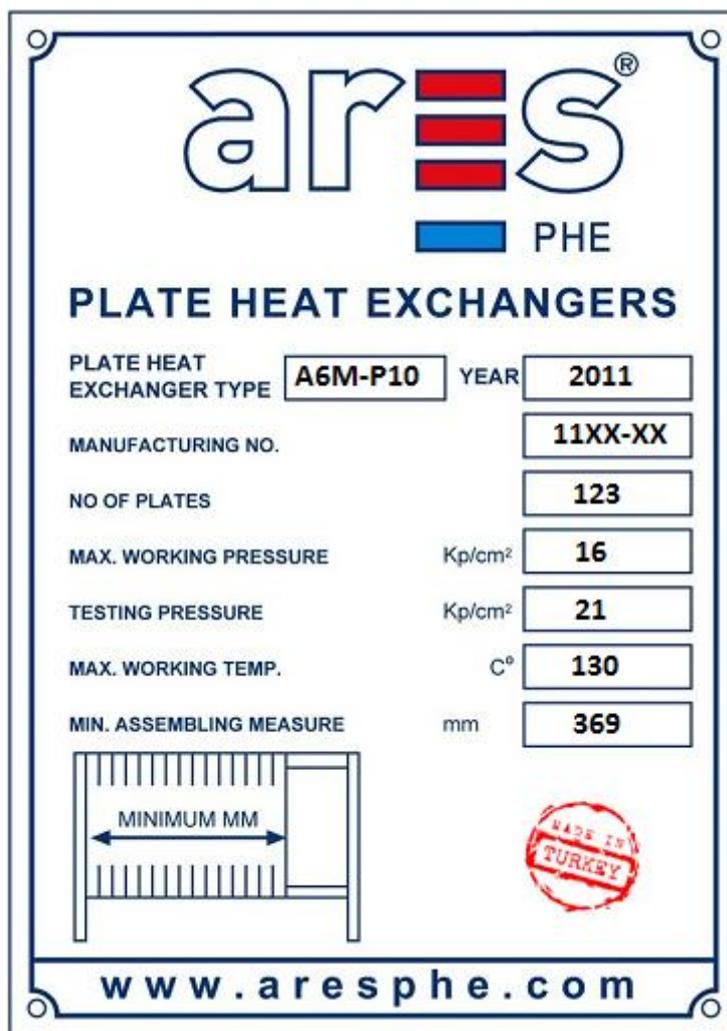
Heat is transferred from one medium to another medium passing through plates, which have been pressed into a special pattern called "herringbone". The hot and cold mediums exchange their heat load between each the plate channel. Positioning of gaskets on heat transfer plates helps to direct the flow of the mediums to prevent mixing the fluids between each other.

Each plate is equipped with a gasket, so that the plates form a pressurized system of parallel flow channels, through which the medias flow alternately at every second interval. Each plate is equipped with a double sealing system that keeps the fluids between the channels. The gaskets are attached on to the plates, which secure tightness between fluids and the atmosphere. When putting plates between the frames, every second plate has to be rotated 180 degrees so that the plates form a closed system. The head plate or/and pressure plate have connections to install pipework which lets the fluids run into the plate heat exchanger.



**IDENTIFICATION OF PLATE HEAT EXCHANGER**

All plate heat exchangers supplied by ARES has a unique name plate fixed to the front (head plate) of the unit. The name plates include necessary information for service and spare part requests. The manufacturing number is a unique one, which holds all the information about the product. In case of loss of this name plate, please ask ARES staff to replace it as soon as possible to avoid any confusion.

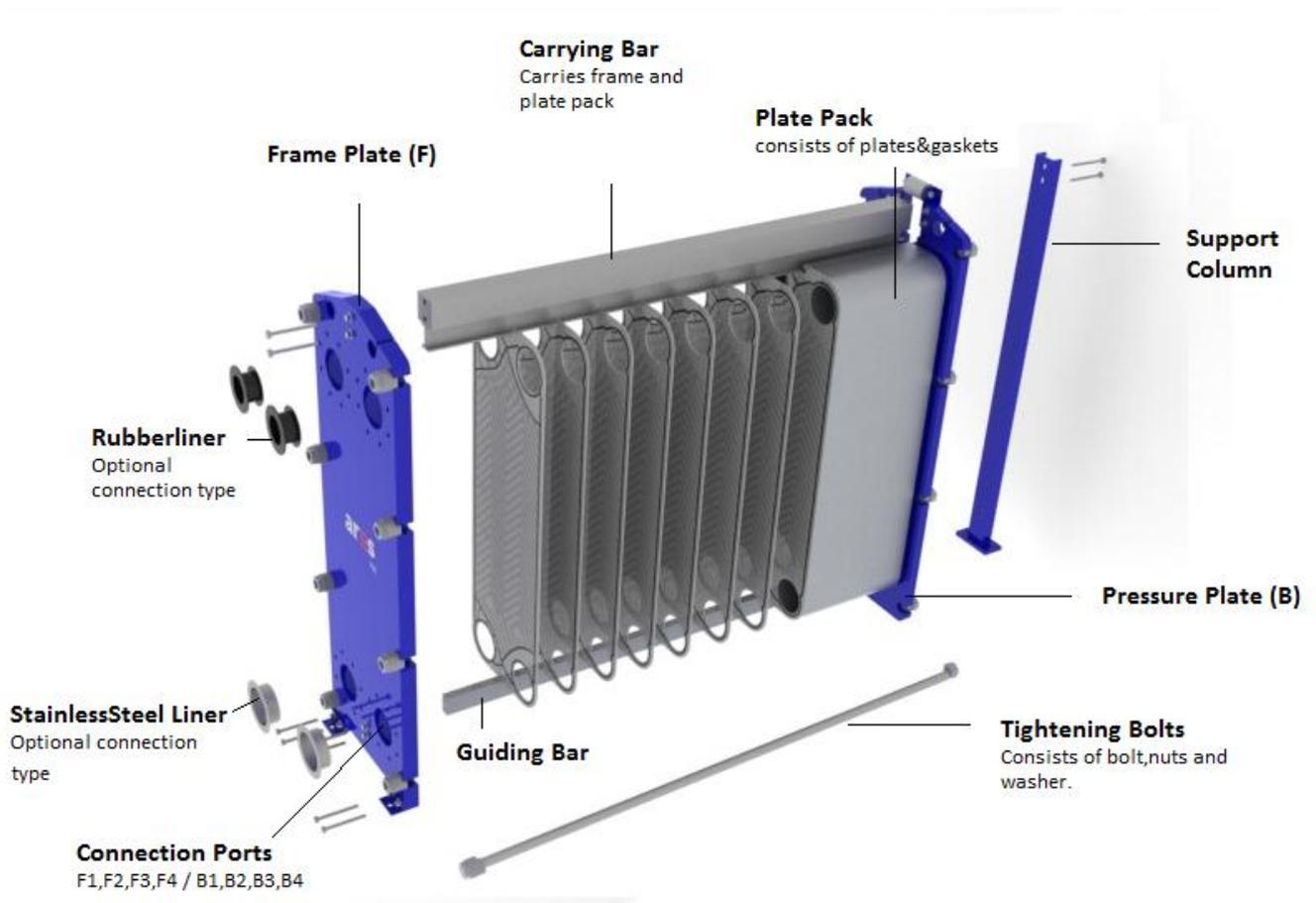


# MAIN COMPONENTS

The plate heat exchanger consists of front frame (head plate), rear frame (pressure plate), carrying bar, guiding bar, tightening bolts, support column and plate pack. The plates are hanged on the carrying bar and are kept in line by a guiding bar at the lower part called guiding bar. The tightening bolts holds the head and pressure plate under pressure.

The length of the carrying bar, guiding bar and tightening bolts vary on different models and plate pack size. In addition, the number of tightening bolts and diameter also vary depending on the model of the plate heat exchanger.

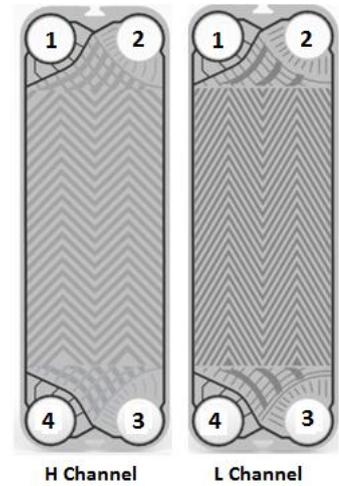
*Optional components are insulation jacket, dripping tray and protective sheet over plate pack. These options are included only during ordering process.*



**PLATES**

The corrugated plates used in plate heat exchangers are manufactured in any metal or alloy which can be cold formed. Stainless steel, nickel alloys, titanium, incoloy are among the most common plate materials. The cold stamping process used to give the herringbone pattern to the plates. The material of the plates vary on the duty of the plate heat exchanger. The fluid properties and corrosion affect determines the quality of the material.

Most of the plate models have two types which are L (Low) and H (High) plates. The plates have different heat transfer and pressure drop performance. Therefore, it is important to identify each plate when assembling or ordering parts for the unit.



The most common plate materials are : AISI316, AISI304 and Titanium Gr.1.

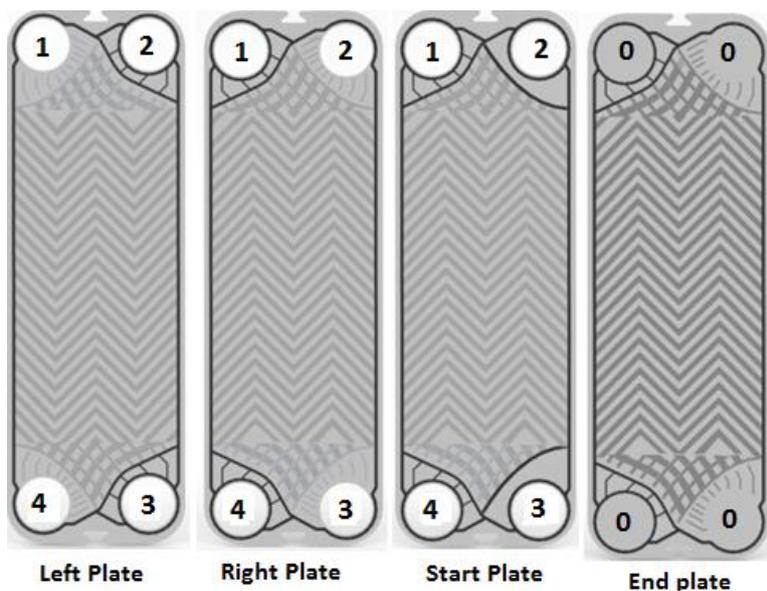
**PLATE TYPES**

The plate pack consists of a start plate, channel plates (H and L ) and an end plate.

**Start Plate** : Two gaskets are cut and glued to the plate as shown on the drawing.

**Left Plate / Right Plate** : These plates are identical to each other. When L plate is turned 180 degrees it becomes right plate.

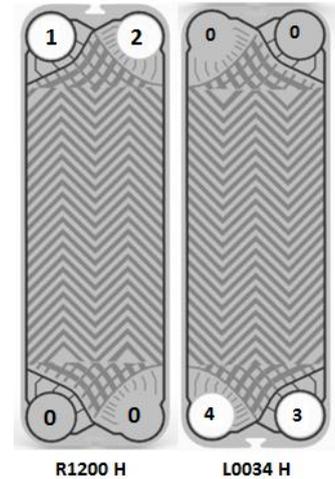
**End Plate** : End plate is a plate without any port hole which is usually situated at the end of the plate pack.



**PLATE PORT HOLES and PLATE TYPES**

Depending on application and plate arrangement the plates might have different hole configurations. Each port is represented by a number. For example: A1S L1234 means that A1S model “L” plate and 4 holes open. 0 means no hole. For example: A1S L1200 means that 1 and 2 ports are open and 3 and 4 are blind ports. It is important to know the plate type whether it is “R(right)” or “L(left)” plate before deciding the port configurations.

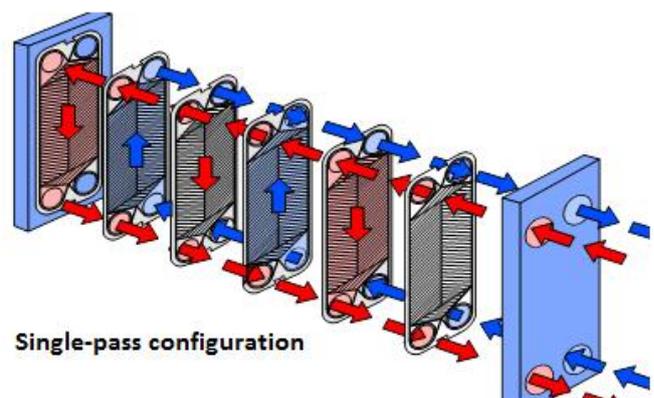
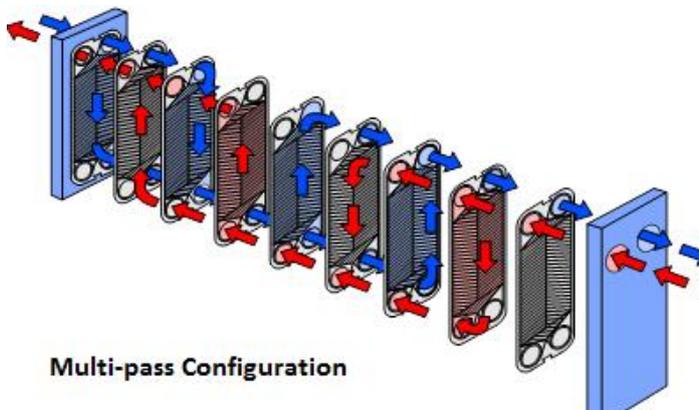
- Flow Plate** : R1234 – L1234
- End Plate** : 0000
- Pass Plate** : Different combinations – 1200, 0034, 1034 etc.



**FLOW ARRANGEMENT**

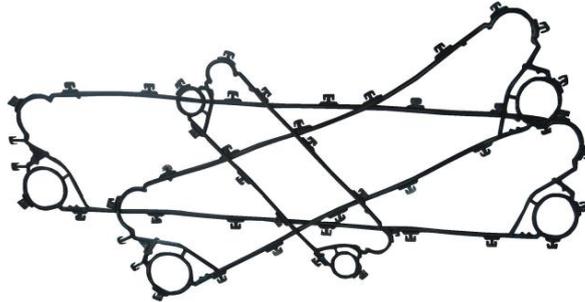
In a single-pass plate heat exchanger design, there is no pass plates with “0” port. A single pass arrangement is when each fluid flows in just one direction in the channels formed by adjacent pair of plates in a plate heat exchanger.

A multi-pass flow arrangement on the other hand is when a plate with less than four port holes is used to make the fluids flow in the opposite direction in a part of the plate heat exchanger.



## GASKETS

The performance and lifetime of the plate heat exchanger is dependent on the gaskets used and their material reliability. Plate heat exchanger gaskets are usually one piece elastomers, and their type is selected on the basis of fluid, operating temperature and conditions. They act as a seal between plates which are seated in gasket grooves on the plates to prevent leakage of the unit.



“A” model ARES plate heat exchangers are all equipped with hang on gasket technology which eliminates the use of glue. Glueless gaskets are much easier for service and operation compared to glued gaskets.

“AWG” model wide gap plate types use only glued type gaskets. Therefore please pay extra attention when servicing these models.



- **IDENTIFICATION OF ARES GASKETS**
  - EPDM : GREY COLOR
  - NBR : BLUE COLOR
  - VITON : BROWN COLOR

*NOTE: For accurate information to order spare parts, please provide serial no. of the plate heat exchanger which is on the name plate over the frame.*



**USE ONLY NITRIL BASED GLUES ON GASKET**

*Note: Please consult ARES for the best solution for glues.*

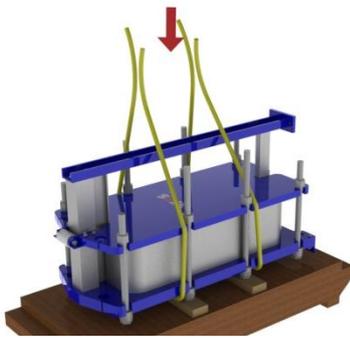
## INSTALLATION

Installation of the plate heat exchanger requires a careful operation. It is important to follow each step in order to have a safe and correct operation.

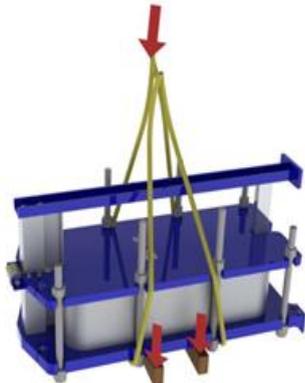
Plate heat exchangers are sensitive equipments which can be damaged during carrying and installation. It is important to use lifting lugs or instructed way to lift and carry them. If handled wrongly, the plate pack might move and result in leakage during start up.

It is also important that the space required for plate heat exchanger is enough for servicing and replacing plates&gaskets. When positioning the unit, the space must be left from all sides for ease of operation.

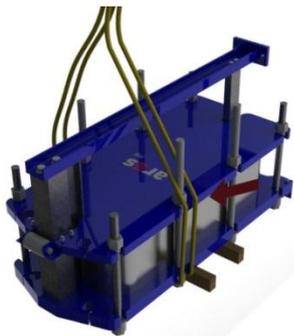
## TRANSPORTATION



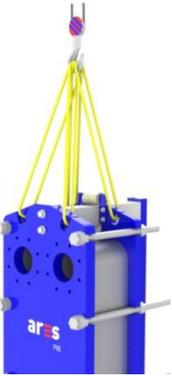
Please follow the necessary steps to lift the product. If the heat exchanger is lying down on a wooden pallet, it must be lifted as shown in the picture. It is important to have balanced lifting technique to avoid any kind of fall and injury.



After lifting the heat exchanger, place it on top of 2 or more timbers which creates a space between the floor and the heat exchanger. You can also use other material than wood such as hard plastic etc. After placing the heat exchanger carefully on the floor. Please follow next to put it on standing position.



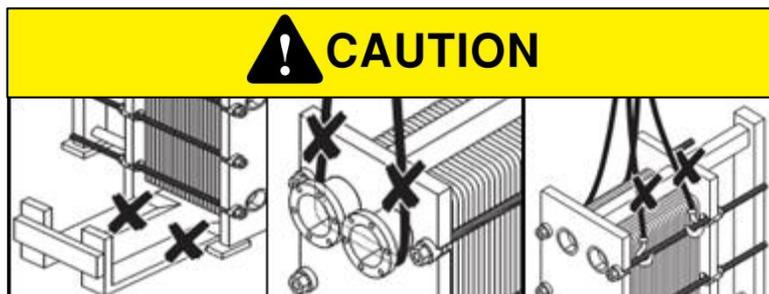
Place straps from bottom to the top of the plate heat exchanger as shown on the left photo. As you do this make sure that the bolt nut is between the straps. This will ensure the equipment will not slide down when lifting.



Please use lifting lugs when lifting and/or carrying the plate heat exchanger (A4,A6,A8, A12 and AWG models). Do not use any other part such as; bolts, carrying bar etc. to avoid any damage. Make sure the that the lines are equal and do not create imbalance when lifting the unit to prevent any injury.

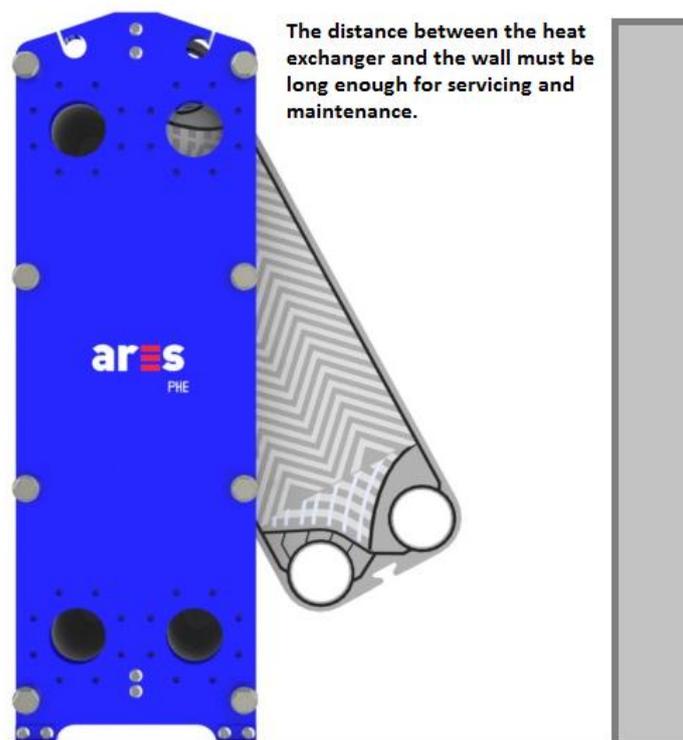
*For (A1,A2,A3) small models there are no special lifting lugs, therefore you can use nuts and bolts on the frame and pressure plate to carry the plate heat exchanger. Please follow same procedure for carrying and lifting.*

*During these operations, please pay attention to the guidelines. Damage to the plate pack and frame construction might create serious problems such as leaking, bending plates and connections.*



## POSITIONING - INSTALLATION

- Make sure the foundation of the plate heat exchanger is flat and level.
- The heat exchanger **MUST** have enough area on either side for easier access during maintenance. The amount of space should be minimum as the plate height.
- The pipe work must be fully supported to avoid weight/forces acting upon the unit.
- Always install flexible connections onto the follow cover to prevent vibrations. These flexible connections also prevent expansion of the pipe work, caused by temperature influence onto the heat exchanger.
- The pipe work needs to be thoroughly cleaned and flushed before connecting up to the heat exchanger.
- Always install vents on the top and drains on the bottom of the heat exchanger for proper venting.
- Install drain valve on lower side of a bottom nozzle, and vent valve on upper side of a top nozzle for plate heat exchanger.
- Install safety valve for suitable capacity near an outlet nozzle for the safety operation of plate heat exchanger.
- Install pressure gauges and thermometers on the inlet/outlet nozzles on both circuits to observe performance/fouling of the plate heat exchanger.
- Install elbows on pressure plate for multipass plate heat exchangers to ease the maintenance of the unit. **DO NOT** install direct piping to the pressure plate which may cause serious problems when the unit needs to be opened.



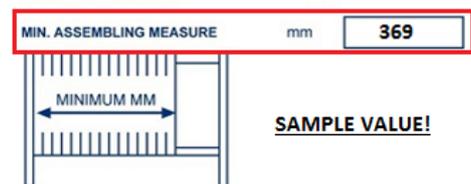
## OPERATION

Commissioning should only be done by a person, which has been trained specially for the job. Control, maintenance and repair of the plate heat exchanger should be done by authorized, trained and properly trained staff.

Maintenance and cleaning should always be done with a shut down heat exchanger. Check if all connections are correctly fitted or not. The media flowing through the heat exchanger should not contain any bigger particles and if necessary, filters should be fitted. Check the pressure and temperatures of the media and make sure that the values are not more than the specified value on the identification plate.

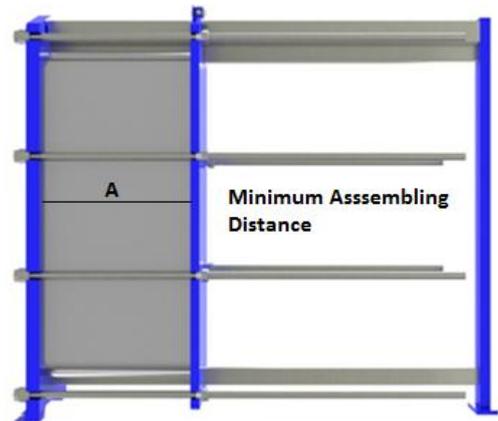
### START - UP

Before starting up for first time or after a long shut down of the system, make sure that the plate pack is compressed to the right measurement (*see name plate - min. assembling measure*). It is very important that the plate heat exchanger is protected against **sudden and extreme change of temperature and pressure** to avoid damages to the plates and the gaskets.



*Before the initial start-up:*

- Check that the operating data does not exceed the data given on the heat exchanger's nameplate: Max. design temperature, max. design pressure.
- Check that all tightening bolts are properly tightened.
- It is recommended that to start the pump first for *cold circuit*. Pumps feeding the plate heat exchanger must be provided with regulating valves. If the pumps can deliver higher pressure than the rated pressure for the plate heat exchanger, safety valves must be installed. The pumps must not suck in air which can affect heat transfer performance. Higher pressure rates may result gasket failure and leakage during start up.



- To avoid pressure shock the pumps must be started against closed valves. The valves on the inlet and outlet should be opened at the same time as possible. The flow rate is then increased slowly until operating temperature is reached. Hammering must be avoided; otherwise the rubber gaskets may slide out of the groove and may result leakage. Check that the exit valve is fully opened during starting condition. Then, open the vent, start the pump, open the valve slowly.
- Immediately after start-up the equipment must be vented. Remaining air can cause air locks and serious deformation of the plates, reducing the heat transfer capacity and increasing the risk of corrosion.
- Cold leakage might happen during cold conditions and when the unit reaches to the working temperature it should stop. Therefore, please observe leakage if there is any, until the working the plate heat exchanger reaches to the working temperatures.

***When using steam as one of the media:***

- Make sure that the steam control valve is fully closed
  - Make sure that the plate heat exchanger is fully drained of condensate
  - Start cold circuit first, then the steam side
  - Open steam control valve slowly – this helps preventing water hammer of any condensate in the steam circuit and reduces the pressure/thermal shock to the exchanger.
    - *Thermal/pressure shocks can create fatigue on plates and may result cracks on them.*
  - Ensure that the steam trap is correctly sized to allow full condensate discharge –this prevents water clogging inside the exchanger which may crack plates and damage gaskets.
- 
- **Always check for pressure pulsations in the heat exchanger caused by the pumps and/or control valves.**
  - **Always check the unit for leakages.**
  - **Check that all vents are closed to prevent air being sucked into the system.**



**SHUT DOWN**

- **Shut-down for a short period**

If the plate type heat exchanger has to be shut down for a short period, please follow the following procedure:

- Slowly close the control valve in the hotcircuit while maintaining the full flow in the cold circuit,
- Shut off the hot circuit pump/s,
- Cool down the heat exchanger to under to safe temperature to handle,
- Gradually close the control valve in the cold circuit,
- Shut off the cold circuit pump,
- Close all remaining shut off valves (inlet and outlet for both circuits).

- **Shut-down for a long period**

Apply procedures for shut-down for a short period, then follow the steps below:

- Let unit to cool down so it can be handled safely,
- Drain all circuits by drain valves
- Lubricate threads on the tightening bolts to prevent friction,
- Loosen tightening bolts until the plate pack is relaxed,
- The tightening bolts should not be removed or loosened to such an extent that dirt is allowed to enter in-between the plates.
- The plate heat exchanger must be drained fully since some steady media can create corrosion or different type of contamination on the plate surface.
- It is recommended to cover the plate pack to protect from sunlight, welding, or any kind of reconstruction work.



## MAINTENANCE

Maintenance of the plate heat exchanger is the most important factor to have safe and reliable operation. ARES PHE recommends preventive maintenance to avoid any sudden problems which can affect your valuable process. Therefore, it is essential; depending on the applications plate heat exchangers must be serviced from time to time. ARES also suggests that to keep minimum number of spare parts as plates and gaskets for any unforeseen problems caused by these equipments.

ARES staff is available at all times for your need and assistance for your service needs.

Before handling the plate heat exchanger:

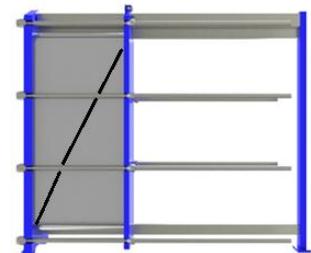
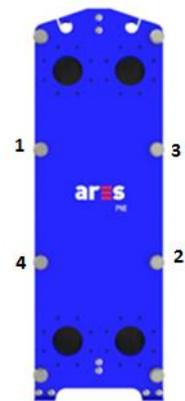
- Always wear protective equipment when handling plate heat exchanger.
- Make sure the media inside the circuits is not dangerous in a way of skin contact, inhaling etc.
- Always work on spacious place to avoid any injury or cut from the plates.
- The plates have very sharp edge, handle them carefully.



## OPENING THE PLATE HEAT EXCHANGER

*Please follow the required steps to open the plate heat exchanger.*

- Slowly close the valves on the inlet nozzles.
- Shut off pumps and close the valves on both outlets.
- If the plate pack is too hot, then wait until the temperature is cooled down.
- Open the drain & vent valve to empty the media (Open the first drain valve, and vent valve).
- Remove pipe connection from head plate and pressure plate (if the unit is multi pass).
- Check sliding surface of carrying bar and roller of movable cover to see for any part as an obstacle.
- Remove protected cover from tie bolts.
- Clean the threads of the tie bolts and lubricate with grease to reduce friction
- Mark the no. of plates in sequence as shown on drawing.
- Remove the tie bolts from the frame.
- Pull away the pressure plate to have access to the plate pack.



## CLEANING

Most of the plate heat exchangers are exposed to fouling/contamination. Contamination/fouling may occur at the inlet ports, plate port area and on the plate itself in different types. Fouling if not cleaned increases the pressure drop (as a result of clogging) and reduces the heat transfer performance. Therefore, cleaning is essential to prevent these problems. Fouling on the plates can be removed manually or by CIP (cleaning in place). The cleaning of the plate heat exchanger may vary depending on the size, application, plate and gasket material.

- **Frame Cleaning**

- Clean the outside of the PHE frame, especially the carrying bar, guiding bar, bolts.
- Grease the tightening bolts so they are not exposed to corrosive environment
- If there is any chipped paint area, redo paint damage on the frames to prevent spreading of corrosion.



- **Plate Cleaning**

Cleaning agent must be chosen carefully, which can remove the scaling on the plates without damaging the plates and gaskets. All stainless steel material has a protecting layer and this film must not be destroyed, since this layer provides the resistance of the stainless steel against corrosion. We advise you to ask for a confirmation from the supplier of the cleaning agent that it will not damage the materials. Follow the instructions carefully as given by the detergent supplier/cleaning specialist.

- **CIP Cleaning**

CIP (Cleaning In Place) is method of cleaning without opening the plate heat exchanger. Cleaning media is pumped through the plate pack to clean the mild/medium fouling on the surface of the plate. Depending on the application and level of fouling CIP might be best solution but not a permanent solution for your process. It is important to use the correct cleaning media against the contamination to be effective.

*Use only recommended cleaning agents by ARES.*

- **Manual Cleaning**

- Open the unit in according to the given disassembly procedures
- Clean each plate separately while hanging or on a flat surface depending on the level of contamination.
- **Never use a steel brush** on the plates. If a brush is required, use the ones with hard plastic or similar which are softer and do not have metal content in it. If iron is forcibly rubbed on a stainless steel surface, it will result in accelerated rusting and/or corrosion.
- Be careful not to scratch the gasket surfaces which can cause leakage.
- After brushing, each plate should be rinsed with clean water.
- Use high pressure rinse when cleaning to be more effective.
- The gaskets must be wiped dry and solid particles to be removed off them ( Even a grain of sand might cause leakage if stuck between a plate and a gasket)
- The lower portion of each plate as hung in the unit should be inspected carefully and cleaned appropriately as this is the primary area where residual solid material tends to accumulate.



- **Do not use hydrochloric acids, or water containing in excess of 300 ppm chlorides, with stainless steel.**
- **Do not use phosphoric or sulfamic acid on titanium plates.**
- **DO NOT USE cleaning solution concentration to 4% in strength, with temperatures not exceeding 60°C unless otherwise specified.**

**RECOMMENDED CLEANING AGENTS**

<p><b>Cleaning agents - Incrustation,scaling</b></p> <p style="text-align: center;"><b>Concentration max 4%</b></p> <p style="text-align: center;"><b>Temperature max. 60 °C</b></p>		
<b>Incrustation-Scaling</b>	<b>Sediment</b>	<b>Cleaning agent</b>
Calcium carbonate	Corrosion products	Nitric acid
Calcium sulphate	Metal oxides	Sulfamic acid
Silicates	Silt	Citric acid
	Alumina	Phosphoric acid
	Diatomic orgsnisms and colours their excrement of various colours	Complexing agnets (EDTA,NTA) Sodium polyphosphates
<p><b>Cleaning agents - Biological growth, slime</b></p> <p style="text-align: center;"><b>Concentration max 4 %</b></p> <p style="text-align: center;"><b>Temperature max. 60 °C</b></p>		
<b>Biological growth -Slime</b>	<b>Cleaning agent</b>	
Bacteria	Sodium hydroxide	
Nematodes	Sodium carbonate	
Protozoa	Cleaning effect can be considerably increased by the addition of small quantities of hypochlorite or agents for the formation of complexes and surfactants	
<p><b>Cleaning agents - Oil residues, asphalt fats</b></p>		
<b>Deposit</b>	<b>Cleaning agent</b>	
Oil residues Asphalt Fats	Paraffinic naphta-based solvent (e.g.kerosine)	
	<b>Gaskets in EPDM swells in these media. Contact time should be limited to 30 minutes.</b>	
<p><b>Cleaning agents - Gasket Glue</b></p>		
<b>Glue Deposit</b>	<b>Cleaning agent</b>	
Dried glue for gasket	Methyl Ethyl Ketone (MEK) - Acetone	

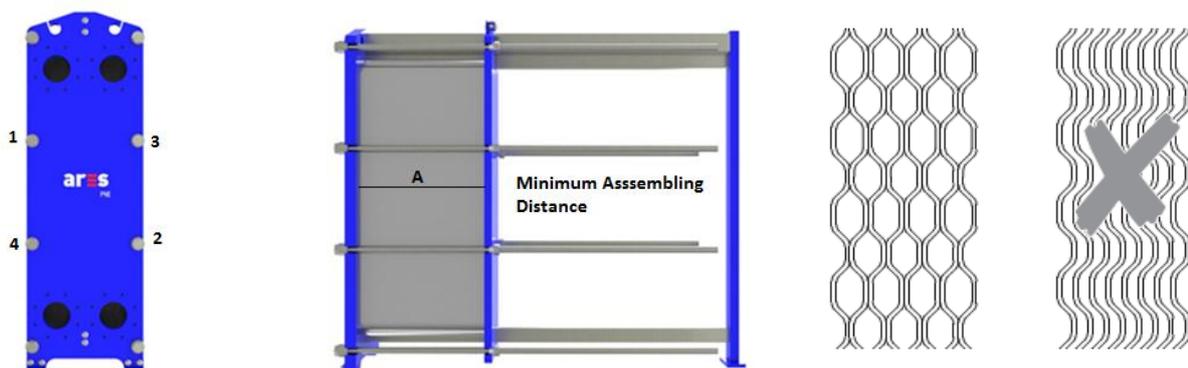


## CLOSING

After maintenance and servicing the heat exchanger, you can close it according to the below specifications.

Different type of tools such as hydraulic and pneumatic can be used to ease the operation of closing. Tightening the plate pack is more difficult as it comes closer to the minimum tightening distance, therefore it is recommended to do it in 30 minutes intervals as it gets harder to let the plate pack settle during this time.

- Put plates one by one in to the frame, checking each gasket surface to prevent any particle to enter between plate and gaskets.
- Make sure that you put plates in the right place as you draw a line before disassembling it.
- After putting all the plates between the frame push/close the pressure plate (rear frame) to keep the plate pack fixed in between.
- Observe that you have a honeycomb pattern as shown on the drawing, which indicates correct placement of the plate pack.
- Put lubrication oil on tightening bolts and nuts to reduce friction force.
- Put longer bolts first and then start tightening by the desired method. Tighten the bolts in cross method so the frame is not deformed by an excessive force.
- When plate pack is tightened to a certain distance, put shorter bolts to keep a balanced tightening method. Make sure the difference along the plate pack is not over 5mm after changing to the other bolts.
- Tighten the unit until the minimum tightening distance (A) is reached.
- Make sure that final difference along the plate pack at each section is not over 3mm.
- Test each circuit before putting into operation to see if there is any leakage at any section.
- Follow procedures for start-up.



**TROUBLESHOOTING**

PROBLEM	POSSIBLE CAUSE	SOLUTION
<b>Leakage</b>	At connection between frame and flange	*Check the rubber liners *Check the flange gasket *Check the O-ring *Fit the pipes tension-free
	Mixing of hot and cold fluids	*Check the plates for holes and/or cracks
	Plate pack	*Check the assembly distance *Check the condition of the gaskets *Check the proper position of the gaskets
	Pressure and temperature above design parameters	*Adjust operating conditions
<b>Insufficient capacity</b>	Air in the system	*De-aerate the pipe system by air-vents *Check the pipe work for possible air traps
	The operating conditions deviate from the specification	*Adjust the operating conditions ( flow rate, inlet temperatures)
	The heat exchanger is dirty	*Clean the heat exchanger
	The connections have been interchanged	*Redo the pipe work (apply inlet and outlet ports as in the datasheet)
<b>Too high pressure drop</b>	Flow larger than the design flow	*Adjust the flow
	Plate channels are blocked	*Flush/clean
	Instrument malfunction	*Check the pressure indicator
	Medium deviating from the design properties	*Addition of cleaning agents or anti-freeze may change performance
	Air in the system	*De-aerate the pipe system *Check the pipe work for possible air traps
	Inlet ports are clogged	*Apply CIP or open heat exchanger to clean port entries
<b>Mixing Fluids</b>	Piping connections are correctly placed	*Change piping according to the datasheet
	Make sure pass plates (if the hex is multi pass) placed according to the plate arrangement list	*Open heat exchanger and place plates correctly according to the flow arrangement list
	Make sure the gaskets on the diagonal part, where the ports are not slipped off the groove	*Open heat exchanger and spot the plate which has a slipped gasket.
	Cracked plates	*Open heat exchanger and dye-penetrant test each plate to find the crack.