EURO HEAT

PLATE AND SHELL HEAT EXCHANGER

INSTALLATION AND OPERATION MANUAL 1.1

TABLE OF CONTENTS

1.0 GENERAL INFORMATION

Manufacturer information

- manufacture of plate heat exchangers

Industrijska bb, 34000 Kragujevac

tel.: 034 345 055, fax: 034 341 342

e-mail: office@euroheat.co.rs

website: www.euroheat.co.rs

1.1 USER INFORMATION

The information in this manual applies to EURO HEAT standard products.

Please always obey the note given by this guide. Otherwise, the company EURO HEAT is not responsible for damage caused by incorrcet instalation, operation or maintenance attributed to failure to observe these instructions.

Only authorized and qualified persons are allowed to perform installation, commissioning and maintenance of heat exchanger.

Users are obliged to comply with all national (international) regulations and norms concerning equipment under pressure, storage and transport of dangerous liquids and gases (if they are used in the operation of heat exchanger)

Explanations and instructions that must be followed in order to avoid system damage and workers' injuries are marked with red triangles 

Explanations and instructions that must be followed in order to ensure proper and smooth operation of heat exchanger are marked with a yellow triangle

If any modification to the heat exchanger installation is required, follow these instructions. In the event that there are no indications related to the specific modification in this manual or some explanation is not explained enough, contact the manufacturer, EURO HEAT.

1.2 APPLICATION OF HEAT EXCHANGER

EURO HEAT heat exchangers are designed to meet the specific requirements (working temperature, operating pressure, flow rate) set by the customer. Exchangers are manufactured in accordance with European standard PED 2014/68/EU.
In the event of any change in operating modes that deviate from the regime specified when ordering a heat exchanger, contact the EURO HEAT and wait for a written approval that the heat exchanger may be used under altered operating conditions.

1.3 IDENTIFICATION OF HEAT EXCHANGER

Each EURO HEAT heat exchanger is supplied with an identification plate, placed on the front of the heat exchanger. The table contains basic information about the heat exchanger. Make sure that the table can always be accessed and that data can always be read from the table.

euro heat	EURO HEAT PLATE HEAT EXCHANGER Serbia, 34000 Kragujevac www.euroheat.co.rs	CE 1837-21 +381 34 345 055
Type		
Year built / Serial number		

	Plate side	Shell side
Working medium		
Design pressure min/max (bar)		
Test pressure (bar)		
Test date		
Design temperature min/max (°C)		
Volume (L)		
Fluid group PED 2014/68/EU		
Weight (empty/in work) (kg)		

Heat load (kw)		
Working temperature inlet (°C)		
Working temperature outlet (°C)		

1.4 BASIC ELEMENTS OF HEAT EXCHANGER

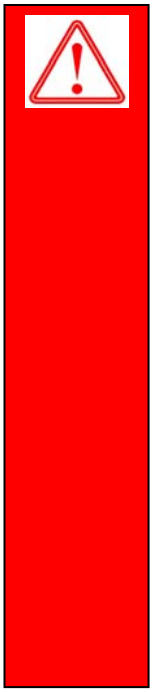


Plate heat exchangers are devices that are under high pressure in working mode and therefore must be connected, put into operation and maintained only by a qualified person.

National and international regulations (eg European Standard PED 2014/68/EU) concerning equipment under pressure, transport and use of hazardous liquids and gases as well as occupational safety regulations must be respected.

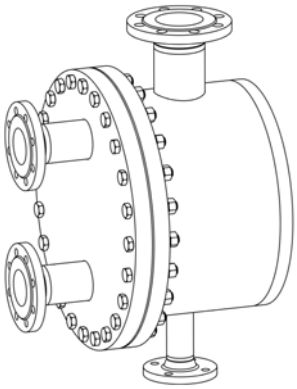
Do not make any modifications or reparations on the heat exchanger while the heat exchanger is pressurized and until the temperature of the exchanger does not drop below 40 °C.

If the operating temperature of the heat exchanger exceeds 90 °C, a certain type of protection (not supplied with the exchanger) must be provided in order to avoid contact with the hot surface and eventual injuries of the work personnel.

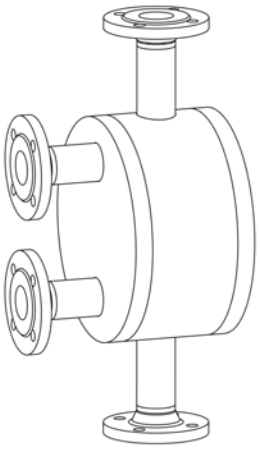
Due to the existence of high pressure, it is recommended to use a safety valve (not supplied with an heat exchanger) in front of an heat exchanger in order to protect the heat exchanger from unplanned pressure increase.

Design operating conditions for each unit appear stamped on the name plate of the unit and are shown on the general arrangement drawing furnished with the unit. The heat exchanger should never be operated under conditions that exceed those stamped on the nameplate.

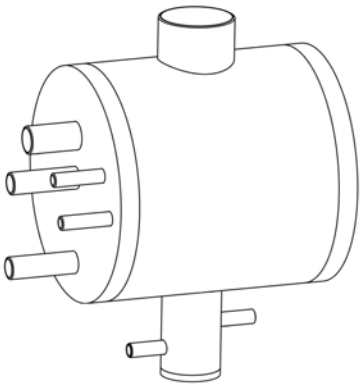
Openable



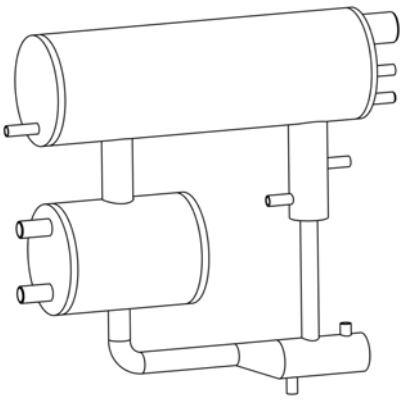
Fully welded



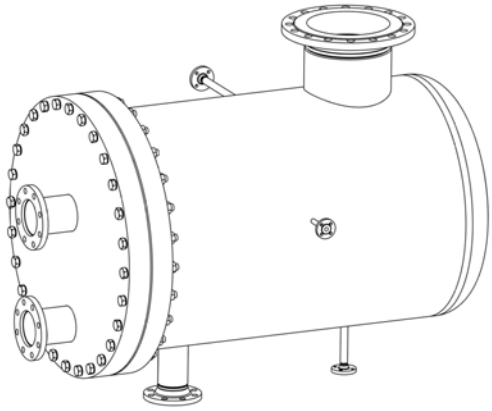
Flooded evaporator
with internal droplet separator



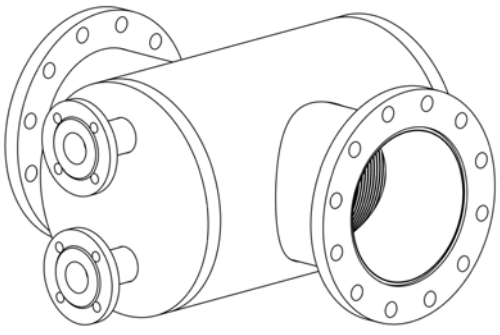
Floded evaporator
with external droplet separator



Steam generator - kettle type



Gas heat exchanger



2.1 WORKING PRINCIPLE OF PLATE HEAT EXCHANGER

The plate heat exchanger consists of a number of profiled metal plates with openings through which two mediums (fluids) pass and between them the heat exchange takes place.

Two inner plates are welded together into a two plate package, and then they are welded with each other into a plate pack and placed inside the shell.

The inner plates are profiled to increase the heat exchange surface. The profile of the inner plates also accelerates the streaming fluids turbulence and strengthens the inner plate and thus protects them from possible deformations that can arise due to the difference in pressure between the primary and secondary side of the heat exchanger.

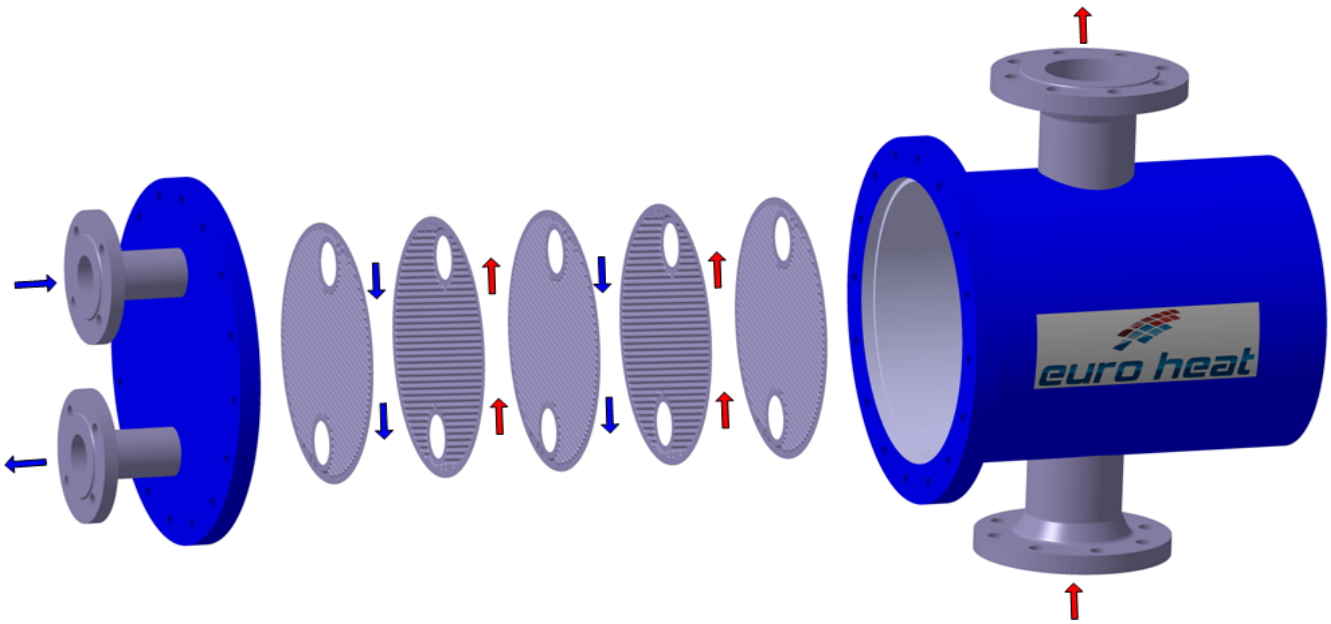
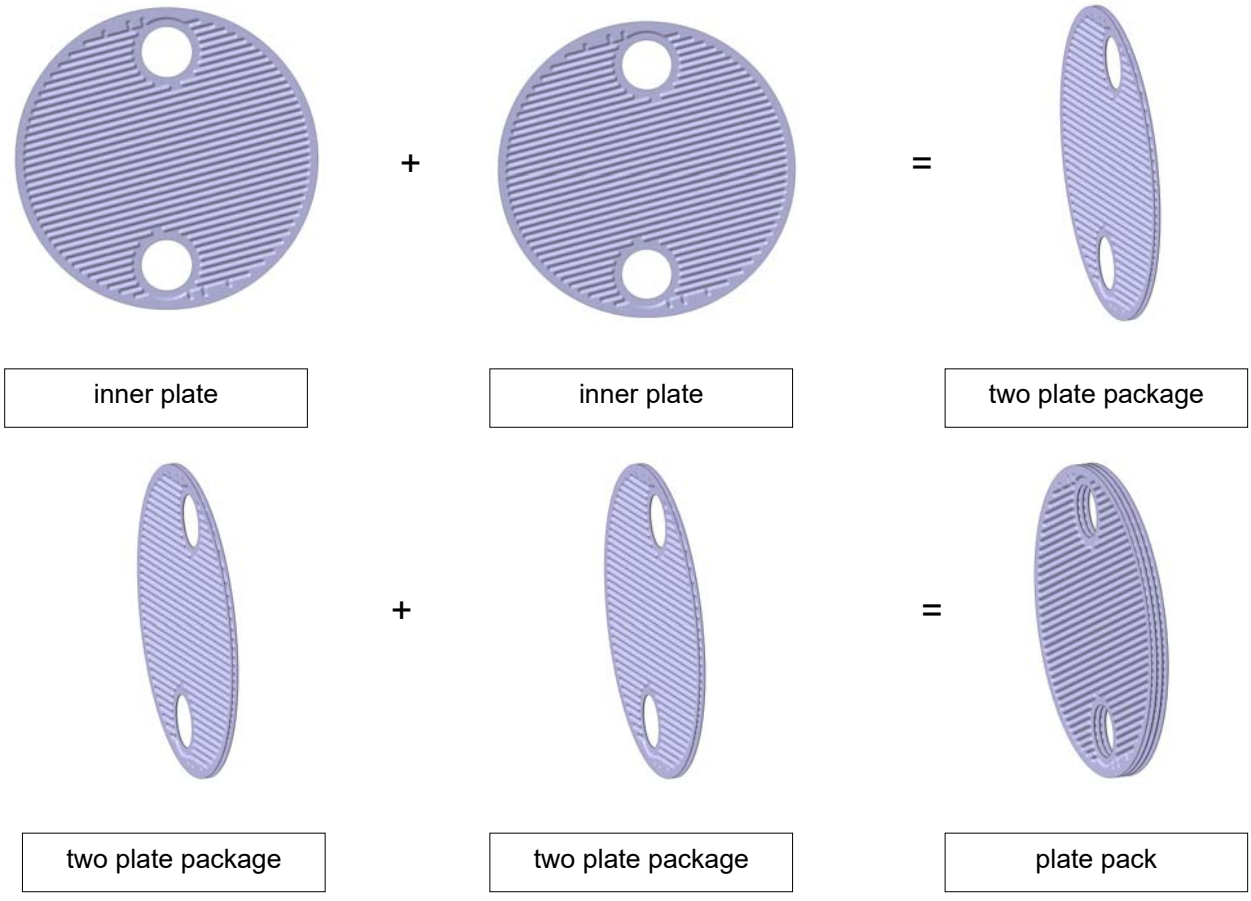


Figure 1. Working principle



2.2 BASIC ELEMENTS OF HEAT EXCHANGER

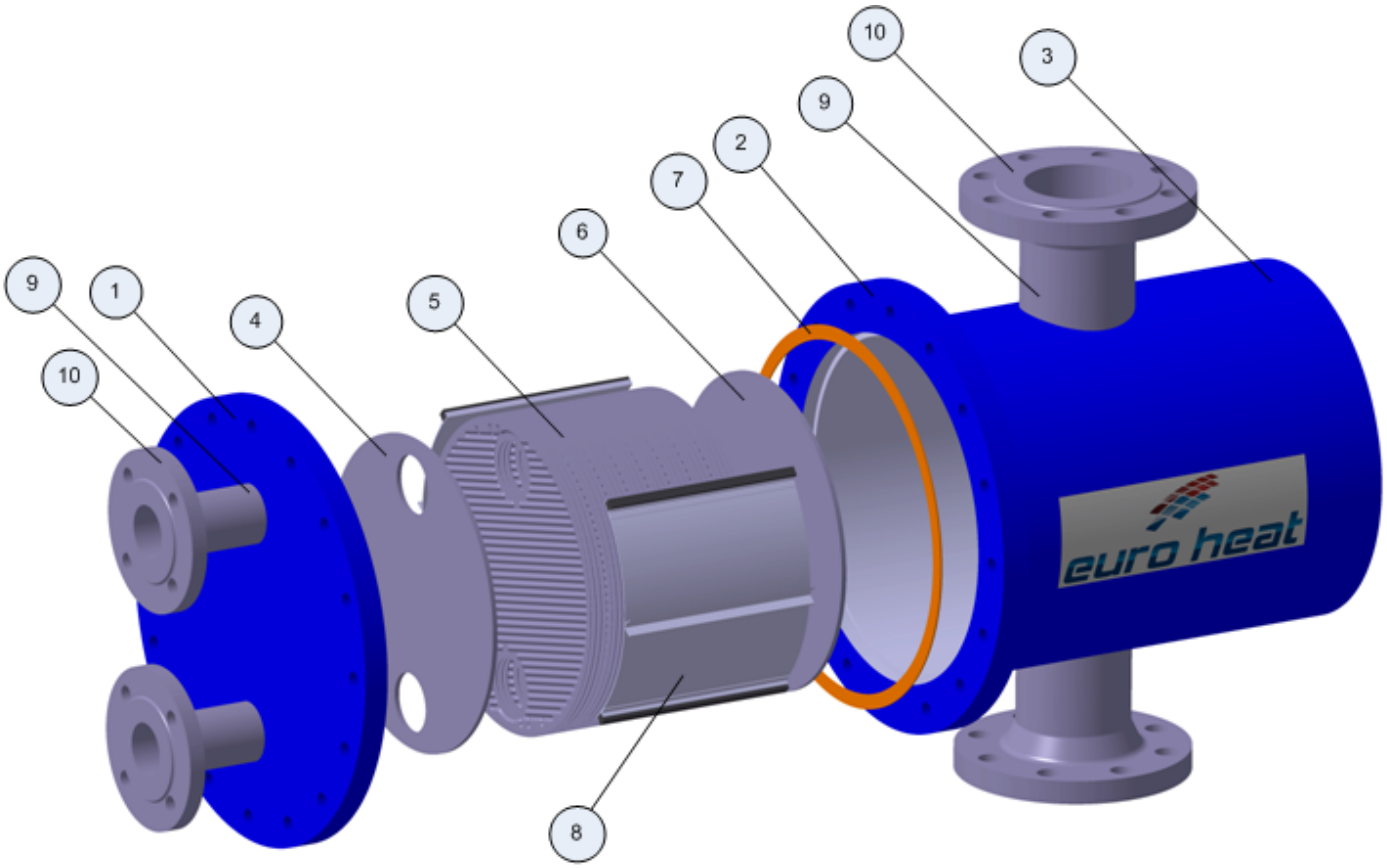


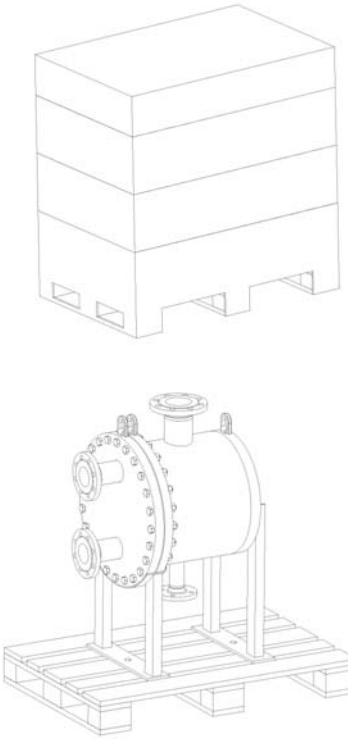
Figure 2. Basic elements of heat exchanger

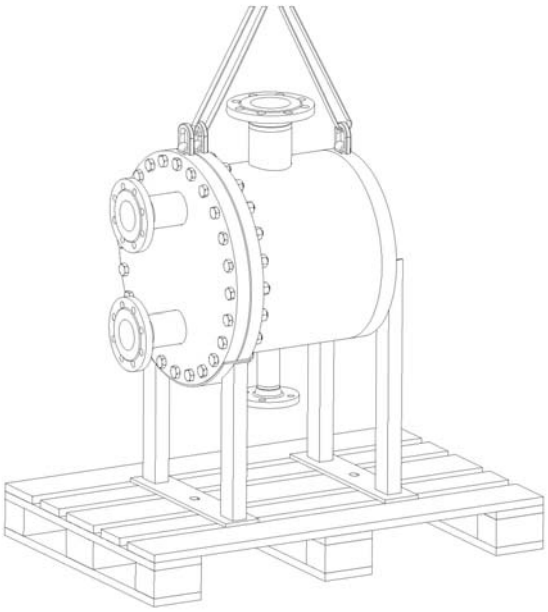
Number of component	Name of component
1	Bottom plate
2	Ring
3	Shell
4	Bottom plate of plate pack
5	Plate pack
6	End plate of plate pack
7	Gasket
8	Flow directors
9	Connections
10	Flanges

3.0 TRANSPORT, UNLOADING, INSTALLATION IN THE WORKING SPACE

3.1 TRANSPORT AND UNLOADING

Plate and shell heat exchangers are usually transported in two ways. If the heat exchanger has feet, it is necessary to attach the carrier straps to the lift lugs (Figure 1). In the second case, if the heat exchanger is without feet, attach the belts around the ring and under the nuts (Figure 2). While unloading, transfering and manipulating, pay attention to the security measures. Generally heat exchanger is delivered with lifting lugs or lifting eye lugs. In case that lifting lug is not on unit, use textile belt around the shell.





WARNING:

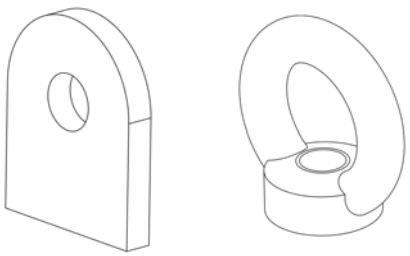
-Never lift the heat excahnger by nozzle or apply any force to the connections while lifting

-Never lift the heat excahnger if unit is not empty.

- Do not weld anything to the heat exchanger without the manufacturer's permission.

- If unit is delivered without feet, customer must support feet, to secure that unit don't have impact on installation and installation on unit.

Wooden pallets can be treated according to IPPC norm: ISPM 15.



Lifting eye/lug	Lifting force
M16 DIN582	700 kg
M20 DIN582	1200 kg
1T (welded)	1000 kg
3T (welded)	3000 kg
5T (welded)	5000 kg
7T (welded)	7000 kg

3.2 INSTALLATION OF HEAT EXCHANGER IN THE WORKING SPACE

During the instalation consider below steps

FREE SPACE

- It is necessary to leave a minimum of 1000 mm of free space between the heat exchanger and the walls to allow access to the heat exchanger for regular inspection and maintenance, as well as possible service interventions (Figure 4).

- In the case of a openable heat exchanger, a free space on the back side is also required. This space is the sum of the length of the shell and additional 1000 mm (Figure 5). The length of the shell is given in the technical documentation of the heat exchanger.

- Ensure that there is enough space above the *heat excahnger in order* to lift it freely.

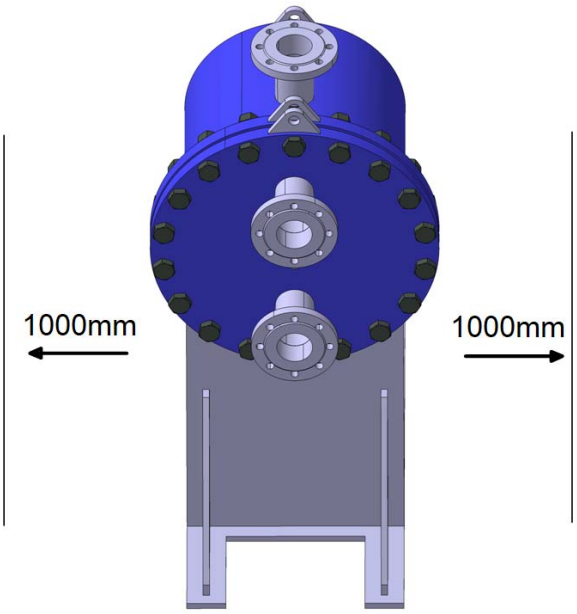


Figure 4. Required space from the sides

FOUNDATION

- The heat exchanger must be placed on a flat surface.
- If necessary use shims to level the heat exchanger.
- Mount the unit securely to the foundation using anchor bolts, anchor hols indicated on GA drawings.

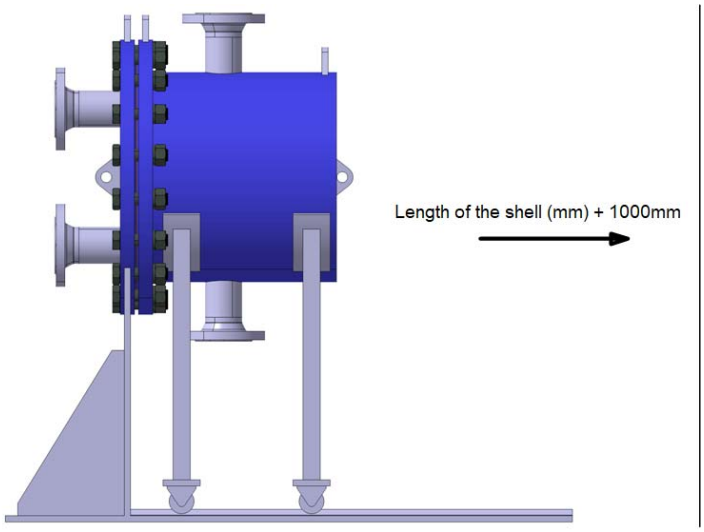


Figure 5. Required space from the back side

SHUT-OFF VALVES

- The shut-off valves must exist both on primary and secondary lines, to allow servicing of the heat exchanger.

FILTERS OR STRAINERS

- The channels of plate pack is designed for use with clear fluids. Thus, fibers or particulate matter can plug channels. External filter or strainer should be used when solids are present.

PIPING

- Connections are marked and should be connected according to the GA drawing.
- Check table to avoid overloading of nozzles during instalation
- Avoid long, straingt piping runs in the inlet and outlet approaches
- Use elbows and expansion couplings to accommodate thermal expansion, pulsation and hydrodynamic shock that could damage the heat exchanger or its nozzle.
- Position pipe support no more than 2m from the connections to prevent stress on the connection nozzle
- For openable construction, take care about piping around the heat exchanger to secure smoothly removing plate pack from shell.

VALVING AND PUMPS

- To prevent water hammer slow-acting valve should be used. It should be possible to increase flow rates gradually and reduce them gradually when the system in being shut down or start up.
- Globe or butterfly valve are recommended; these should be mainteined in good working order.
- When the maximum pump discharge pressure exceeds the maximum design pressure of the heat echanger, a pressure reducing valve should be installed at the exchanger inlets.

VENTS AND DRAINS

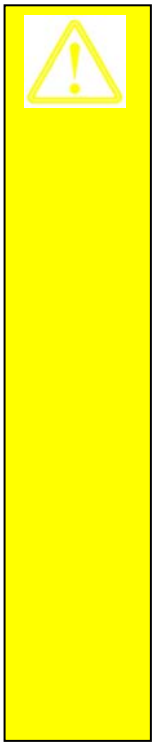
- Vents and drains are stadard on multi-pass units adn all units where the application involves gases, noncondensable gases, refiregants or two-phase flow.
- In these applications always connect the vent and draing couplings to the drawining and venting circuits through valves.

RECOMMENDATIONS FOR STEAM SERVICE

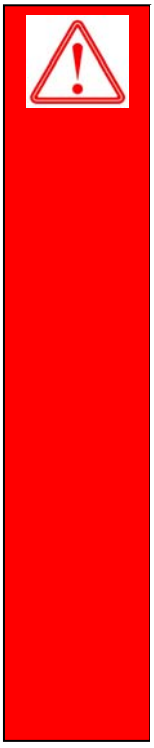
- Instal moisture separators, pressure relief valves and float & thermostatic steam traps to prevent condensate accumulation in the plate pack channels. This will protect the exchanger from possible water hammer damage.
- When the unis is operating with vacuum steam, condensate pumps should be used to prevent backflow of condensate into unit and system-inducted ''stall'' conditions.
- Vacuum breakers should be installed at the plate pack channel inlet to prevent condensate nackflow into plate pack due to the vacuum produced by condensation of steam during shut-down.
- If unit work as steam condenser, control process on the steam side. If it must be controlled on the condensate side, the condensate control valve should operate within 80-110% of its range to avoid ''on/off'' cycling.

VACCUM OPERATION

- If unit will operate under vacuum, make sure that the circuit of concern is rated for full vacuum as indicated on the data sheet and GA drawing. Install a vacuum break at the outlets to prevent liquid backflow and water hammer problems.



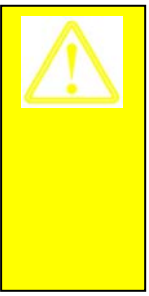
- Before connecting to the pipe network, check that there is no foreign body in the heat exchanger.
- When connecting to the pipe network, check that the pipes do not exert any pressure on the heat exchanger.
- It is not advisable to use quick-release valves in order to avoid the risk of hydraulic shock.



- Safety valves should be installed in accordance with the current technical regulations for pressure vessels.
- If the surface of the heat exchanger on shell side is below -10°C or above 65°C, it is recommended to add the insulation or some other protective layer.
- The maximum operating temperatures and pressures for each model of heat exchanger are indicated on the identification plate and must not be exceeded.
- Never apply pressure in plate pack, if plate pack is out of shell.

4.0 START UP OF HEAT EXCHANGER

4.1 START UP



Before start up check the following:

- Inspect unit carefully. For openable unit, ensure that the cover plate nuts are properly torqued (not for new product, only after service).
- Connections comply according to GA drawing and properly support.
- Heat exchanger and pipeline must be properly vented
- Check any safety appliances are properly connected
- Secure no risk factors in the pipes that could cause **hydraulic shock** (water hammer) or suddne changes in pressure.
- If there are more than one pump in the system, check which of the pumps needs to be put into operation first.

Start up:

First start with cold side, and than gradually start the flow on hot side. If liquid has high viscosity start hot side fisrt. For operation of the heat exchanger at low temperatures, if there is a possibility of freezing, always start the hot side first, then easy put the cold side into operation.

The flow adjustment should be carried out slowly and gradually in order to protect the system from sudden changes in pressure and temperature. **Recommended limit of the heating rate is 100°C per hour for first 100°C. Heatinig rate is max 5°C/ minute Pressure increase or decrease is max 1 bar/minute.**

For steam application cooling water must be on higher pressure than steam pressure in condensate side controlled unit. If pressure is smaller cooling water can evaporate and that can be risk for damage of plate pack.
Never leave the steam on with the liquid side turned off. Alaways steam turn off first and on last.

To start up heat exchanger follow next steps:

1) Make sure the cold side inlet shut off valve between the pump and heat exchanger is closed.
2) Make sure that shut off valve on cold side outlet is open.
3) Open vent valve to remove air, then start the pump.
4) Slowly open the shut off valve on cold side inlet. Close hte vent valve when all air has been removed.
5) Wait few minutes, than repeat steps from 1-4 for hot side.

4.2 SHUTTING DOWN

Shutting down:

To shut down unit follow steps from 1-4 fot hot side , then repeat the procedure for the cold side. Always decrease the flow rate to the hot side until closed. Then shut fown the cold side flow.

1) Slowly close the hot side inlet shut off valve.
2) Switch off the pump.
3) Close the outlet valves shut off valve
4) Drain and vent the unit
5) Repeat steps 1-4 for the cold side.

Warining:
In steam application, always first close shut off valve on steam side.

4.3 STORAGE OF THE PSHE AND LONG TIME SHUTDOWNS

Storage time 30 days or less

- Keep heat exchanger indoors and protect them against water or rain.
- Caps on flanges or connections can be removed before installing to piping system.

Storage time mpre than 30 days

- Must be requested separately in purchase order.
- Heat exchanger will be filled with nitrogen 0,5-1 bar g.

Storage time more than 30 days after working

- Heat exchanger must be filled with clean, distilled water or clean condensate. The unit must be 100% full during the storage and it must not leak during storage.

4.4 PERIODICAL INSPECTIONS

Fully wedled heat exchanger:

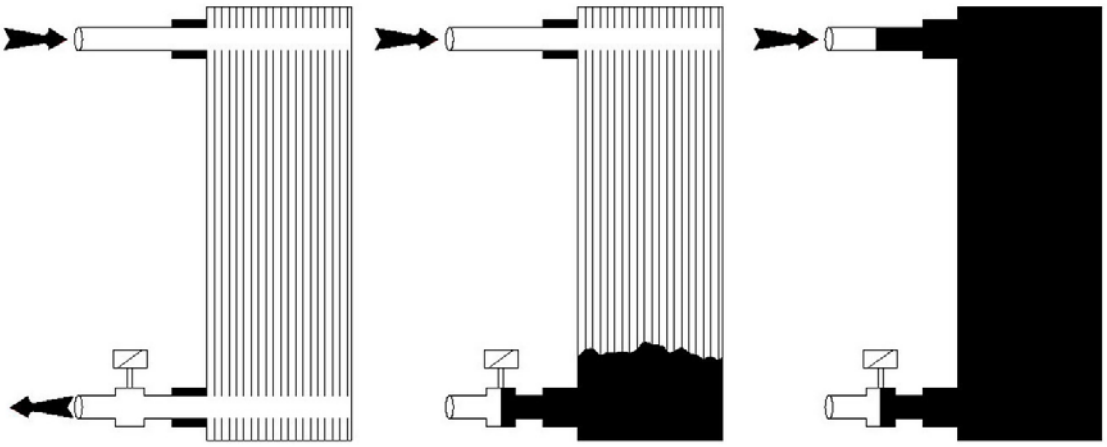
-Inspection period 2 years, external inspection visually.
-Inspection period 4 years, internal inspection of shell chamber with endoscope.
-Inspection period 8 years, pressure test.

Openable heat exchanger:

-Inspection period 2 years, external inspection visually.
-Inspection period 4 years, internal inspection of shell chamber with endoscope.
-Inspection period 8 years, pressure test.
-Internal inspections by opening the unit.
Visual check of shell chamber and plate pack.

4.5 FLOW RATE AND WATER HAMMER

The flow adjustment should be carried out slowly to avoid the risk of a **hydraulic shock**.
Sudden changes in the velocity of incompressible fluids flow (such as water) can cause a hydraulic shock, a phenomenon that can seriously damage pipes, valves, heat exchanger and other components of the system. The most common cause of hydraulic shock is the closing the shut-off valve too fast. An abrupt discontinuity of the fluid flow leads to a multiple pressure increase relative to the normal operating pressure. A very high pressure wave is moving through the pipes between the breakpoint and the exit point of the system. At the exit point of the system the velocity of the pressure wave is approximated to the speed of sound.



Normal operating conditions, the valve is open

The rapid closing of the solenoid valve causes a sudden increase in pressure

Very high pressure waves move back and forward through the installation

The impact wave generated in this way can cause significant damage as it leads to alternating expansion and collecting of the pipeline. With gasket heat exchanger a hydraulic shock can cause the popping out of the gaskets as well as the large deformation of the inner plates, resulting in leakage of the working fluid. Valves with controlled closing times can be used to avoid the risk of hydraulic shock

4.6 FLUIDS

Material of heat exchanger are selected according to the information (fluids, temperatures pressure etc.) provided by the customer.

When working fluid in heat exchanger is water, it's necessary to check quality of water. Minimal quality of water must be according to EN 12953-10 and VdTUV 1466. Water must be softened without mechanical impurities, chemical preparation of water is necessary, see Table 1, which is related to the above-mentioned standards.

	Slightly salty		Salty
El. Conductivity on 25°C µS/cm	10-30	>30-100	>100-1500
General requirements	Clear, no sediments	Clear, no sediments	Clear, no sediments
pH value on 25°C	9-10	9-10,5	9-10,5
pH value according to -drinking water provisions -provisions on the preparation of drinking water	≤9,5	≤9,5	≤9,5
Oxygen (O_2) mg/L (values for continuous operation significantly lower)	<0,1	<0,05	<0,02[*1]
Earth alkalis (Ca + Mg) mmol/L	<0,02	<0,02	<0,02
Phosphate (PO_4) mg/L	<5	<10	<15
Phosphate (PO_4) according to mg/L -drinking water provisions -provisions on the preparation of drinking water	≤7	≤7	≤7
Phosphate (PO_4) mg /L for manufacturers of boiling water	<2,5	<5	<15
When using agents for mg/L Oxygen binding Sodium sulphite (Na_2SO_3).The relevant guidelines of the supplier must be observed when using other suitable products.	-	-	<10

Table 1.

* 1 If suitable inorganic corrosion inhibitors are used, the oxygen concentration in the water cycle can be up to 0.1 mg / liter.
VdTUV 1466 draws attention to the fact that other means of binding oxygen are offered in the form of chemicals that may contain the following substances:
Ascorbic acid, carbohydrate, diethydroxylamine (DEHA), Hydroquinone, Methylethylketomix (MEKO) and Tannins.

5.0 MAINTENANCE AND CLEANING THE HEAT EXCHANGER

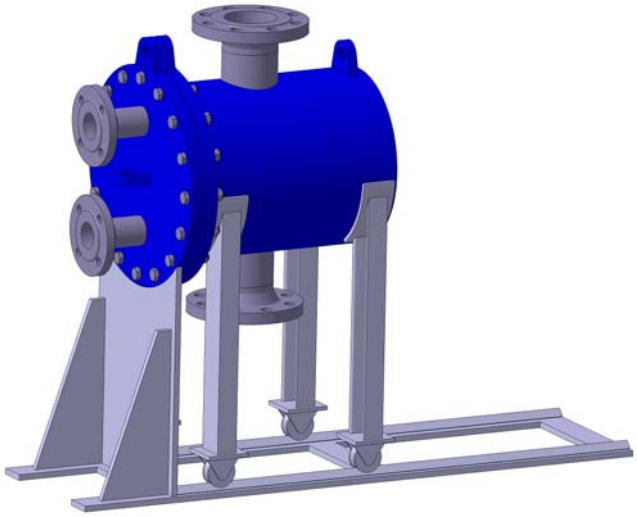
5.1 TROUBLESHOOTING

Problem	Possible causes	Check	Corrective action	Remarks
External leakage at cover plate on openable unit	Flange gasket failure Improperly torqued nuts.		Retorque nuts, if leak does not stop replace gasket.	Follow required moment for tighten bolts, and material of gasket.
Mixing fluid on plate and shell side	Plate pack failure due to water hammer, thermal shock. Hole in a plate due to corrosion. Mechanical damage	Check that plate side liquid is visible on shell side. Close plate or shell side valves increase pressure and follow is there pressure falling.	Contact the manufacturer.	If corrosion is reason of failure, check chloride contect of the fluids. If high, consider purchasing appropriate material.
Low thermal performance and very high pressure drop.	Plate or shell side clogged with accumulation of debris or scale from the process. Connection on plate and shell side must be connected according to GA drawing		Measure pressure drop across each side of the unit to make sure which side have problem. If connection is not correct, change according to GA drawing.	
Gradual decline of heat transfer performance	Progressive fouling of the plate and/or the shell side.		Clean one or both channels as required.	Review the cleaning strategy to avoid unscheduled

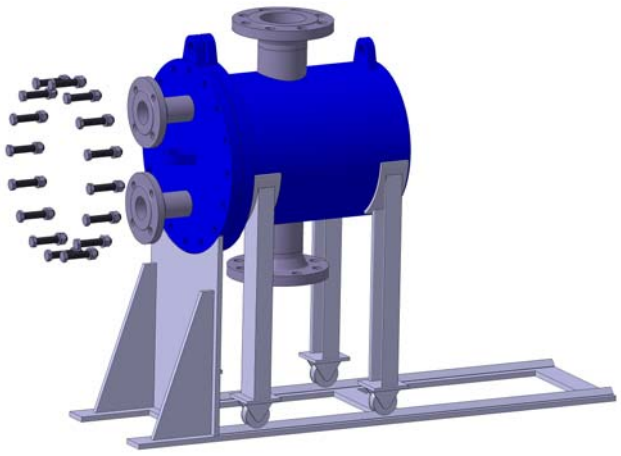
5.2 OPENING AND CLEANING

5.2.1 MECHANICAL CLEANING

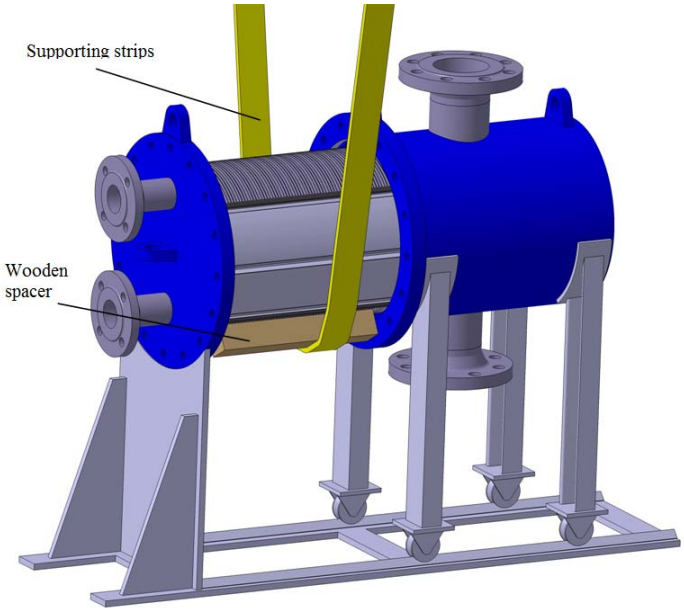
1 The heat exchanger is removed from the pipe network



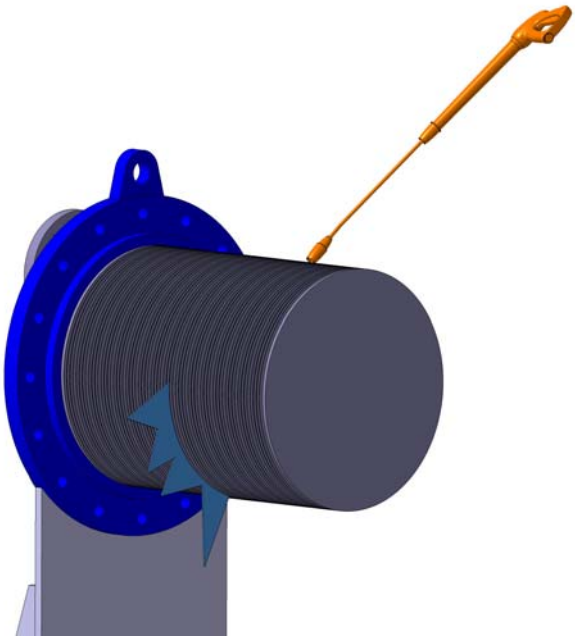
2 Dismentle all the screws



3 Opening the heat exchanger



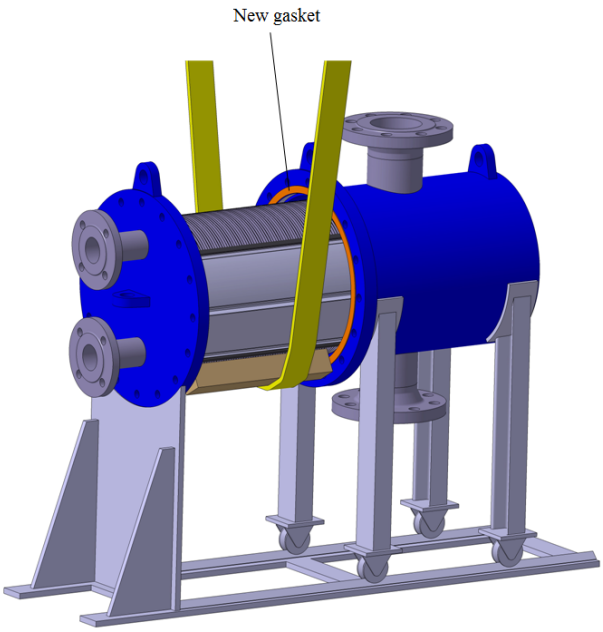
4 Washing the plate pack



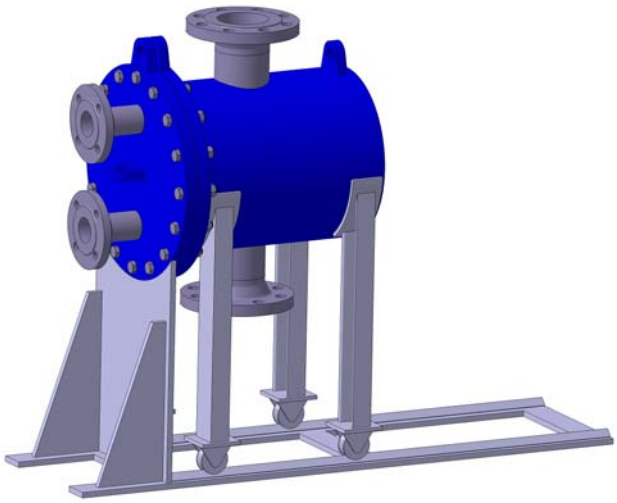
After washing and cleaning, put back the plate pack of the heat exchanger in the same way. Also it is necessary to replace the gasket as shown in Figure 1.

Never apply pressure in plate pack, if plate pack is out of shell.

1 Putting back the plate pack to the shell with a new gasket



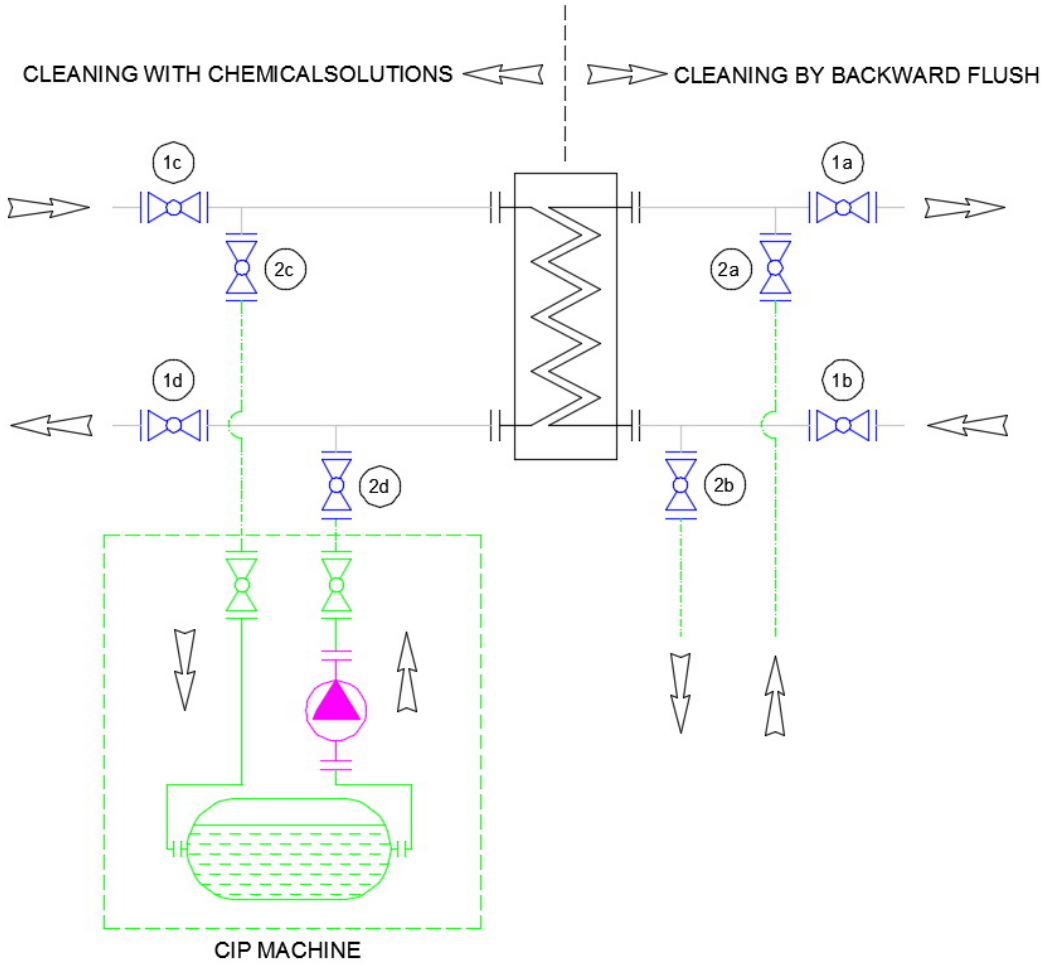
2 Closed heat exchanger and ready for use



5.2.2 CIP

SUGGESTIONS FOR CLEANING PLATE HEAT EXCHANGER BY CIP (CLEANING IN PLACE) METHOD

Reasons for cleaning plate heat exchanger can be many, depending of type of heat exchanger, application in which heat exchanger is used, etc. If there is possibility of fouling it is necessary to monitor performance of heat exchanger by measuring inlet/outlet temperatures and also pressure drop on primary and secondary side of heat exchanger. If working parameters differ much from designed, it is time to clean heat exchanger.



CLEANING BY BACKWARD FLUSH

In cases when deposits on inner plates are created by loose materials or organic compounds and deposits are not solid, most commonly used cleaning method is backward flow.
Warm water or cleaning medium is flushed through heat exchanger with high velocity (velocity should be 2÷3 times greater than normal velocity) through primary/secondary side of heat exchanger in direction opposite to working direction. Valves connecting heat exchanger to pipes must be closed and drain valves on pipelines must be open. Cleaning medium (dirty) that was used for cleaning heat exchanger must be disposed in accordance with law regulations.

Description of backward flush method :

- close valves 1a and 1b

- wait till temperature of heat exchanger drops between 10ºC and 30ºC

- drain working fluid on primary/secondary side of heat exchanger (side that is to be cleaned) by opening drain valve 2b

- connect a hose to valve 2a

- start water flow through heat exchanger during 20÷30 minutes

- check dirt and organic dirt that is flushed from heat exchanger

- stop water flow and close valve 2a

- fill heat exchanger with working fluid in accordance with startup procedure for heat exchanger

- close valve 2b

If it is impossible or insufficient to clean inner plates by this procedure (using only warm water) it is necessary to use some detergent.

CLEANING WITH CHEMICAL SOLUTIONS

When it is necessary to use chemical solutions for cleaning heat exchangers it is highly recommended that cleaning is performed by company or individual that already has experience with this kind of procedures.

When using chemical solution for cleaning heat exchangers, CIP (Cleaning In Place) machine should be used. There is large number of this kind of machines on the market and it is possible to use any of them.

Cleaning is done by use of common cleaning fluids designed for cleaning heat exchangers that are available on market. Cleaning fluids must contain chemical additives that make cleaning more effective and also prevent corrosion. EURO HEAT strongly suggest that before acquiring cleaning fluid one should contact fluid manufacturer and inform them about kind of deposits and dirt that needs to be cleaned and also about materials that heat exchangers are made of.

If deposits and dirt can not be cleaned and removed by water back*ward flush or use of commercial* cleaning fluids it is possible to use some of flowing solutions :

- water solution of soda or caustic soda in concentration up to 2%

- water solution of nitric acid (HNO3) in concentration up to 0.5%

- water solution of sulphamic (H3NSO3) (NOT SULPHIRIC ACID) in concentration up to 5%

- water solution of phosphoric (H3PO4) in concentration up to 5%

Temperature of cleaning fluid should not overstep 60ºC

TYPE OF DEPOSITS AND FOULING	SUGGESTED CLEANING SOLUTIONS
Calcium Sulphate, Silicates	Citric, Nitric, Phosphoric or Sulphamic Acid
Calcium Carbonate	Nitric Acid
Alumina, Metal Oxides, Slit/Sludge, ….	Citric, Nitric, Phosphoric or Sulphamic Acid
Biological growth	Sodium carbonate or sodium hydroxide

(keep in mind recommended concatenations)

Description of backward flush method :

- close valves 1c and 1d

- wait till temperature of heat exchanger drops between 10ºC and 30ºC

- drain working fluid on primary/secondary side of heat exchanger (side that is to be cleaned) by opening drain valve 2d

- connect a hose of CIP machine to valves 2c and 2d

- fill the tank of CIP machine with cleaning fluid

- start CIP machine and let it run for 30÷60 minutes

- during cleaning process check activity and concentration of cleaning fluid on inlet and outlet of side of heat exchanger

- stop cleaning when there are no more changes in cleaning fluid

- when dirt is removed, drain cleaning fluid from heat exchanger and CIP machine

- disconnect CIP machine from pipelines

- connect a hose to valve 2d

- start water flow through heat exchanger during 10÷15 minutes

- stop water flow and close valve 2c

- fill heat exchanger with working fluid in accordance with start up procedure for heat exchanger

- close valve 2d

Depending on nature of fouling and dirt and cleaning fluid that is used there is possibility that cleaning process must be repeated.
If it is not possible to clean heat exchanger using CIP method it is necessary to perform mechanical (physical) cleaning.

WARNINGS

Handling chemical solutions and dirt from heat exchangers can be dangerous and it is necessary to take all necessary safety measures so persons that are performing cleaning wouldn't be harmed.

Handling (keeping and storing) cleaning fluids and dirt from heat exchanger must be done in accordance to law and legal procedures.

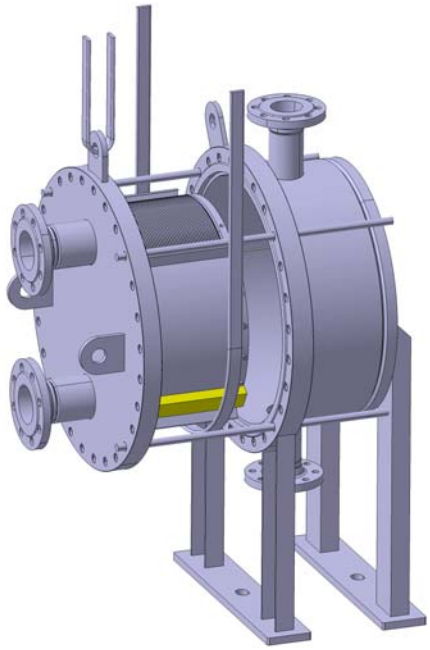
After using soda, acid or some other cleaning fluid (detergents) it is necessary to thoroughly clean heat exchanger with clean water.

Never use hydrochloric acid (HCl) to clean parts made of stainless steel, even in low concatenations.

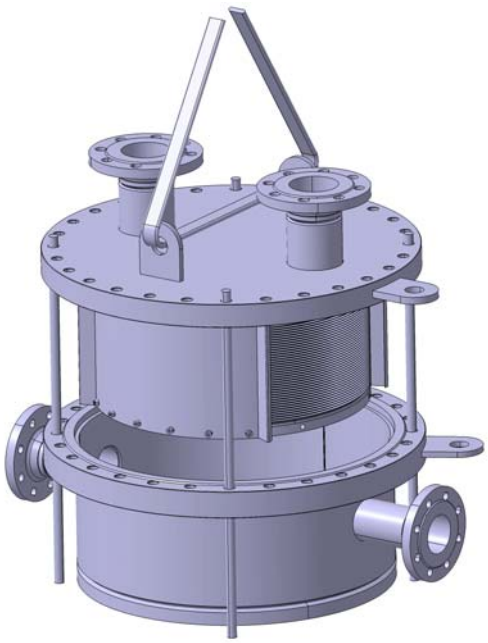
Never use phosphoric or sulphamic acid to clean parts made of titanium, even in low concatenations.

5.3 MOUNTING THE PLATE PACK

5.3.1 Mounting the plate pack in horizontal position and vertical positions indicated on photo below. During the mounting in horizontal position use guid bars and lifting tapes to keep plate pack horizontaly. Use wood bars bellow lifting tape to avoid damage of flow directos.
Mounting the plate pack in vertical position indicated on photo below. During the mounting in vertical position use guid bars and lifting tape.
Before instaling check that flow directors are ok, during the process of assembling flow directos must be cheked continuously.

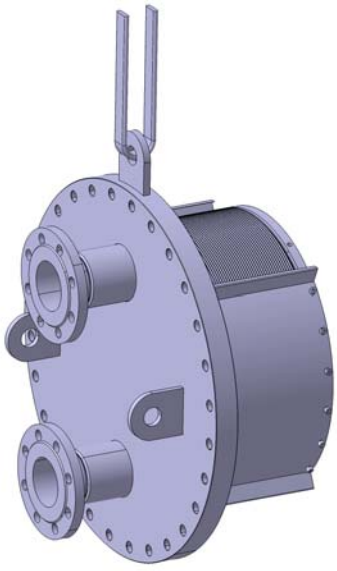


Mounting the plate pack in horizontal position

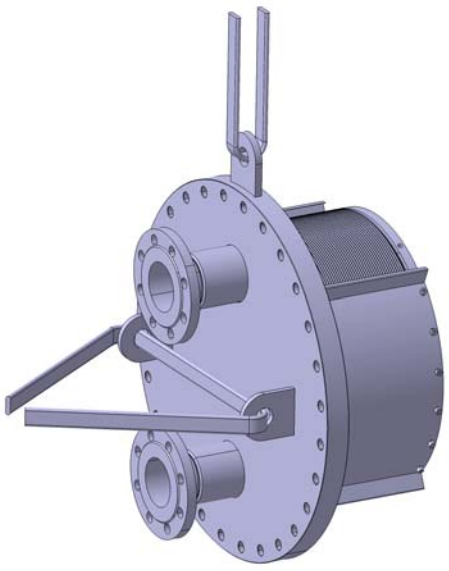


Mounting the plate pack in vertical position

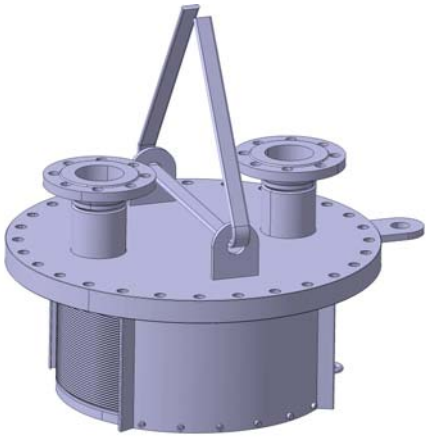
5.3.2 Changing position of plate pack. Lift up unit with two lifting tapes. Easily move down right lifting tape to change in vertical position or left to change in horizontal position. Before lifting check mass of plate pack and max load for lifting tapes.



Horizontal possition



Lifted on 2 lifting tape

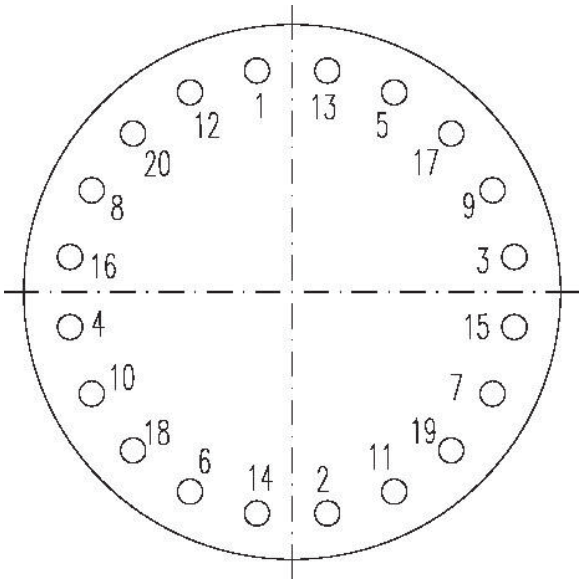


Vertical possition

5.4 BOLT / NUT TIGHTENING PATTERN

When tightening bolts, never use an impact tool. It is important to tighten the bolts to the same torque value. Always use a torque wrench or other calibrated tightening tool.

The sequence in which the bolts are tightened has a substantial bearing upon the distribution of the pressure on the gasket. Improper bolting may move the flange out of alignment. A gasket will usually allow for a small amount of distortion of this kind. Always tighten the bolts in a cross bolt tightening pattern. See picture, where the sequence is numbered.



Always screw in the nut or bolt by hand. This ensures that the thread remains in satisfactory condition (if the nut will not screw in by hand, check the thread, replace damaged parts and start again).

Tighten the connections using a minimum of 5 revolutions, following the sequence. The following procedure is recommended:

Revolution 1 – Tighten the start of the nut by hand following the sequence, after which tighten all of them by hand evenly.

Revolution 2 – Using a torque wrench, tighten the bolts, following the sequence. Use a maximum of 30% of the eventual tightening toque. Check the position of the gasket between the cover plate and flange.

Revolution 3 – Tighten using 60% of the eventual torque, following the sequence.
Revolution 4 – Tighten to full torque in a clockwise direction.