

Instructions for installation, start-up
and maintenance of a
BlokSma heat exchanger.

P-type (P/PF, IV/MV)

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The P-type heat exchanger can be subdivided into four sizes: P10, P13, P20 and P28. The number indicates the shell size in centimetres. The construction of the P10 is slightly different from the others. When necessary this manual has special texts (indicated with: “**For P10 only:**”) which apply to the P10 only.

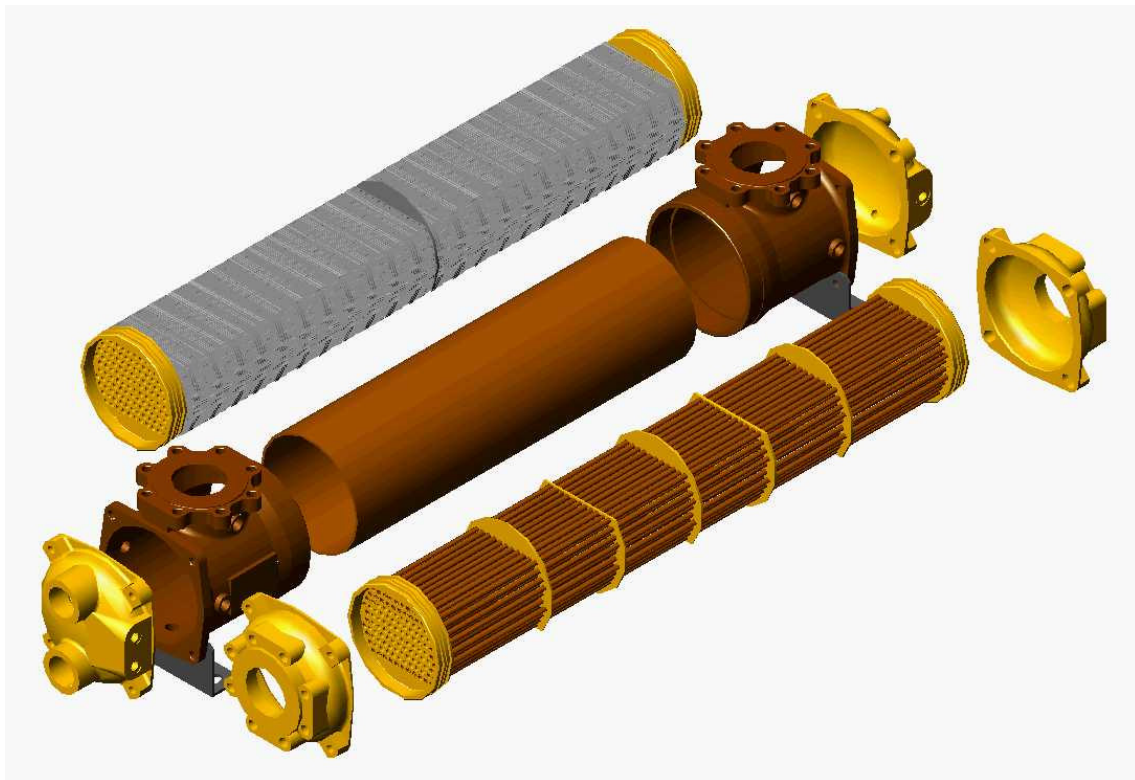
There are two executions: the IV (Industrial Version) and the MV (Marine Version). Main difference is the anodes in the tube side circuit of the MV. It is pointed out in the text when there are differences between the two models. Please note that type P10 is only available in MV version.

In addition this manual applies to P-heat exchangers with plain tubes (PT-type) as well as PF heat exchangers with bundles with plate fins (PF-type).

Glossary

Refer to the figure(s) in the paragraph “Assembling and disassembling of the heat exchanger” for an explanation of the designation of parts of the heat exchanger in the text.

Conditioned circuit	Closed circuit with a non-corrosive medium.
Unconditioned circuit	Open circuit (for instance seawater) or a closed circuit with a corrosive medium.
Coating	Applied layer protecting the coated material against corrosion. The coating separates the coated part from the corrosive medium.
Inhibitor	Additive to a medium flowing through the heat exchanger which - expressly tailored to that medium - reduces the quickness of chemical reactions like corrosion.
Anodes / anodic protection	Introducing a base metal to a more precious metal (on purpose) in order to protect this metal. The part serving as anode is being sacrificed.



1 Introduction

1.1 Remarks

- Read this instruction manual before proceeding.
- This instruction & maintenance manual must be interpreted together with the technical specification and dedicated Bloksma drawing(s) for this specific selected heat exchanger. The in the technical specification listed design pressures and design temperatures must not be exceeded.

1.2 Warranty and liability

All Bloksma products are being supplied under the Bloksma general conditions.

These can always be seen and downloaded on the Bloksma website at www.bloksma.net , or contact your local Bloksma supplier.

Not covered under warranty are loss of performance and/or damage to the heat exchanger as a result of:

- neglecting the instructions in this manual
- replacement with non-original parts
- all forms of corrosion and erosion

1.3 Environment

- The environmental laws and rules of the area where the heat exchanger is installed, should always be respected.
- Always be on the alert for possible leakage.
- When the product is being disposed, please respect all environmental regulations.

1.4 Safety

Some symbols are used in the text to underline safety aspects:



Pay attention: the heat exchanger can be hot during operation!



Maintenance and repair: depressurize both circuits of the heat exchanger and let these cool down to ambient temperature!

In connection with safety, all Bloksma heat exchangers are tested under pressure which is higher in regard to the design pressure before leaving the factory. This also applies to heat exchangers which are not tested according to a certification agency.

1.5 Inhibitors

There can be reasons to add an inhibitor to one of the circuits of the heat exchanger. Contact a specialized company, which can also check for harmfulness of the inhibitor to the materials of the heat exchanger (see specification sheet). Follow the instructions of the supplier for use of the inhibitor.

2 Installation and start-up

2.1 Receipt of goods

Please check the packaging and the heat exchanger after receipt:

- if damaged, please report to Bloksma
- compare the data on the nameplate, drawing(s) and order confirmation (if available)
- check whether or not the correct instruction manual has been supplied (article number on the cover sheet and article number of the instruction manual on the order confirmation must be identically)

Always store the heat exchanger in a dry, conditioned room. When the heat exchanger is being stored after receipt, please follow the “Instructions for conservation” (Appendix A).

2.2 Installation

Warning: Beware of any rust preventive layers (see “Instructions for conservation”) that might still be present in the heat exchanger before proceeding.

- Remove all protective plugs and covers from the connecting flanges prior to installation of the heat exchanger.
- A 1- or 3-pass model (tube side) has to be mounted in such a way that shell and tube side will be in counter flow.
- Check whether the positions of the vent and drain connections on the heat exchanger correspond with the mounting position of the heat exchanger.
- In models with shell side thread connections, the couplings must not reach the bundle.
- Mount the heat exchanger level and square on a flat surface in order for the pipe connections to be made without tension.
- Do not weld anything to or on the heat exchanger.
- Mount one support in a fixed position, while the other one is mounted in such a way that it is able to slide in the direction of the longitudinal axis of the heat exchanger. The heat exchanger will thus be able to expand under thermal stress. (Not applicable for adjustable clamp supports.)
- When installing 1-pass types larger than P10 vertically, the water box at which the position of the tube sheet is fixed¹, has to be located on top.
- Before connecting piping to the heat exchanger flanges, make sure that the gasket surface is clean and free from scratches and other defects. Always use new gaskets, of the correct type and size and tighten the bolts crosswise.
- Take care when lifting the heat exchanger. Please be aware to use at least two hoops around the shell of the heat exchanger for lifting purposes.
- Check the presence and correct positions of drain/vent connections in both circuits.
- When installing the heat exchanger and the piping, please make sure there is sufficient room for disassembling (parts of) the heat exchanger (tube bundle, drain plugs, etc.).

¹ On a 2-pass model the side of the heat exchanger at which the position of the tubesheet is fixed is always the side where the tubeside medium enters and exits the heat exchanger. On 1-pass models this is the side on which fixation plates are bolted between waterbox and shell (on the other side distance rings are bolted between shell and waterbox). Furthermore the side of the heat exchanger where the serial number is located, is also the side with the fixed tubesheet.

2.3 Start-up

Never exceed the design temperatures and design pressures as stated on the nameplate and specification sheet. Avoid abrupt temperature fluctuations; these can cause leaking of tube-to-tube sheet or other connections.

- Make sure that the cold medium circulation is established first, followed by the gradual introduction of the hot medium.
- Vent both circuits.
- Vent both circuits again when the operating temperatures and pressures are reached.
- Check for leakage.

Do not deviate from the flows as stated on the specification sheet and what the heat exchanger is selected for. Higher or lower velocities of fluids could cause erosion or corrosion respectively.

Avoid standstill: at non-conditioned circuits this may cause corrosion. In case of standstill follow the instructions for shut down periods.

If the heat exchanger is equipped with anodic protection (see specification sheet) always inspect the anodes (or part that functions as anode) when starting up the heat exchanger after a shut down period. (Picture of anode status on page 7 of this book)

3 Maintenance



For (dis-)assembling instructions please refer to “3.5 Assembling and disassembling of the heat exchanger”.

3.1 Cleaning and inspection intervals

Preventive maintenance of the heat exchanger is a user responsibility. The tube side circuit is usually the more fouling side of the heat exchanger. Because the degree of fouling strongly depends on the operating conditions we recommend the following:

- Inspect the tube side at least four times a calendar year.
- Inspect the shell side at least twice a calendar year.

With the results of these inspections you will be able to determine the required cleaning intervals. Always keep performing regular inspections.

3.2 Anodic protection

Not applicable for IV models (without anodic protection).

The MV models of P-type heat exchangers are fitted with anodic protection: the tube side circuit is provided with anodes. When inspecting the tube side of the heat exchanger also inspect the state of the anodes (always drain the tube side circuit before removing the anodes). The consumption of the anodes strongly depends on the operating conditions. If most of the anode material is dissolved, they need to be replaced.

For example only:



The **anode 1** is a new one (for comparison), **anode 2** should be replaced if a high consumption of the anodes has been determined. **Anode 3** and **anode 4** need to be replaced immediately. Please note that above example is indicative only, the user still remains responsible for the estimation, when anodes need to be replaced.

3.3 Cleaning of the heat exchanger

3.3.1 Mechanical cleaning of the tube side

The tubes can be cleaned with a tube brush. Use original Bloksma brushes only; these have the correct dimensions and are of a suitable material. Other brushes may damage the protective layer that is in the normal course of events present on the tube walls. For original Bloksma parts, please visit www.bloksma.net to download the service parts list or contact your local Bloksma supplier.

3.3.2 Chemical cleaning of the shell/tube side

Warning: Chemical cleaning may damage the heat exchanger. Make sure your supplier of a cleaning agent verifies and confirms the compatibility of his product with the materials of the heat exchanger (see specification sheet).

Cleaning of the shell side will normally seldom be necessary.

The shell as well as the tube side can be cleaned by circulating a chemical solution through the heat exchanger. Another possibility is disassembling of the heat exchanger and submerging the tube bundle in a tank filled with a chemical solution. Remove all plastic partitions (on 2- or 3-pass heat exchangers to divide the tube side circuit) from the tube sheet(s) first.

There are several international companies (example in Appendix B) which supply equipment and fluids for chemical cleaning of heat exchangers. Their specialized cleaning centres, situated at ports all over the world, are able to give you a cleaning advice or to clean the heat exchanger for you. To give an idea of the possibilities, an example of a cleaning procedure is given below.

Please note: The cleaning advice below is just an example. Cleaning methods and procedures, as well as fluids for cleaning will differ depending on the materials of the heat exchanger (see specification sheet) and the application.

This cleaning advice is meant for water heaters/coolers.

Descalant NF (inhibited cleaning agent)

- Submerge the tube bundle (time is dependent on the degree of fouling) in a tank with dissolved cleaning agent
- After cleaning neutralize the tube bundle and the cleaning agent with a special neutralizing fluid
- Flush the tube bundle with fresh water
- Dry the tube bundle

3.4 Shut down periods

During shut down periods longer than a week the heat exchanger has to be drained completely and dried by means of preheated compressed air. In fact this also has to be done during short shut down periods (longer than a day) when there is risk of freezing, and it also applies when a corrosive medium is used in the heat exchanger. After draining a corrosive medium, the heat exchanger has to be rinsed with fresh water.

Stopping of the flows, cooling down and draining of the heat exchanger has to be done in such a way to minimize thermal stresses on the heat exchanger. To avoid the risk of boiling, never stop one of the flows of the heat exchanger while the other one stays in operation.

3.5 Assembling and disassembling of the heat exchanger

The circumferences of the tube sheets are fitted with three grooves. The two outer grooves carry O-rings (sealing between shell and tube side). At one of the tube sheets the middle groove is for the fixation of the position of the tube bundle by means of 'fixation plates' (this tube sheet is called the fixed tube sheet).

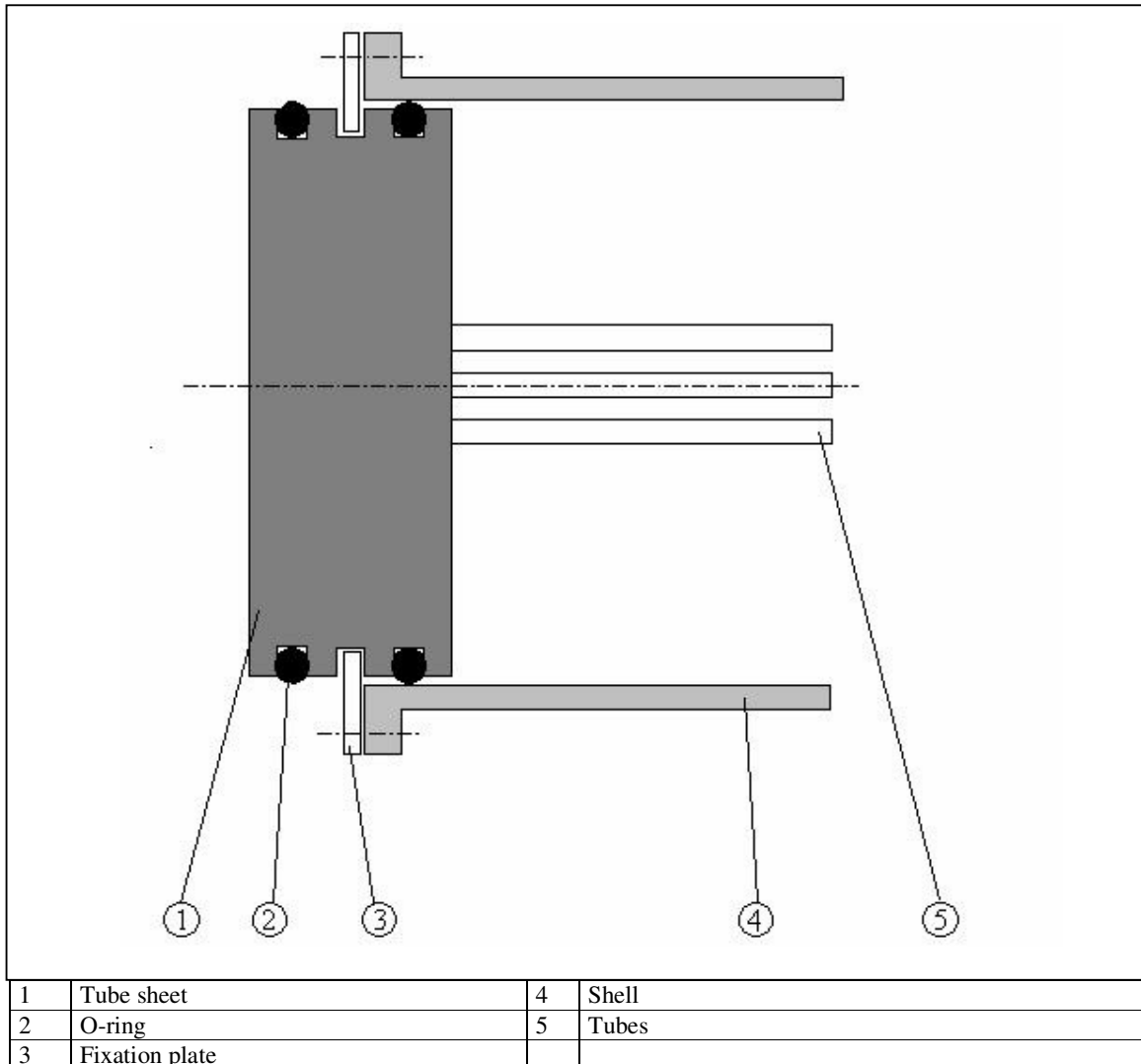




Figure 1: Schematic drawing of tube sheet construction

For P10 only: Instead of fixation plates the P10 has a metal spring ring in the middle groove of the tube sheet. As soon as the bolts are untightened the position of the tube bundle is no longer fixated. Tube side inspection or cleaning remains possible, but extra attention is required because the tube bundle is not fixed anymore. Except when performing a pressure test, we recommend to drain both circuits.

 For tube side inspection, shell side pressure testing or cleaning of the tubes with a tube brush, only the tube side connections and the water boxes (these are the parts on both ends of the shell, on which the tube side connections are made) need to be removed (follow step 1 and 3). **Pay attention: when the nuts are untightened the fixation plates are also untightened, so the tube bundle comes loose.** In order to fixate the tube bundle temporarily, fasten the fixation plates with the nuts.

 For shell side inspection (for instance), the tube bundle has to be removed completely (follow step 1, 2 and 3), and both circuits have to be drained.

When assembling as well as disassembling follow the “Instructions for gaskets and bolting”.

Step 1: Tube side disassembling



- depressurize shell and tube side circuits
- let both circuits cool down to ambient temperature
- drain the tube side circuit, by opening the drain in the lowest point and the vent in the highest point
- mark the position of all parts that will be disassembled, so they can be mounted in the correct position later on

In case the heat exchanger is placed **vertically**, disassemble the water box with the fixation plates first and fasten the fixation plates immediately with the nuts before proceeding. **For P10 only:** A vertically placed P10 will always have to be disassembled completely because the tube bundle does not stay in position.

- remove the water box(es)/end cover by untightening the nuts (the fixation plates come loose as well). Please not that brackets might come loose as well (except for clamp-on adjustable brackets).
- 2- or 3-pass heat exchangers have composite (or optional Brass) partitions on the tube sheet(s) for dividing the tube side circuit; mark their position and remove them
- mount the fixation plates again with the nuts (not necessary when the tube bundle is going to be removed (see step 2))
- remove the first O-ring from both tube sheets
- only for a pressure test: pressurize the shell side again. Depressurize the shell side again after the pressure test. **For P10 only:** Remember that the tube bundle is not fixated!

Step 2: Removing the tube bundle

- drain the shell side circuit, by opening the drain in the lowest point and the vent in the highest point
- mark the position of the tube bundle
- move the tube bundle to one side until the second O-ring shows (do not move the tube bundle further than necessary) and remove this O-ring
- move the tube bundle to the other side and remove the second O-ring on this side as well
- carefully pull the tube bundle from the shell
- support the tube bundle at the baffles when lifting it, but be careful not to bend the baffles (this will affect the thermal performance of the heat exchanger)

Step 3: Assembling

- assemble the heat exchanger in reversed order (pay attention to the earlier made marks):
 - Mounting of the tube bundle (only in case it was removed):
 - push the tube bundle in the shell (let it stick out of the shell a little bit)
 - mount the inner O-ring on the first tube sheet
 - move the tube bundle further and let it stick out somewhat on the other side of the shell
 - mount the inner O-ring on the second tube sheet
 - **Hint:** when it is difficult to move the tube bundle through the shell because the already mounted O-ring is hard to compress, you can use a strip between tube sheet and water box and then tighten two of the four bolts and nuts
 - move the tube bundle in its final position
 - Tube side assembly:
 - mount the outer O-rings on both sides
 - mount the composite (or optional Brass) partition(s) on the tube sheets of 2- or 3-pass models
 - mount the fixation plates (**for P10 only:** mount the metal spring ring)
 - mount the water boxes and all connections
- start-up the heat exchanger again:
 - make sure that the cold medium circulation is established first, followed by the gradual introduction of the hot medium
 - vent both circuits
 - vent both circuits again when the operating temperatures and pressures are reached
 - check for leakage

3.6 Instructions for gaskets and bolting

3.6.1 Gaskets (for Plugs, Drains and O-ring sealing)

Two types of gaskets are being used in this heat exchanger (gaskets for piping connections, drains or vents excluded):

O-rings: After disassembling the heat exchanger never use the old O-rings again. Replace them with original Bloksma O-rings.

Warning: The O-rings have to be lubricated with a special O-ring lubricant (O-ring silicone paste or Parker O-lube) for easy assembly and a good sealing capacity. Lubricants not suited for O-rings can affect the sealing capacity of the O-ring (for instance never use vaseline). Any warranty claim will be rejected when unsuited lubricants are used.

Soft metal rings: After disassembly of the heat exchanger never use the old soft metal rings again. Replace them with original Bloksma soft metal rings.

3.6.2 Bolting

Check bolts and nuts for damages. Tighten the bolts crosswise (see figure 2). This also applies to connecting piping to the heat exchanger. Make sure the gasket surface is clean (remove all dirt and all corrosion residues) and undamaged.

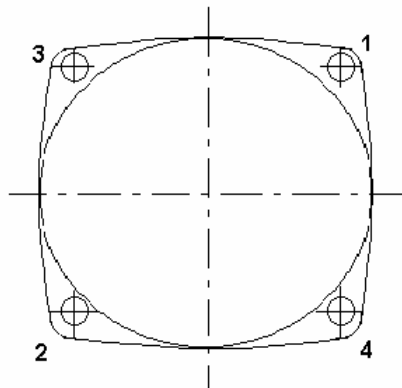


Figure 2: (Un-)bolting sequence

4 Trouble shooting & repairs



4.1 Poor performance

Check:

- whether all connections have been assembled according to the drawing
- whether the heat exchanger and the system have been properly vented
- whether the flows are according to the specification sheet (check all valves, lines and pumps, as well as the flow directions)
- whether the shell as well as the tube side have recently been cleaned (fouling can cause a drop in performance and an increased pressure loss; an increased pressure drop is a good indication that cleaning is necessary)
- whether the heat exchanger has been reassembled properly after disassembly (the plastic partitions on the tube sheet(s) of 2- or 3-pass heat exchangers; the position of the tube bundle (this might accidentally be mounted rotated 180° around its axis))

4.2 Leaking tubes / tube-to-tube sheet connection

It is often very difficult to determine whether leakage occurs because of a leaking tube or because of a leaking tube-to-tube sheet connection. The shell side of the heat exchanger can be hydro tested, after disassembling the tube side connections and water box(es)/end cover. Follow the instructions in “Assembling and disassembling of the heat exchanger”. Subsequently pressurize the shell side. After hydro testing depressurize and drain the shell side again. Assemble the heat exchanger again.

The tubes are roller expanded into the tube sheet. It is either not possible (finned tube bundles) or relatively complicated (unfinned tube bundles) to replace a leaking tube, but it can be plugged with soft copper Bloksma plugs (other materials are too hard and may cause leakage of the adjacent tube-to-tube sheet connections) in both tube ends. Contact Bloksma or your local Bloksma dealer when more than 10% of the tubes is plugged or should be plugged.

4.3 Leaking gaskets

- Check the gasket surfaces.
- Remove dirt or corrosion residues
- Mount new gaskets

It is possible to determine which of the O-rings is leaking, by determining the medium that is leaking from the heat exchanger.

5 Spare parts & tools

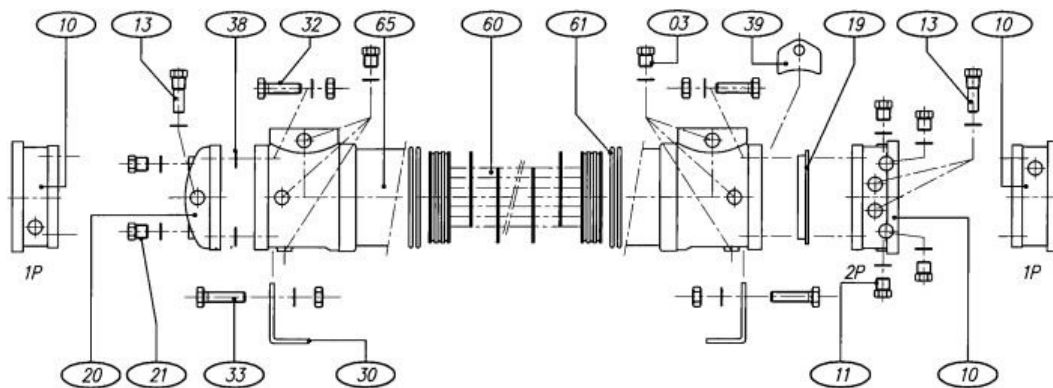
Available spare parts and tools for P-type heat exchangers:

- Set of gaskets (four O-rings)
- Set of soft metal rings for drains/vents
- Soft copper plugs
- Nylon tube brush
- Bolts / nuts
- Complete tube bundle
- **For P10 only:** Metal spring ring
- Fixation plates (for types > P10)
- Composite (or optional Brass) partitions (not for 1-pass heat exchangers)
- Water box
- Cover
- Anode

When ordering spare parts, please refer to the Bloksma drawing number or serial number (listed on name plate).

For updated spare parts lists of each Bloksma heat exchanger type, please visit www.bloksma.net in order to download an original parts list or contact your local Bloksma supplier.

The exploded view below is an example only



Appendix A: Instructions for conservation

Standard conservation (controlled conditions)

All heat exchangers supplied by Bloksma are treated with a rust preventive (Rust Veto 157A or equal) layer (on both shell and tube side). This layer will protect the heat exchanger when it is stored at controlled conditions, i.e. **inside, in a dry room at constant temperature**. When these conditions are met, the heat exchanger can be stored without special treatment for a longer period (up to 24 months).

The rust preventive layer can (but must not) be removed with a mineral solvent (petroleum).

Advise for conservation (uncontrolled conditions)

When the above stated storage conditions are not met, it will be necessary to fill up the heat exchanger with an inert gas and all openings have to be closed airtight (additionally silica gel can be added to absorb liquids). Alternatively, the heat exchanger can be treated with a rust preventive liquid of a type suited for long term conservation.

When necessary contact a specialized company. Take the materials of the heat exchanger (see specification sheet) into consideration. Be aware that in uncontrolled storage conditions large amounts of water can accumulate in the heat exchanger as a result of condensation.

Appendix B: AddressesChemical cleaning and products for chemical cleaning

Ashland Services B.V.
Shared Services Center
Pesetastraat 5
2991 XT Barendrecht
P.O. Box 8619
3009 AP Rotterdam
The Netherlands
Telephone : + 31 (0) 10-4975000
Telefax : + 31 (0) 10-4975111

Internet: www.ashspec.com

Appendix C: Constructional directions for mounting a P-type heat exchanger in a piping design.

Pay attention to the following points:

- Level and square mounting possibility.
- Bends in the piping must be located at a distance of at least three times the nominal diameter of the pipe from the inlet of the heat exchanger.
- When a vaporizing cryogenic medium is used, the heat exchanger has to be placed under an angle of 3° - 10°, in order for the vapour to be able to exit the heat exchanger, aided by natural circulation. For a proper thermo siphon functioning, the height between the oil cooler and the condenser should be at least 3 meters.
- Check if vent and drain connections are present in both circuits of the heat exchanger (when not on the heat exchanger then construct them in the piping).
- Put a filter (with a permeability of 3 mm) before the inlet of both circuits of the heat exchanger.
- Stress- and vibration free mounting possibility of the connections and the supports (fit expansion bellows and/or silencer blocks when necessary).
- Disassembling possibility of the tube bundle (and other parts like drain and vent plugs).
- Expansion possibility of lockable liquid circuits.
- Danger of freezing of liquid circuits.
- The design data of the heat exchanger on the specification sheet² and the drawing. For instance the flows: deviating from these can cause unacceptable high or low velocities. A (temporary) lower flow in a conditioned circuit is acceptable when caused by a control system. Avoid standstill (unless the heat exchanger is drained and flushed according to the Bloksma instructions at 3.4).
- When adding an inhibitor to one of the fluids in the heat exchanger, always check whether this inhibitor can be harmful for the materials of the heat exchanger (see specification sheet).
- Make sure that in case of flow control (with conditioned circuits only) this is done gradually (no 'on-off-control').
- To prevent leakages at cold start-ups (especially PF-type oil coolers) the shell side of the heat exchanger must always be completely filled with the operating fluid **before** start up.
- Although this will almost never occur in practice, Bloksma reserves the right (according to TEMA RGP-RCB-2) to plug a maximum of 1% of the tubes.
- When selecting a heat exchanger, Bloksma's choice for use of materials is based and judged on the fluids specified by the customer at the time of selection. However, if possible contaminations, higher or lower than normal degrees of acidity and other for the choice of materials important properties are exceeding the heat exchanger base selected materials, Bloksma cannot be held responsible. Therefore, please always check whether both fluids are compatible with the materials of the heat exchanger.
- Check whether the materials of the connecting piping are compatible with the materials of the heat exchanger (when the materials of the bundle are, from a corrosion point of view, weak in comparison with the materials of the piping, the bundle could corrode faster than expected).

² In connection with the applied materials the instruction manuals refer to the specification sheet of the heat exchanger. Therefore always keep the specification sheet at your documentation.