BLOKSMA HEAT EXCHANGERS

Instruction manual for the installation, operation and maintenance of Bloksma V-heaters (LP, HP)

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Glossary

Refer to the figure(s) in the paragraph 3.5 “Disassembling and assembling of the heat exchanger” for an explanation of the designation of parts of the heat exchanger as mentioned 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	Layer protecting the material against corrosion. The coating separates the base metal from the corrosive medium.
Inhibitor	Additive to a fluid flowing through the heat exchanger that – expressly tailored to that medium - reduces the speed of chemical reactions like corrosion.
Anodes / anodic protection	Connecting a base metal (anode) to a more noble metal in order to protect the noble metal. The matal serving as anode is being sacrificed.
Partition gasket	Gasket with a partition which divides the tubeside circuit of the heat exchanger into two (or four) parts.

1 Introduction

1.1 Remarks

- Read this instruction manual before proceeding.
- Important documents besides this instruction manual are the order confirmation, the specification sheet, the drawing(s) and the constructional directions (appendix C).
- The design pressures and design temperatures as listed in the specification sheet and nameplate may never be exceeded.

1.2 Guarantee and liability

The “General sales conditions of Bloksma B.V.” are applicable. Also refer to the confirmation of the order for possible additions.

Not covered by the guarantee is loss of performance and/or damage to the heat exchanger as a result of:

- not following the instructions in this manual
- replacement with non-original parts
- every form of corrosion

1.3 Environment

- The environmental laws and rules of the area where the heat exchanger is installed, always have to be respected.
- Always be on the alert to the possibility of leakage.
- When disposing of the unit at the end of its life span, see to it that this takes place according to the applicable regulations.

1.4 Safety

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

Pay attention: depending on the application the heat exchanger will be hot during operation

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

Most heaters contain fluids, which are hot, irritating or dangerous to humans. These fluids could cause problems. So any leaks might cause severe dangers or burns.

A heater is a pressure vessel designed for operation at certain specific limits of pressure and temperature. The heating system – which includes the heat exchanger - must be safeguarded with safety valves and controls so that these heat exchanger design conditions are not exceeded. All operating personnel should be made aware of these specific design pressures and temperatures.

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

At receipt check the packaging and the heat exchanger:

- report any damage to Bloksma
- compare the data on the nameplate, confirmation of the order and on the drawing
- check whether or not the correct instruction manual is present by comparing the article number on the cover sheet with the article number of the instruction manual on the confirmation of order

Always store the heat exchanger in a dry room, free of large temperature changes. When the heat exchanger is not being put into operation immediately after receipt, follow the "Instructions for conservation" (Appendix A).

2.2 Installation

Warning: Beware of any rust preventive layers (see Appendix A "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.
- Preferably mount the heat exchanger in a horizontal position.
- Mount the heat exchanger level and square on a flat surface in order for the pipe connections to be made without forcing.
- In case of a vertical mounting position, make sure that the tubeside connections are located at the bottom side.
- Do not weld anything to 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.
- 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 tighten the bolts crosswise.
- Take care when lifting the heat exchanger. Use at least two hoops around the shell of the heat exchanger for lifting purposes.
- Check for the presence of a drain and vent connection in the tubeside circuit.
- Install the heat exchanger and the piping in such a manner that there is still enough room to disassemble (part of) the heat exchanger (tubebundle, drain plugs, etc.).

2.3 Start-up

Do not 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-tubesheet 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. Higher or lower velocities can 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) you will have to inspect the anodes (or part that functions as anode) when you are starting up the heat exchanger after a shut down period.

3 Maintenance

If necessary refer to “Assembling and disassembling of the heat exchanger” for (dis-)assembling instructions.

3.1 Inspection and cleaning intervals

Preventive maintenance of the heat exchanger is a user responsibility. The tubeside 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 tubeside at least quarterly.
- Inspect the shellside at least twice a 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

You can check the specification sheet to verify whether or not the heat exchanger is fitted with anodic protection. If that is the case, the cover will be coated and the intermediate ring will be partly coated. The uncoated part of the intermediate ring acts as an anode.
When performing inspections you will have to inspect the state of the inside of the intermediate ring as well (after tubeside disassembling of the heat exchanger). Remove rust/corrosion product from the ring first.

3.3 Cleaning of the heat exchanger

3.3.1 Mechanical cleaning of the tubeside

The bends of the U-tubes can only be cleaned chemically. The straight parts of 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.
Do not clean the cover and the intermediate ring of heat exchangers with anodic protection (see specification sheet) with scraping tools because of the risk of damaging the coating.

3.3.2 Chemical cleaning of the shell-/tubeside

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).
For heat exchangers with coated parts (see specification sheet), the temperature may not exceed 150 °C, and no bleaching agents may be used because of this coating.

The shell- as well as the tubeside can be cleaned by circulating a chemical solution through the heat exchanger. Another possibility is disassembling of the heat exchanger and submerging the tubebundle in a tank filled with a chemical solution.

There are several international companies (example in Appendix B) which supply equipment and fluids for chemical cleaning of heat exchangers. Their specialized cleaning centers, 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 advise is meant for steel oil heaters.
Depending on the degree of fouling there are two products, and therefore two cleaning methods.

1 Water based Alkaline HD
(for oil heaters without carbon sediments)

- A tank resistant against the product and the temperatures
- Water based Alkaline HD in 5-10% solution in water
- Heating to 80-90 °C (when not possible: use method 2)
- Submerge the tubebundle approximately 6 hours (depending on fouling)
- After cleaning flush the tubebundle with fresh water
- Dry the tubebundle

2 Carbon Remover B85
(for oil heaters with a lot of carbon sediments)
Same procedure as 1, however with Carbon remover B85, 100 %. No additional heating is necessary in this case.

3.4 Shut down

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 a manner to minimize thermal stresses on the heat exchanger.

Never stop one of the flows of the heat exchanger while the other one stays in operation, because of the risk of boiling.

3.5 Disassembling and assembling of the heat exchanger

3.5.1 Difference between LP / HP version

There are two versions of the V-type heat exchanger: an LP (low pressure) and an HP (high pressure) version. The version is indicated on the specification sheet and the drawing.

The main difference is the tubesheet construction:

- **LP-version:** The tubesheet has bolt holes with thread and is kept in position independently of the cover and the intermediate ring (figure 1a).
- **HP-version:** The tubesheet has bolt holes without thread or has a diameter within the bolt circle and is kept in position by the cover, the intermediate ring and the shell flange (figure 1b).

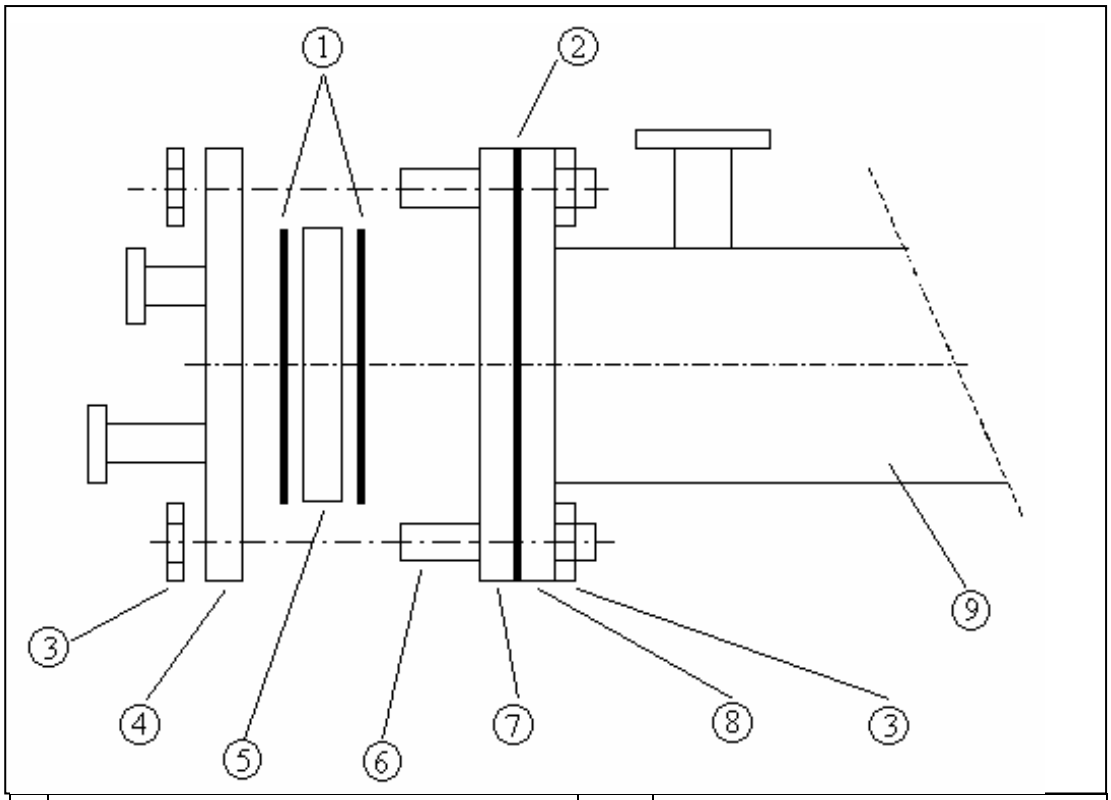
The tubesheet construction determines whether or not the tubesheet and the bundle stay in position when the nuts on the side of the cover are un-tightened (when un-tightening the nuts on the shellside, tubesheet and bundle will never stay in position).

When you are uncertain about the version you have: un-tighten one of the nuts on the shellside and check if the studbolt is loose (HP) or not (LP).

Warning: Always check the version before disassembling the heat exchanger. When you are uncertain always drain both circuits.

3.5.2 Disassembling / assembling LP-version

The tubesheet is –together with the intermediate ring for division of the tubeside flow- bolted against the shell of the heat exchanger, in between the cover with the tubeside connections and the shell flange.



1	Partition gasket	6	Stud bolt
2	Gasket	7	Tubesheet
3	Nut	8	Shell flange
4	Cover	9	Shell
5	Intermediate ring		

Figure 1a: Schematic drawing of tubesheet construction LP-version

For tubeside inspection, shellside pressure testing or cleaning of the straight parts of the tubes with a tube brush, only the tubeside connections, the cover, the intermediate ring and the gaskets have to be removed (follow step 1 and 3). In this case the tubesheet can stay in position **by un-tightening the nuts on the side of the cover only, while keeping tightened the bolts and nuts on the side of the shell** (the tubesheet has threaded holes). There is no need to drain the shellside circuit then. Depressurize the shellside circuit and let it cool down to ambient temperature before proceeding.

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

This page applies to the LP-version only!!

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

Step 1: Tubeside disassembly

- depressurize both circuits
- let both circuits cool down to ambient temperature
- drain the tubeside 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
- remove the cover by un-tightening the nuts on the side of the cover only (**by keeping the bolts and nuts tightened on the side of the shell, the tubesheet can stay in position and there is no need to drain the shellside**)
- remove the first partition gasket, the intermediate ring and the second partition gasket

Step 2: Removing the tubebundle

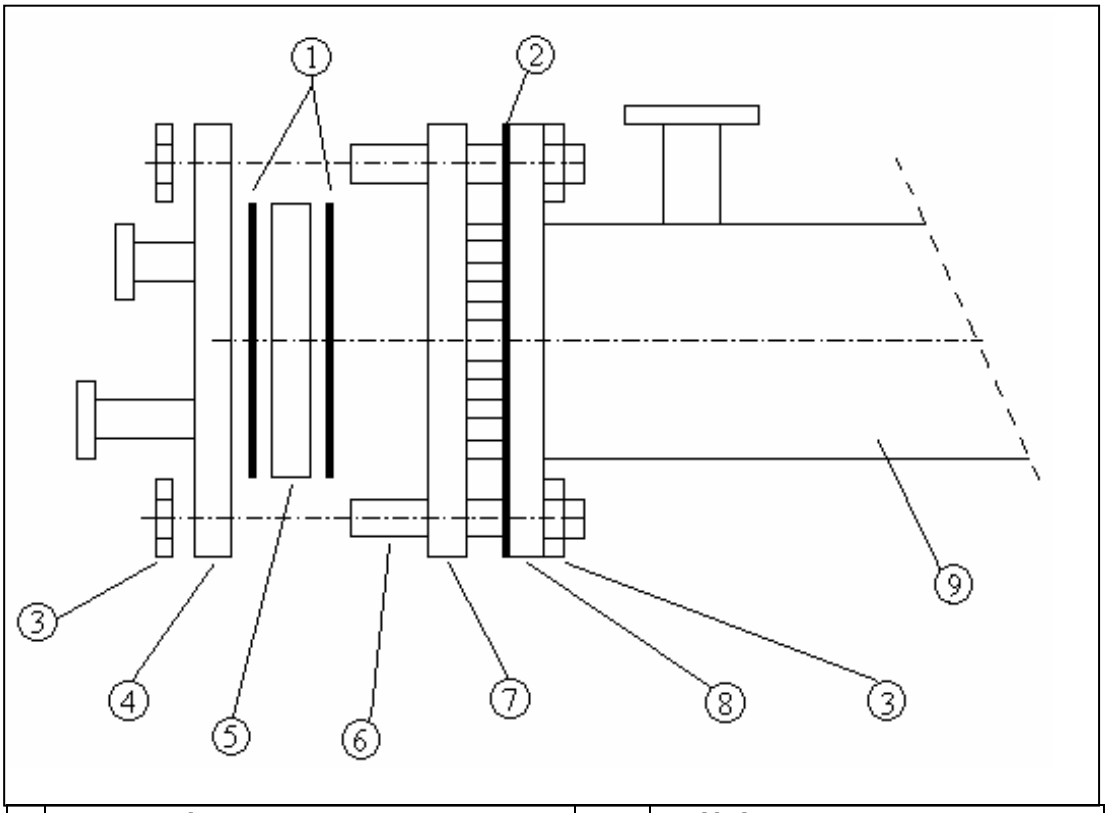
- drain the shellside circuit, by opening the drain in the lowest point and the vent in the highest point
- in case of vertical mounting position: there is no drain in the shellside circuit; use the lower shellside connection (**pay attention:** the shellside can not be drained completely; a small part of the contents remains in the heat exchanger; remember this when removing the tubebundle)
- mark the position of the tubebundle in relation to the shell flange
- un-tighten the nuts on the shellside
- pull the tubebundle carefully from the shell
- support the tubebundle at the baffles when lifting it, but be careful not to bend the baffles (this will affect the thermal performance of the heat exchanger)
- remove the gasket at the shellside of the tubesheet

Step 3: Assembling

- assemble the heat exchanger in reversed order (pay attention to the earlier made marks):
- 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

3.5.3 Disassembling/assembling HP-version

The tubesheet is –together with the intermediate ring for division of the tubeside flow- bolted against the shell of the heat exchanger, in between the cover with the tubeside connections and the shell flange.



1	Partition gasket	6	Stud bolt
2	Gasket	7	Tubesheet
3	Nut	8	Shell flange
4	Cover	9	Shell
5	Intermediate ring		

Figure 1b: Schematic drawing of tubesheet construction HP-version

For tubeside inspection, shellside pressure testing or cleaning of the straight parts of the tubes with a tube brush, only the tubeside connections, the cover, the intermediate ring and the gaskets have to be removed (follow step 1 and 3). Always drain both circuits. **Pay attention: when the nuts are un-tightened the tubebundle comes loose** (the tubesheet either has holes without thread or the tubesheet is smaller in diameter than the flanges and thus has no holes at all).

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

This page applies to the HP-version only!!

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

Step 1: Tubeside disassembly

- depressurize both circuits
- let both circuits cool down to ambient temperature
- drain both circuits, by opening the drain in the lowest point and the vent in the highest point
- in case of vertical mounting position: there is no drain in the shellside circuit; use the lower shellside connection (**pay attention:** the shellside can not be drained completely; a small part of the contents remains in the heat exchanger; remember this when removing the tubebundle)
- mark the position of all parts that will be disassembled, so they can be mounted in the correct position later on
- remove the cover by un-tightening the nuts
- remove the first partition gasket, the intermediate ring and the second partition gasket

Step 2: Removing the tubebundle

- mark the position of the tubebundle in relation to the shell flange
- pull the tubebundle carefully from the shell
- support the tubebundle at the baffles when lifting it, but be careful not to bend the baffles (this will affect the thermal performance of the heat exchanger)
- remove the gasket at the shellside of the tubesheet

Step 3: Assembling

- assemble the heat exchanger in reversed order (pay attention to the earlier made marks):
- 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

Make sure the gasket surface is clean (remove remains of old gaskets) and undamaged. The surface has to be cleaned in a circular direction (parallel to the circumference) in order to avoid radial grooves (risk of leakage) are created.
Do not re-use the same gasket again. Always use original Bloksma gaskets for replacement (low priced replacements will have a shorter lifetime and higher failure rate). See paragraph 5 “Spare parts and tools” for ordering instructions. Before installing the gaskets, please check whether gasket and gasket surface has compatible dimensions.

Warning: Gaskets must be applied completely dry (i.e. mounted without any sealing aid, jointing compound, molykote, graphite, grease or other lubricant). Any sealing-aid will affect the sealing capacity of the gasket. Any warranty claim will be rejected when sealing-aid is used.

Attention must be paid that the gasket is placed on the centerline of the heat exchanger. It is not allowed for the gasket to cover any tube. In most cases the intermediate ring has to be lifted somewhat, to guarantee a position on the correct height.

3.6.2 Bolting

Check bolts and nuts for damages. In order to ensure a low friction and a proper tightening torque, the thread has to be lubricated slightly, with a proper lubricant.

The bolts are to be tightened crosswise (according to figure 2) in three stages. At first the torque has to be 50%, then 80% and finally 100% of the end value to ensure an equal load on gasket and flange.

Use a torque-tensioning device. The correct tightening torque depends on the material of the bolts (as indicated on the ends of the bolts):

Bolt material: A193-B7

Type of heat exchanger	**Bolt**	**Tightening torque 50%**	**Tightening torque 80%**	**Tightening torque 100%**
V11	M16	83 Nm	133 Nm	166 Nm
V16-V22	M20	162 Nm	260 Nm	324 Nm
V27-V32	M24	280 Nm	450 Nm	560 Nm

The bolts are to be tightened in the proper sequence, according to figure 2. Of course the principle is the same for flanges with fewer or with more bolts.

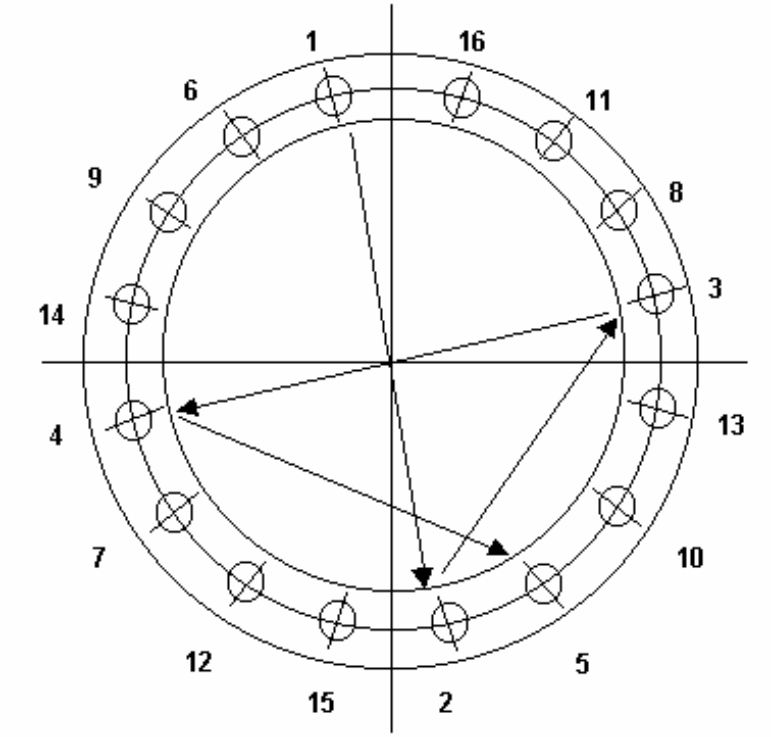


Figure 2: (Un-)bolting sequence

4 Troubleshooting and repairs

4.1 Thermal performance too low

Check whether:

- all connections have been made according to the drawing
- the heat exchanger and the system have been properly vented
- the flows are according to the specification (check all valves, lines and pumps, as well as the flow directions)
- the shell- as well as the tubeside have been cleaned recently (fouling can cause a drop in performance and an increased pressure loss; an increased pressure drop is a good indication that cleaning is necessary)
- the heat exchanger has been reassembled properly after disassembly

4.2 Leaking tubes / tube-to-tubesheet connection

It is often very hard to determine whether leakage occurs because of a leaking tube or because of a leaking tube-to-tubesheet connection. The shellside of the heat exchanger can be hydro tested, after disassembling the tubeside. Follow the instructions in “Assembling and disassembling of the heat exchanger”. Subsequently pressurize the shellside. After hydro testing depressurize and drain the shellside again. Assemble the heat exchanger again.

Pay attention: For hydro testing of the HP version (see paragraph 3.5.3 “Disassembling and assembling of the heat exchanger”) you will need a test ring, which keeps the tubesheet in position. The test ring replaces the cover and the intermediate ring during hydro testing. Bloksma can supply such a test ring (see paragraph 5 “Spare parts and tools”).

The tubes are roller expanded into the tubesheet. For some applications (for example thermal oil) the tube-to-tubesheet connections have been seal welded as well.
A leaking tube cannot be replaced, but it can be plugged with soft copper Bloksma plugs (other materials are too hard and may cause leakage of the adjacent tube-to-tubesheet connections) in both tube ends. A maximum of approximately 5% plugged tubes will not influence the thermal performance of the heat exchanger too much. Contact Bloksma when more than 5% of the tubes is plugged.

4.3 Leaking gaskets

- Check the gasket surfaces
- Remove dirt or corrosion residues
- Mount new gaskets
- Check if the correct tightening torque is applied

5 Spare parts and tools

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

- Set of gaskets (*)
- Soft copper plugs
- Brass tube brush
- Bolts / nuts
- Test ring (only necessary for HP-version)
- Intermediate ring
- Cover
- Complete U-bundle

When placing orders, please specify the Bloksma nameplate data.

(*) The flat gaskets consist of some rubber, which is subject to age-ing.
Recommendations for storage:

- dry atmosphere at a constant temperature of 20 °C or less
- constant humidity
- dark conditions (no direct sunlight)
- store gaskets in a flat position (not hanging on hooks)

Appendix A: Instructions for conservation

Standard conservation (controlled conditions)
All heat exchangers supplied by Bloksma are treated with a rust preventive layer (on both shell- and tubeside). 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 till 24 months).
The rust preventive layer can be removed with a mineral solvent (petroleum).

Advise for conservation (uncontrolled conditions)
When the above mentioned storage conditions are not met, you will have to fill 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: Addresses

Chemical cleaning and products for chemical cleaning

Ashland Chemical Netherlands B.V.
Drew Marine Division
Malledijk 20
3208 LA Spijkenisse
The Netherlands

Telephone : + 31 (0)181-457074
Telefax : + 31 (0)181-625792

Internet: www.ashchem.com

Appendix C: Constructional directions for including a V-type heat exchanger in a piping design.

Pay attention to the following points:

- Level and square mounting possibility.
- Bends in the piping have to be located at a distance of at least three times the nominal diameter of the pipe from the inlet of the heat exchanger.
- The tubeside circuit of the V-type heat exchanger is not equipped with vent and drain connections. You will have to accommodate them in the piping.
- Put a filter 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 tubebundle (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 sheet and the drawing. For instance the flows: deviating from them can cause unacceptable high or low velocities. A (temporary) lower flow is acceptable when caused by a control-system and a conditioned circuit is involved. Avoid standstill (unless the heat exchanger is drained and flushed with fresh water).
- 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’).
- 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.
- Always check whether both fluids are compatible with the materials of the heat exchanger; Bloksma chooses the materials judging on the fluids specified by the customer, but is often not well informed about possible contamination’s, higher or lower than normal degrees of acidity and other for the choice of materials important properties.
- 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 will corrode faster than expected).