BLOKSMA HEAT EXCHANGERS

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

N-type (AEU/BEU, hp)

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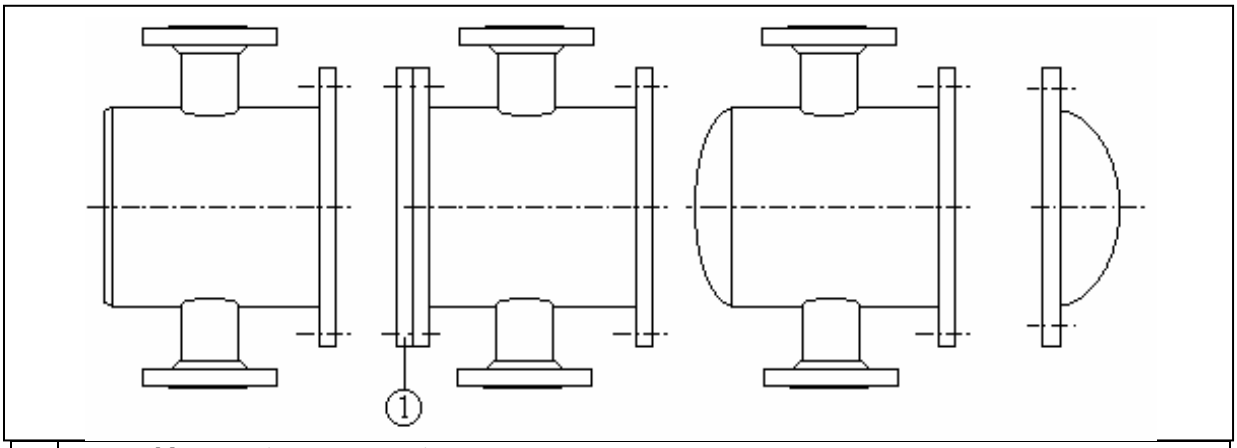
Glossary

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	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.
Partition gasket	Gasket with partition, which divides the tubeside circuit of the heat exchanger into separate parts (only at heat exchangers with more than 1 passes on the tubeside).
Water box	Depending on the model and the application of the heat exchanger, the tubeside front and back can have different shapes (see figure below). In this manual “water box” is used, also when the tubeside medium is not water.



1	Removable cover (TEMA type A)

Figure 0: Possible types of water boxes

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 sheet with constructional directions (appendix C). In the specification sheet the design pressures and temperatures are listed that must of course not be exceeded.

1.2 Guarantee and liability

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

Not covered by the guarantee are 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 lifespan, see to it that this takes place according to the then 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.

In connection with safety every Bloksma heat exchanger is tested under higher pressure than the design pressure before it leaves the factory. This applies to heat exchangers that are not tested by 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 specialised 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 "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.
- Mount the heat exchanger in the position as shown on the drawing (regarding vertical/horizontal position).
- Mount the heat exchanger level and square on a flat surface in order for the pipe connections to be made without forcing.
- 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 the lifting lugs (not all Bloksma heat exchangers are fitted with them). Otherwise use at least two hoops around the shell of the heat exchanger for lifting purposes.
- Install the heat exchanger and the piping in such a manner that there is still enough room to disassemble (part of) the heat exchanger (tube bundle, drain plugs, etc.).
- Make sure that, when the heat exchanger is used for steam service, the condensate can not flow back from the condensate discharge pipe into the heat exchanger. When this can not be prevented by the position of the heat exchanger with respect to the piping, mount a one-way valve in the condensate discharge pipe. A good condensate discharge will further be promoted by mounting a steam trap.

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 Cleaning and inspection 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, there are one or more anodes in the tubeside circuit. Often, the waterboxes will be (internally) coated. When performing tubeside inspections you will have to inspect the state of the anodes (drain the tubeside circuit before removing the anodes).
The anodes are equipped with a control hole: when the anode is completely wasted, leakage will occur through this hole as a warning.
The heat exchanger will not be protected against corrosion when the anodes are not replaced (in time). For replacement use Bloksma original anodes only. Refer to “Spare parts & tools” for ordering instructions.

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 coated waterboxes (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).
At heat exchangers with coated waterboxes and/or internally coated tubes (see specification sheet), the temperature may not exceed 100 °C, and no bleaching agents may be used because of the 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 various international companies (example in Appendix B) who can deliver products for the chemical cleaning of heat exchangers. They have worldwide offices in harbors and can give you cleaning advice or can clean the heat exchanger for you.

3.4 Shut down periods

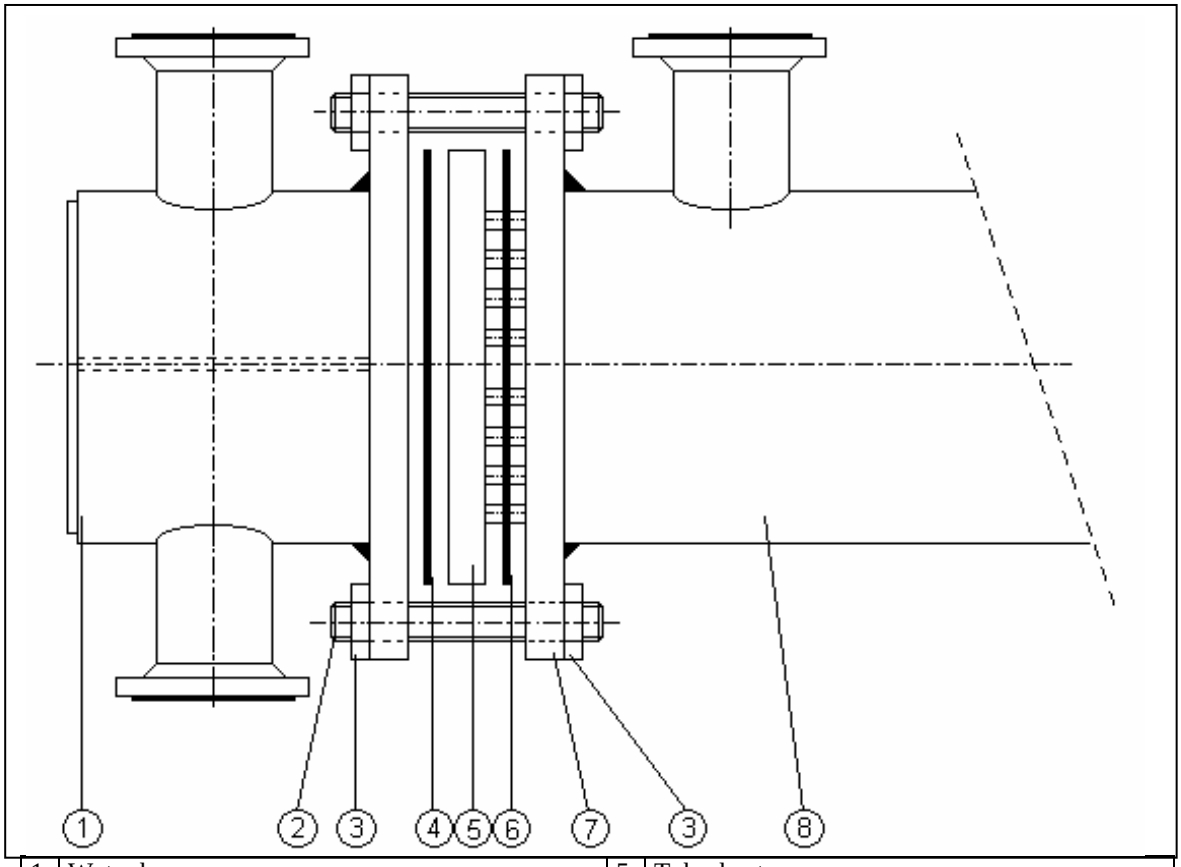
During shut down periods longer than a week the heat exchanger has to be drained completely and dried by means of preheated compressed air. In fact this also has to be done during short shut down periods (longer than a day) when there is risk of freezing, and it also applies when a corrosive medium is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

The tubesheet is bolted against the shell of the heat exchanger, between the flange of the waterbox and the shell flange. Sealing is provided by two flat gaskets:

- a gasket between tubesheet and shell flange
- a partition gasket between the tubesheet and the water box



1	Water box	5	Tubesheet
2	Stud bolt	6	Gasket
3	Nut	7	Shell flange
4	Partition gasket	8	Shell

Figure 1: Schematic drawing tubesheet constructions

For tubeside inspection or cleaning of the straight parts of the tubes with a tubebrush, the tubeside connections will have to be disassembled and the waterbox and the partition gasket will have to be removed (follow step 1 and 3). Always drain both circuits. **Pay attention: when the nuts are untightened 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).

In case the waterbox is equipped with a detachable cover (TEMA type A; on specification sheet type AEU), only this cover has to be removed (after draining the tubeside circuit). The tubeside connections will not have to be removed and the waterbox can remain in position. Do however 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.

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
- mark the position of all parts that will be disassembled, so they can be mounted in the correct position later on
- remove the waterbox by untightening the nuts
- remove the partition gasket

Step 2: Removing the tubebundle

- mark the position of the tubebundle in relation to the shellflange
- 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 on the shellside of the tubesheet

Step 3: Assembly

- 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 regarding gaskets and bolting

3.6.1 Gaskets

The gaskets used in this heat exchanger are flat 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 that radial grooves (risk of leakage) are created.
Do not re-use the same gaskets again. Always use original Bloksma gaskets for replacement (low priced replacements will have a shorter lifetime and higher failure rate). See “Spare parts & tools” for ordering instructions. Before installing the gaskets, please check whether gasket and gasket surface have 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.

The gasket has to be positioned on the centre line of the heat exchanger, and should not cover any tubes.

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.

In order to ensure a proper gasket pressure, the bolts have to be tightened in a controlled manner. Use a torque tensioning device. 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.
The correct tightening torque depends on the material of the bolts (as indicated on the ends of the bolts):

(Tightening torque in Nm)

Material	**Ck 35 (DIN 17240)**	**5.6 (DIN 267)**	**8.8 (DIN 267)**	**A193 B7 (ASTM)**
Dimension				
M16	65	69	148	166
M20	126	135	288	344
M24	218	233	498	560

In case your heat exchanger is equipped with stud bolts of a different material or dimensions, contact Bloksma for the correct tightening torque.

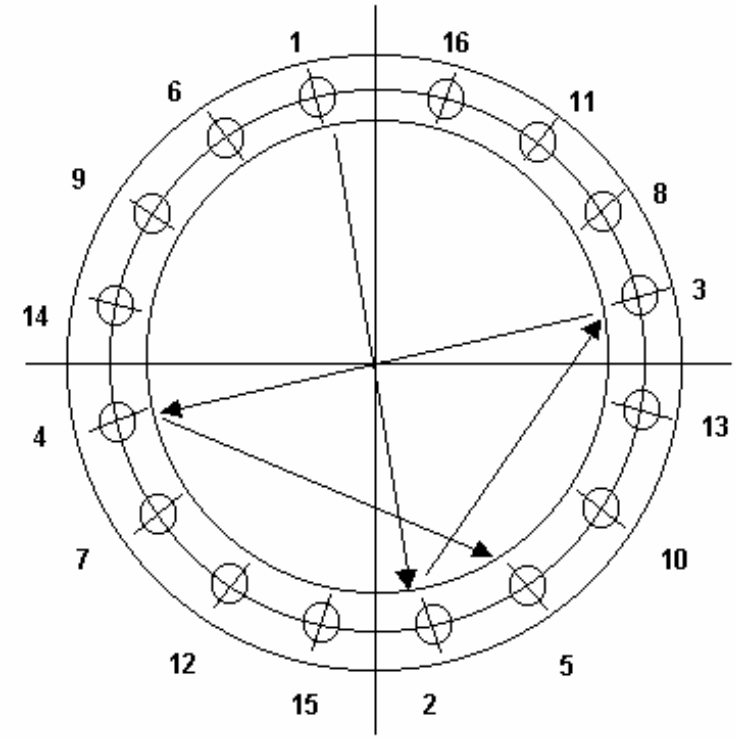


Figure 2: (Un-)bolting sequence

4 Trouble shooting & repairs

4.1 Performance too low

Check:

- whether all connections have been made according to the drawing
- whether the heat exchanger and the system have been properly vented
- whether the flows are according to the specification (check all valves, lines and pumps, as well as the flow directions)
- whether 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)
- whether the heat exchanger has been reassembled properly after disassembly
  (the position of the bundle (this could be installed, being rotated 180°))

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 hydrotested, after disassembling the tubeside. Follow the instructions in “Assembling and disassembling of the heat exchanger”. Subsequently pressurize the shellside. After hydrotesting depressurize and drain the shellside again. Assemble the heat exchanger again.

Pay attention: For hydrotesting (see “Assembling and disassembling ot the heat exchanger”) you will need a testring, which keeps the tubesheet in position. The testring replaces the flange of the water box during hydrotesting. Bloksma can supply such a testring (see “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 & tools

Available spare parts and tools:

- Set of gaskets (*)
- Soft copper plugs
- Tube brush
- Bolts / nuts
- Water box
- Testring
- Anodes (if applicable)
- Complete U-bundle

When ordering spare parts, please refer to the Bloksma drawing number (see nameplate).

(*) Recommendations for storage of the flat gaskets:

- 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 specialised 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: Adresses

Chemical cleaning and products for chemical cleaning

Ashland Nederland B.V.
Drew Marine Division
Pesetastraat 5
2991 XT Barendrecht
The Netherlands

Telephone : + 31 (0)10-4975000
Telefax : + 31 (0)10-4975111

Internet: www.ashspec.com

Appendix C: Constructional directions for including an N-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.
- For steam service however, it is advisable to locate a bend in the piping just before the inlet of the heat exchanger (because of the often very high velocities).
- 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 (if extractable) 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 specifiationsheet[1] 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 controlsystem 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 contaminations, 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, less noble than materials of the piping, the bundle will corrode faster than expected).

[1] In connection with the applied materials the instruction manuals refer to the specification sheet of the heat exchanger. Therefore always keep the specification sheet.