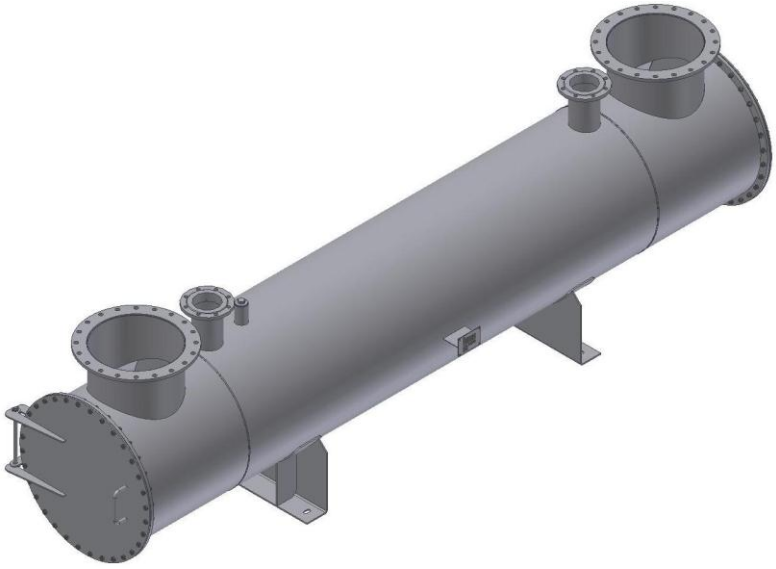
Operating and Maintenance Instructions

Exhaust gas heat exchanger



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1. Contents

List of Figures

List of Tables

2. About These Instructions

These operating instructions apply to the exhaust gas heat exchanger used with water or a mixture of water/glycol as the cooling medium.

Given the many different types of connections, divergence from the figures is possible with certain details.

Before using the exhaust gas heat exchanger, read these instructions carefully and make sure you understand them.

These instructions are designed to familiarise you with basic work on the exhaust gas heat exchanger.

These instructions contain important information on using the exhaust gas heat exchanger safely and in the proper manner.

By observing them you will:

- avoid hazards
- reduce repair costs and downtimes and
- increase the reliability and service life of the exhaust gas heat exchanger.

Regardless of these instructions, the regulations applicable in the country of utilisation and the place of usage governing accident prevention and environmental protection must be observed.

These instructions describe the use of the exhaust gas heat exchanger.

A copy of these instructions must be accessible to attendance staff at all times.

2.1. Additional documentation

Besides these instructions, the following documents relating to the exhaust gas heat exchanger are also provided. These documents form an integral part of the operating instructions in accordance with the EU directive 97/23/EC.

The manufacturer provides the following documents:

- For exhaust gas heat exchangers with a design temperature (water side) up to and including 110°C and depending on the product of the pressure and volume

  - Manufacturer's Declaration
- Or for exhaust gas heat exchangers with a design temperature (water side) greater than 110°C and depending on the product of the pressure and volume

  - Declaration of conformity and, if appropriate, conformity certificate of the notified body
- Technical data
- Safety equipment operating instructions if included in the scope of supply.

2.2. Signs and symbols used

The signs and symbols in these instructions are designed to help you use the instructions and the exhaust gas heat exchanger quickly and safely.

2.2.1. General signs/Symbols

Advanced Organizer

The Advanced Organizer briefly informs you about the content of the following section.

NOTE Note tells you about the most effective and/or practicable use of the system and these instructions.

➢ Requirements that must be satisfied for a procedure are marked in this way

1. ... **Operations**
2. ...
3. ... The numbered sequence of operations laid down facilitates proper and safe usage of the system.

✓ **Result**

This describes the result of a sequence of operations.

Bold Emphasis in the text or unnumbered heading

2.2.2. Safety signs

The safety sign symbolises a source of danger in graphical form. The safety signs in the work area of machinery/plant and the overall technical documentation comply with the harmonised standard EN 61310 Part 2: Safety of machinery – Indication, marking and actuation and EC directive 92/58/EEC – Minimum requirements for the provision of safety and/or health signs at work.

Warning signs

Warning about a general hazard

This warning sign precedes activities in which a risk may result from various causes.

Warning about hazardous electrical voltage

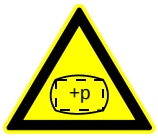
This warning sign precedes activities involving hazards presented by electrical shock, possibly with fatal consequences.

Warning about suspended loads

This warning sign precedes activities involving hazards presented by falling objects, possibly with fatal consequences.

Warning about hot surfaces

This warning sign precedes activities in which there is a risk of burns due to hot surfaces or also hot media.



Warning about pressurised vessels

This warning sign precedes activities involving hazards presented by pressurised vessels.

3. General Safety Provisions

In this section you will find the basic safety provisions for operation of the exhaust gas heat exchanger.

Anyone operating or working with the exhaust gas heat exchanger must read this section and put its provisions into practice.

3.1. Proper usage

The exhaust gas heat exchanger or hot water generator (referred to below as the exhaust gas heat exchanger) has been built, tested and factory-inspected according to the European Pressure Equipment Directive 97/23/EC (referred to below as PED 97/23/EC) in conjunction with the AD 2000 regulations or Technical Rules for Steam Boilers (TRD).

The corresponding certificates form part of the scope of supply.

Testing

The exhaust gas heat exchanger is partially subject to testing prior to commissioning as well as to recurrent tests during standard operation.

The respective applicable national regulations of the country of installation must be observed for these tests.

In Germany, the Industrial Safety Ordinance and the steam boiler agreements 2000/1 and 2003/2 (where applicable) must be observed.

The defence against hazards is achieved by the special warning instructions directly in the technical documentation.

The operator must comply with all the instructions in these operating instructions when operating the system. It is his or her duty to perform all the specified inspection and maintenance work, including exchanging wear parts. APROVIS Energy Systems GmbH cannot be held responsible for any damage arising from improper use of the system.

Correct and proper use includes:

1. complying with all the instructions in this manual

2. performing all inspection and maintenance work on schedule

3. complying with the general and special safety instructions in these operating instructions, as well as with the applicable accident prevention regulations

3.1.1. Proper usage

The exhaust gas heat exchanger extracts energy from the exhaust gas mass flow and dissipates it via the cooling medium.

The exhaust gas is routed via the smoke tubes. Routing of the cooling medium (water or water/glycol mixture, referred to below as water) is around the tubes.

The exhaust gas heat exchanger must be operated according to the specifications in the Operating and Maintenance Instructions.

Any improper usage or activities involving the exhaust gas heat exchanger not described in these instructions shall constitute unauthorised misuse, so falling outside the manufacturer's statutory limitations of liability.

Further information

Proper usage also includes observing the following information.

The exhaust gas heat exchanger cools the exhaust gases with uncontaminated heat transfer surfaces below the exhaust gas outlet temperature specified in the technical data. This may result in increased condensation of exhaust gas components. This effect may also occur when starting the system or under partial load.

The exhaust gas condensate produced is aggressive and will attack the components of the exhaust gas heat exchanger in the long term. The exhaust gas condensate produced must be discharged directly and should not be allowed to accumulate in the exhaust gas heat exchanger. The functional efficiency of condensate discharge should be checked at regular intervals.

The volumes of water specified in the technical data are the volume of water for operation at nominal rating and the minimum water volume. It is not permitted to operate the system with less than the minimum water volume specified.

The minimum working pressure on the circulating water side in the exhaust gas heat exchanger should be at least 2 bar above the saturated steam pressure at the outlet temperature.
When operating the exhaust gas heat exchanger with a mixture of water/glycol, higher minimum working pressure must be ensured to prevent the glycol components from decomposing. If you are unclear about anything, please contact APROVIS Energy Systems GmbH.

3.2. Safety equipment

The exhaust gas heat exchanger must be equipped with suitable safety devices to prevent the permissible operating limits, such as pressure and temperature, from being exceeded (see PED 97/23/EC, Annex 1).

In addition, the regulations of the respective country of installation must be observed.

If the place of installation is Germany, the following rules and regulations, directives and standards apply to the maximum inlet temperature of:

- ≤ 110°C: TRD 702, DIN EN 12828
- > 110°C up to 120°C: TRD 702, DIN EN 12828, DIN EN 12953-6, PED 97/23/EC (Annex 1)
- > 120°C: TRD 402, TRD 604/2, DIN EN 12953-6, PED 97/23/EC (Annex 1), DDA Information 1001.

NOTE The safety equipment does not have to be included in the manufacturer's scope of supply for the exhaust gas heat exchanger. It can be procured by the operator on his own responsibility.

If the safety equipment is supplied by APROVIS Energy Systems GmbH, the relevant operating instructions for the components can be found in the appendix.

3.2.1. Foreseeable misuse or improper handling

Any misuse or improper handling of the exhaust gas heat exchanger shall render the manufacturer's warranty null and void in all respects, automatically invalidating the operating licence at the same time.

Foreseeable misuse or improper handling include:

- operation above/below the permissible design temperatures
- operation above/below the permissible design overpressure
- operation below the required minimum water pressure
- operation following the removal of safety devices
- failure to comply with the minimum water volume
- failure to comply with the maintenance intervals
- failure to perform measurements and testing to ensure the early detection of damage

- failure to change wear parts
- incorrectly performing maintenance or repair work
- performing defective maintenance or repair work
- improper usage

3.2.2. Residual hazards

The exhaust gas heat exchanger has been designed and built according to the applicable technical standards. This is evidenced by the Manufacturer's Declaration or Declaration of Conformity (see section 2.1.)

According to the manufacturer's hazard analysis, risks and associated residual hazards may arise mainly from operation and the operating conditions, i.e. under the responsibility of the operator.

Residual hazards are nevertheless described in these operating instructions.

Residual hazards during the entire lifecycle of the exhaust gas heat exchanger may include:

- risk to life
- risk of injury
- risk to the environment
- material damage to the exhaust gas heat exchanger
- material damage to other tangible assets
- restrictions on performance or functionality

Existing residual hazards can be avoided by the practical implementation and observance of the following stipulations:

- the special warnings on the exhaust gas heat exchanger
- the general safety information in these instructions
- the specific warnings in these instructions
- the operating instructions of the operator

Risk to life

A risk to human life may result at the exhaust gas heat exchanger from:

- misuse
- improper handling, esp. operation not complying with the performance data specified in the technical data
- missing safety devices
- defective or damaged mechanical, electrical or pneumatic components

Risk of injury

A risk of human injury may result at the exhaust gas heat exchanger from:

- improper handling, especially at the blow-off piping, condensate discharge
- transportation
- defective or damaged mechanical, electrical or pneumatic components

Risk to the environment

A risk to the environment may result at the exhaust gas heat exchanger from:

- improper handling
- working materials (lubricants etc.)
- escaping media presenting a risk to the environment (e.g. glycol)
- noise emission

material damage to the exhaust gas heat exchanger

Material damage to the exhaust gas heat exchanger may result from:

- improper handling
- failure to comply with specifications for operation and maintenance
- unsuitable working materials

Material damage to other tangible assets

Material damage to other material assets in the operating area of the exhaust gas heat exchanger may result from:

- improper handling

Restrictions on performance or functionality

Restrictions on the performance or functionality of the exhaust gas heat exchanger may result from:

- improper installation and handling
- improper maintenance or repair
- unsuitable working materials

3.3. Staff qualifications and duties

All activities involving the exhaust gas heat exchanger may only be performed by staff authorised for this purpose.

Authorised staff can be broken down into several groups:

- operator
- transport staff
- operating and service staff

Authorised staff must

- have reached the age of 18;
- be trained in First Aid and capable of providing the same;
- be familiar with the accident prevention regulations and safety instructions and be able to apply the same;
- have read and understood section "General Safety Provisions"
  (section 3);
- be able to apply and put section "General Safety Provisions" (section 3) into practice;
- have received training that provides the guarantee of sufficient expert and technical knowledge; The required national qualifications must be taken into account;
- follow the operating manual and operating instructions together with the checklist and maintain the log book;
- be in possession of the physical and intellectual abilities required to perform their responsibilities, duties and activities involving the exhaust gas heat exchanger;
- be trained and instructed about their duties and activities involving the exhaust gas heat exchanger according to their responsibilities;
- have understood the technical documentation relating to their responsibilities, duties and activities involving the exhaust gas heat exchanger and be able to put the same into practice.

3.3.1. Operator

The operator is responsible for ensuring that

- the exhaust gas heat exchanger is only used for its intended purpose;
- the exhaust gas heat exchanger is only operated when fully operational and safe to operate;
- the exhaust gas heat exchanger is protected from unauthorised usage;
- the necessary personal protective equipment is available;
- the necessary personal protective equipment is worn;
- the authorised staff members are sufficiently qualified;
- the authorised staff members are instructed about all relevant issues of health and safety;
- the authorised staff members are instructed about all relevant issues of environmental protection;
- the safety and information signs on the exhaust gas heat exchanger are clearly legible;
- a risk assessment of the whole system has been carried out and the results summarised in operating instructions;
- only authorised staff have access to the exhaust gas heat exchanger;
- repairs are only carried out after having consulted the manufacturer beforehand;
- any defects or abnormal operating states / malfunctions observed are corrected at once and documented in the log book;
- operation of the exhaust gas heat exchanger is stopped during troubleshooting.

3.3.2. Transport staff

Transport staff must

- be able to select and use suitable lifting equipment;
- be able and authorised to use transport devices;
- report instances of transportation damage at once;

Transport staff are responsible for ensuring that

- no transportation damage occurs.

3.3.3. Operating and service staff

Operating and service staff must

- be able to demonstrate that they have the required knowledge for the operation and maintenance of an exhaust gas heat exchanger as specified in the national regulations by participating in training courses or instructional sessions;
- use the exhaust gas heat exchanger for its intended purpose;
- wear the necessary personal protective equipment;
- immediately shut down the exhaust gas heat exchanger in the case of defects or abnormal operating states / malfunctions;
- immediately report any observed defects or abnormal operating states / malfunctions as well as record them in the log book.

Operating and service staff are responsible for ensuring that

- the safety and information signs on the exhaust gas heat exchanger are clearly legible;
- the exhaust gas heat exchanger is protected from unauthorised usage;
- repairs are agreed with the manufacturer;
- the exhaust gas heat exchanger is only operated when fully operational and safe to operate.

3.4. Personal protective equipment

Personal protective equipment must be worn when work is carried out on the exhaust gas heat exchanger. This may include:

- safety shoes
- work gloves
- protective clothing
- work helmet
- hearing protection

The precise scope of the required protective equipment must be specified in accordance with the activity to be carried out and the applicable standards.

3.5. General safety information

It is not permitted to make design modifications to the exhaust gas heat exchanger.

All safety devices must be available and fully operational.

All identification on the exhaust gas heat exchanger must be present and legible.

The authorised staff are responsible for the safety of operation of the exhaust gas heat exchanger.

The authorised staff are responsible for ensuring that the exhaust gas heat exchanger is protected from unauthorised operation.

The authorised staff are obliged to comply with the applicable accident prevention regulations.

The authorised staff are obliged to comply with the safety and work instructions of the supervisors and safety officers.

The authorised staff are obliged to wear their personal protective equipment.

The consumption of alcohol, drugs, medication or other mind-expanding or altering substances is prohibited.

The authorised staff must be familiar with the components of the exhaust gas heat exchanger and their function and be able to apply the same.

The authorised staff must be familiar with the five safety rules of electrical engineering and be able to apply the same.

Before commencing work:

- perform safety isolation
- secure from reconnection
- verify isolation from supply
- install equipotential bonding
- insulate or block off adjacent energised parts.

Transportation

The exhaust gas heat exchanger should only be lifted and transported with adequately dimensioned transport devices.

The exhaust gas heat exchanger should only be lifted at the transport points provided / specified for this purpose.

When transporting the exhaust gas heat exchanger, watch out for any shift in the centre of gravity.

Secure the exhaust gas heat exchanger from slipping / tilting.

Only transport the exhaust gas heat exchanger 10 cm above the ground where possible.

The exhaust gas heat exchanger should be lifted and set down evenly.

Assembly

Only set up the exhaust gas heat exchanger on a sufficiently stable surface.

Only set up the exhaust gas heat exchanger on a flat surface.

When installing the exhaust gas heat exchanger, watch out for any shift in the centre of gravity.

Commissioning

Whenever commissioning the exhaust gas heat exchanger, check its functionality and safety of operation.

Before recommissioning, the reason for shutdown (e.g. maintenance work, EMERGENCY-OFF) must be resolved.

Only a fully operational exhaust gas heat exchanger that is safe to operate should be put into service.

Only the settings described in the supplier's operating instructions for the control system / pneumatics should be selected.

Operation

Only a fully operational exhaust gas heat exchanger that is safe to operate should be operated.

Immediately shut down the exhaust gas heat exchanger in the case of abnormal operating states or malfunctions.

Immediately report abnormal operating states or malfunctions and enter them in the log book.

Maintenance / Cleaning

Do not clean the exhaust gas heat exchanger while in operation.

Observe the cleaning intervals.

Observe the information on cleaning.

Maintenance

Do not maintain the exhaust gas heat exchanger while in operation.

Observe the maintenance intervals specified in these instructions.

Only the operator's service staff may carry out maintenance work described in these instructions.

All other maintenance work should only be performed by the manufacturer's service staff.

Repair

Do not repair the exhaust gas heat exchanger while in operation.

Only the operator's service staff may carry out repair work described in these instructions.

Repairs should only be carried out after prior consultation with the manufacturer.

All other repair work should only be performed by the manufacturer's service staff.

Shutdown / Dismantling

The exhaust gas heat exchanger is shut down / dismantled in reverse order to the procedure used for start-up / assembly.

The exhaust gas heat exchanger must be recycled according to the environmental protection regulations applicable at the place of usage.

Documentation

A copy of these instructions is accessible to authorised staff at all times.

These instructions should always form an integral part of the operating instructions that are drawn up by the operator.

Environmental protection

Packaging materials must be recycled according to the environmental protection regulations applicable at the place of usage.

Used or left-over working materials must be recycled according to the environmental protection regulations applicable at the place of usage.

4. Exhaust Gas Heat Exchanger

In this section you will find a description of the components and functionality of the exhaust gas heat exchanger.

4.1 Components of the exhaust gas heat exchanger

The main components of the exhaust gas heat exchanger are:

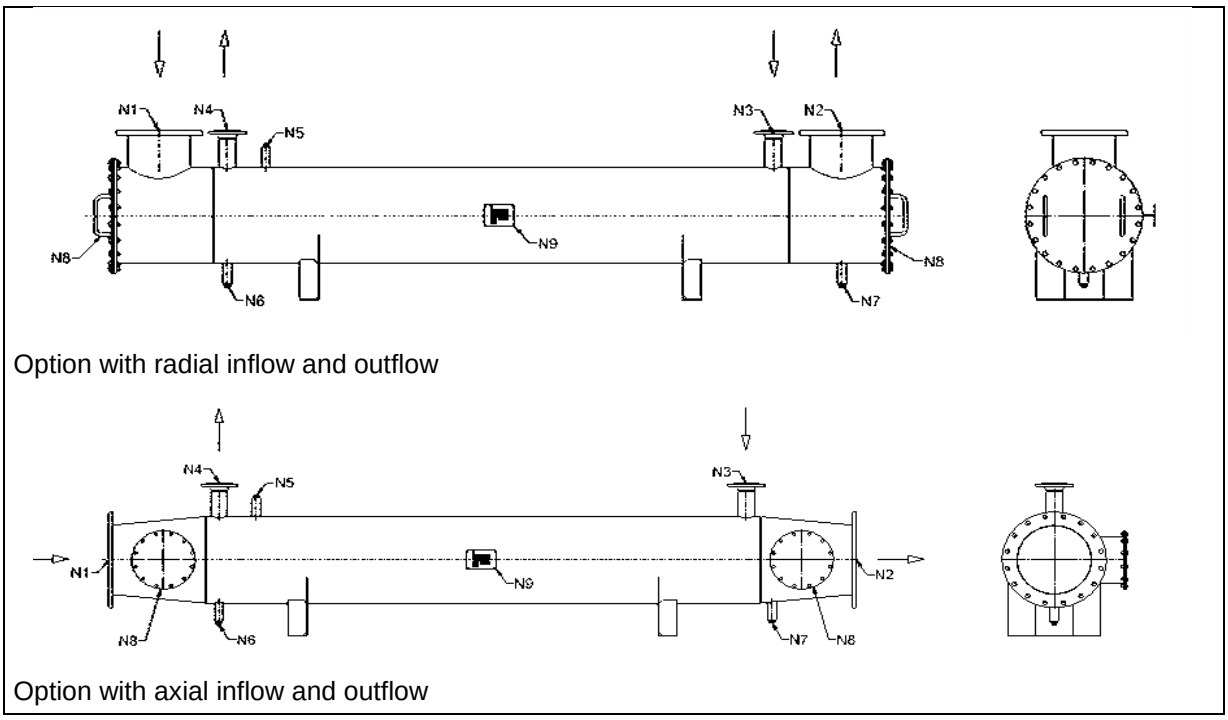


Fig. 4 1.: Components of the exhaust gas heat exchanger

N1	Exhaust gas inlet	N6	Drainage water side
N2	Exhaust gas outlet	N7	Condensate exhaust gas side
N3	Water inlet	N8	Inspection openings exhaust gas side
N4	Water outlet		
N5	Venting water side	N9	Name plate

NOTE **If it is not clear which connections to use correctly from the diagram, please contact the manufacturer without fail.**
The figure shown above is only an example. The exhaust gas heat exchanger supplied may differ from the figure shown above.

4.2. Technical data

The technical data of the exhaust gas heat exchanger is described in the "Technical Data" section (see section 14).

NOTE **The technical data specified for pressure and temperature are limit values and must be observed.**

These values are also given on the name plate.

The water volume specified (minimum) on the water side must be observed.

Proper insulation should be installed on the exhaust gas heat exchanger.

5. Transportation

In this section you will find a description for transportation of the exhaust gas heat exchanger.

For transportation, a distinction should be made between transportation to the place of installation (transportation on wooden pallet) and transportation for assembly (transportation with slings).

Transportation on wooden pallet

Transportation on the wooden pallet is carried out as shown in the following diagram:

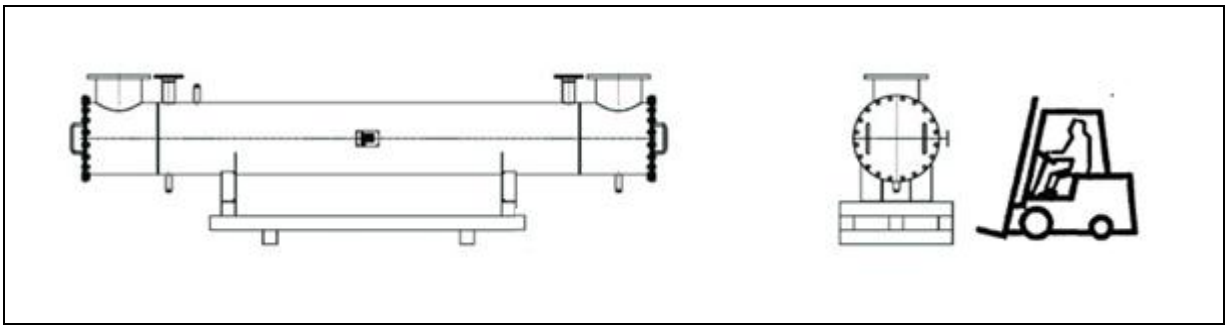


Fig. 5.1: Transportation on factory-assembled wooden pallet

When lifting the exhaust gas heat exchanger with a fork-lift truck, it should be secured so that it is in a stable position.

Transportation with a fork-lift truck is only permitted when the exhaust gas heat exchanger is secured on the factory-assembled wooden pallet.

For installation (after removal of wooden pallet), lifting is only permitted using rope slings on the heat exchanger shell. See next page.

Transportation with slings

Transportation using lifting lugs is preferred by the manufacturer. Transportation is carried out as shown in the following diagram:

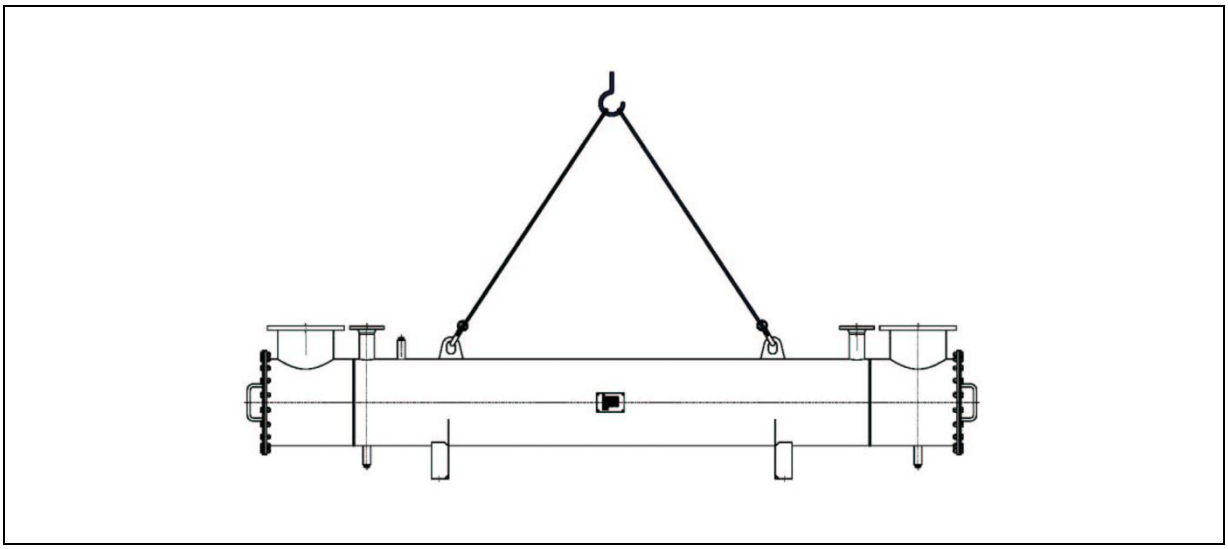


Fig. 5.2: Transportation with ropes using lifting lugs

If no lifting lugs are available, lifting is only permitted using rope slings on the heat exchanger shell – not on the exhaust gas chambers.

Transportation is then carried out as shown in the following diagram:

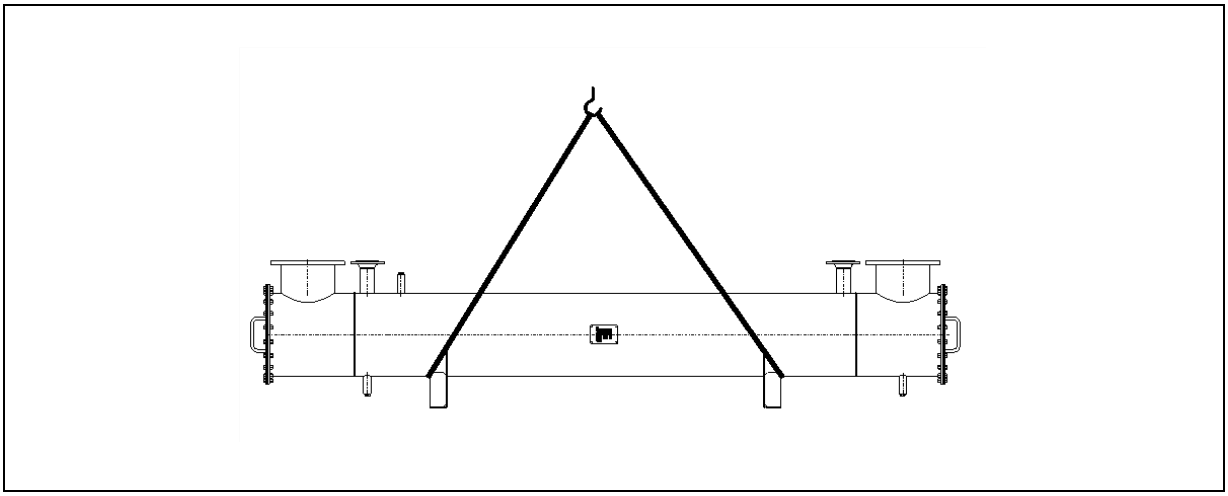


Fig. 5.3: Transportation with ropes on heat exchanger shell

NOTE **In both cases, transportation with a fork-lift truck is not permitted!**

Prerequisites The following prerequisites must be fulfilled for transportation:

- an adequately dimensioned transport device must be available
- all moving parts are secured to prevent slipping
- the place of destination is prepared

HAZARD!

If the exhaust gas heat exchanger slips or falls, there is a risk of fatal crushing.

- Take weight into consideration, see section 14 "Technical Data".
- Watch out for any shift in the centre of gravity.
- Secure components from slipping / tilting.
- Only transport components 10 cm above the ground where possible.
- Components should be lifted/set down evenly.
- If necessary, make use of fork extensions.

5.1. Storage

If the exhaust gas heat exchanger is to be put into storage before use, it should be ensured that all surfaces are kept dry over the entire period to avoid damage from corrosion.

6. Assembly and Installation

The national regulations and laws for installation and operation of the exhaust gas heat exchanger must be complied with!

The exhaust gas heat exchanger must be assembled so that it is not subject to external forces. To prevent resonance vibrations in the exhaust gas connection, provision should be made for pulsation dampeners.
The exhaust gas heat exchanger will expand during operation. This thermal expansion must be taken into account during installation using fixed and floating support.

The direction of flow is shown by flow direction arrows on the exhaust gas heat exchanger. The downstream piping should be connected according to the direction of flow.

MATERIAL DAMAGE!

Irreparable damage to the exhaust gas heat exchanger.

- Operation of the exhaust gas heat exchanger with the flow contrary to the flow direction arrows is not permitted.
- Connect piping according to the flow direction.
- The drainage may only be opened once the water temperature is lower than 60°C. Failure to comply with this condition may result in material damage.

The seals used on the downstream piping must be suitable for the prevailing pressure and temperature ranges. The resistance to media should also be checked here.

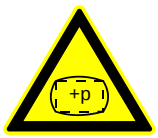
On assembly, make sure that the inspection openings are accessible.

On alignment, ensure that full venting on the water side is possible.

When installing the insulation, make sure that the inspection openings remain accessible. Removable insulation should be installed at these points.

The same applies to all flanged joints on the exhaust gas side.

The connection for discharge of the condensate should not be closed so that any condensate produced can drain off freely.



MATERIAL DAMAGE!

Damage due to excess pressure on the exhaust gas side.

- Due to the excess pressure on the exhaust gas side, it is necessary to install a siphon that is dimensioned according to the maximum excess pressure present.

To avoid burns from hot surfaces, the exhaust gas heat exchanger must be insulated and/or touch protection provided.

The insulation must be designed so that a maximum surface temperature of 60°C is not exceeded.

With surface temperatures exceeding 60°C, touch protection must be fitted in the traffic zone.

7. Initial Commissioning

7.1 Filling the water circuit (circulating water side)

The exhaust gas heat exchanger may only be operated with the media specified in section 14 "Technical Data".

For flushing and filling, only use water that complies with the "Requirements on the quality of circulating water" (see section 13).

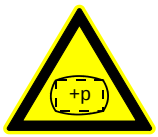
Before filling the exhaust gas heat exchanger, the piping of the external heating circuit should be flushed. In particular, make sure that no rust, slag or other contamination enters the exhaust gas heat exchanger.

The exhaust gas heat exchanger must be filled slowly with the vent slightly open and monitored in the process. Once no more air bubbles escape, the process is complete. Even if the automatic venting system is used, the exhaust gas heat exchanger must be filled slowly.

When using antifreeze, check that this has been taken into account in the design of the exhaust gas heat exchanger. In addition, the appropriate antifreeze concentration must be used as well as an antifreeze product with corrosion inhibitors that is licensed for increased temperatures. Only antifreeze with a boiling point of at least 170°C at 1013 mbar should be used. The fitness of the antifreeze in terms of material compatibility and usability must be agreed with the supplier.

Leakage due to transport should be rectified.

All flanged and screwed piping connections should be tightened up during filling.



MATERIAL DAMAGE!

Material damage or explosive vaporisation

- Filling is only permitted if the temperature of the exhaust gas heat exchanger is below 60°C. Failure to comply with this condition may result in material damage or explosive vaporisation.
- No exhaust gas must flow through the exhaust gas heat exchanger before it is filled and the water pumped. Failure to comply with this condition will cause irreparable damage to the exhaust gas heat exchanger.

8. Operation

The national regulations and laws for installation and operation of the exhaust gas heat exchanger must be complied with!

8.1. Commissioning and trial operation

Commissioning requires specialist staff who have experience in starting up exhaust gas heat exchangers and are in possession of the necessary skills as described in "Operator, Staff qualifications and duties" (section 3.3.1).

In addition, the staff to be responsible for subsequent maintenance and supervision must be sufficiently qualified, at the latest by the start of trial operation.

Start-up with cold circulating water should be avoided. Slow external heating is essential. During operational stoppages it is advisable to keep the exhaust gas heat exchanger at the working temperature by means of external heating.

Procedure for commissioning

The following procedure should be followed when commissioning the exhaust gas heat exchanger:

Procedure for commissioning:

1. Ensure that the entire system is vented on the water side.
2. Start up the circulating pump and check that the circulating water is flowing through the exhaust gas heat exchanger. To protect the exhaust gas heat exchanger, it is essential to ensure that the minimum flow rate specified is observed. See "Technical Data" (section 14)
   The water must always circulate at the minimum amount during heating.
3. Check all safety equipment (safety valve, water level limiters and flow control instruments, temperature and pressure switches as well as limiters).
4. Start the heating on the exhaust gas side.
5. During commissioning all flanged joints and screwed piping connections should be checked for leakage once again and tightened in a depressurised state, if necessary.

✓ Commissioning is completed, and the exhaust gas heat exchanger is ready for operation.

When releasing screws, steam, hot water or hot exhaust gas may escape!

HAZARD!

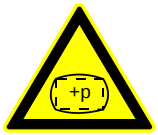
Serious burns may be caused by escaping steam, hot water or hot exhaust gas.

- Assembly and maintenance should only be performed when the system is cold!

When commissioning the exhaust gas heat exchanger, the system must be vented and the function of the automatic venting system checked.

After switching off the heating on the exhaust gas side, circulation must continue on the water side for at least 10 min to avoid damage (overheating) of the exhaust gas heat exchanger.

If a malfunction occurs, ensure that circulation continues on the water side.



MATERIAL DAMAGE!

Material damage through gas or vapour cushions.

- Failure of the automatic venting system or the heating water circulating pump may cause a gas or steam cushion to form in the exhaust gas heat exchanger. This may destroy the exhaust gas heat exchanger.
- Operation of the exhaust gas heat exchanger without circulating water is not permitted and leads to immediate destruction of the exhaust gas heat exchanger.

8.2. Monitoring during operation

The national regulations must be observed during operation. An authorised member of staff must check that the system is in proper condition in accordance with the time intervals of the national regulations and make an entry in the log book confirming this.

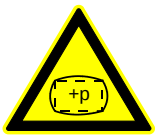
The operating instructions must be posted or displayed in a clearly visible place in the boiler room.

Whenever starting up the plant, an authorised member of staff must make sure that the plant is in proper condition. The same also applies to the pressure and temperature conditions in the hot water network.

When starting up the system, an authorised member of staff (boiler attendant) must be present in the boiler room. Startup refers to the period up to reaching the operating state at which proper operation of all monitoring devices can be observed.

An automatic restart after a normal shutdown does not count as startup.

8.3. Bypass mode



MATERIAL DAMAGE!

Irreparable damage to the exhaust gas heat exchanger.

- Operation of the exhaust gas heat exchanger without circulating water and/or failure to adhere to the minimum flow rate on the circulating water side is not permitted and may result in the exhaust gas heat exchanger being immediately damaged beyond repair.

In the case of exhaust gas heat exchangers with a bypass on the exhaust gas side, leakage flows may occur despite the exhaust gas damper (to the exhaust gas heat exchanger) being closed, thus resulting in heating of the exhaust gas heat exchanger.
Heat input via radiation heat is also possible depending on the position of the exhaust gas dampers.

For this reason, the exhaust gas heat exchanger should not be operated below the minimum flow rate at any time, including in bypass mode (medium around the tubes, see section 14 "Technical Data").

To prevent any damage to the exhaust gas heat exchanger, observe the following during commissioning and shutdown:

Procedure for commissioning in bypass mode

Commissioning

Before starting the engine (heating), observe the following:

The exhaust gas heat exchanger must be filled on the water side, including in bypass mode (exhaust gas damper to exhaust gas heat exchanger closed, bypass open), with the circulating pump and the safety equipment also being in operation. (see section 8.1).

Procedure for shutdown in bypass mode

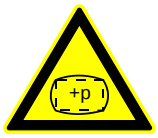
Shutdown:
The procedure for shutdown is the same as that described in section 8.4.

8.4. Shutdown

Procedure for shutdown

The following procedure should be followed when shutting down the exhaust gas heat exchanger:

1. Switch off the heating on the exhaust gas side.
2. Make sure that the heating on the exhaust gas side is switched off
   (the engine with a combined heat and power plant) to rule out any flow through the exhaust gas heat exchanger on the exhaust gas side.
3. Continue the flow on the water side for at least 10 minutes. Switch off the flow on the water side after 10 minutes at the earliest.



MATERIAL DAMAGE!

Material damage through stresses.

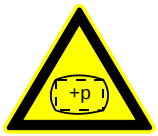
- It is essential to ensure that the heating of the exhaust gas heat exchanger is switched off first.
- To avoid stresses, the exhaust gas heat exchanger should not be allowed to cool down abruptly.

✓ The exhaust gas heat exchanger is shut down.

8.5. Operational stoppage

Procedure for operational stoppage

1. To avoid damage from corrosion during operational stoppages, it is advisable to keep the exhaust gas heat exchanger at roughly working temperature on the water side, if necessary by means of external heating.
2. To avoid burns, it must be ensured before drainage that the water side is not pressurised (check using manometer provided by the customer) and that the water temperature has fallen to below 60°C.
3. If the exhaust gas heat exchanger is to be shut down for a lengthy period and drained for this purpose, it must be ensured that all surfaces are kept dry over the entire period to avoid damage from corrosion.
4. It is essential to observe section 8.3 for systems with an exhaust gas bypass.



MATERIAL DAMAGE!

Material damage caused by corrosion.

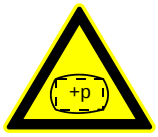
- It is essential to ensure that the exhaust gas heat exchanger is stored and preserved properly.

✓ The exhaust gas heat exchanger is shut down.

9. Inspection and Maintenance of the Exhaust Gas Heat Exchanger

Tests to be carried out and malfunctions to safety-relevant fittings (see section 9.5) must be entered in the log book and confirmed by an authorised member of staff.

Maintenance work on the exhaust gas heat exchanger (see section 9.6) must be entered in a maintenance book and confirmed by the tester.



HAZARD!

Risk from plant or plant parts under pressure or containing hot medium.

- It is not permitted to work on plants or plant parts that are under pressure or contain hot medium.
- Such work may only commence when the plant or plant parts have been reliably depressurised or drained beforehand, and this condition is assured.

9.1. operating hours after initial commissioning

- Check all flanged joints and screwed piping connections. Immediately rectify any leakage.
- The functionality of the condensate drain should be checked.

9.2. Regular inspections

Necessary tests and maintenance work can be found in the checklists in section 9.4 "Test schedule" and section 9.5 "Maintenance schedule".

In the course of the customary service inspections, but at least every 6 months:

- Check all flanged joints and screwed piping connections. Immediately rectify any leakage.
- The function of the safety equipment (safety valve, water level limiters and flow control instruments, temperature and pressure switches as well as limiters) as well as other valves and fittings should be checked.
- Check the values of circulating water. See section 13.
- Inspect the exhaust gas side heating surfaces of the exhaust gas heat exchanger. If any deposits are present, the heating surface should be cleaned at once.
- The back pressure on the exhaust gas side should be checked. If the values are too high, the exhaust gas heat exchanger should be cleaned on the exhaust gas side.
- The drainage of the exhaust gas heat exchanger on the water side should be opened. If deposits are observed, the water quality should be checked at once for compliance with the specified values. In addition, the entire heating water system should be checked for impermissible deposits. If necessary, the exhaust gas heat exchanger must be flushed on the water side.
- It is recommended checking the water side to make sure that no deposits have formed on the tube sheet of the exhaust gas inlet side. If deposits are found, the water quality should be checked at once for compliance with the specified values, and the exhaust gas heat exchanger subjected to chemical cleaning on the water side.
- The functionality of the condensate drain must be checked.

Note **After opening inspection openings and measuring nozzles, new seals must be fitted.**

9.3 General information on the maintenance of an exhaust gas heat exchanger

Note **After opening inspection openings and measuring nozzles, new seals must be fitted.**

9.3.1. Water side

Monitoring of the circulation and make-up water is extremely important.

The time, volume and quality of make-up water must be documented in the log book.

Damage can be avoided by suitable water treatment, correct operation and periodic internal inspection.

Special attention should be given to the formation of deposits on the tube sheets. Internal cleaning must be performed at the latest when the coating thickness is 0.2 mm on the water side.

Deposits on the exhaust gas heat exchanger tubes must not be removed mechanically. Specialist contractors should be commissioned with the performance of chemical cleaning.

We recommend carrying out the first internal inspection 3 months after commissioning at the latest.

If no deposits are found and water treatment and water quality are checked regularly, internal inspections at intervals of 12 months are sufficient.

9.3.2. Exhaust gas side

Cleaning on the exhaust gas side is necessary when there is a significant reduction in heating output or a sharp increase in the pressure drop on the exhaust gas side.

Cleaning may be performed:

- mechanically using brushes with plastic bristles
- using high-pressure cleaning equipment or
- by chemical cleaning of the entire space on the tube side.

Mechanical cleaning with stainless steel brushes is not recommended as this roughens the inside surfaces of the tubes. This will cause renewed fouling at a faster rate.

The cleaning product used for chemical cleaning must be free of chlorine. It is recommended having chemical cleaning only performed by specialist contractors.

We recommend the following authorised contractor:

ABX Energy Services GmbH
NL Süd (South)
Tel. +49 (0)9826 / 65 59 981

ABX Energy Services GmbH
NL Nord (North)
Tel. +49 (0)40 / 54 75 34 97 0

Internet: www.abx-gmbh.de

9.4. Maintenance schedule

	Maintenance work	3 days	Week	1 month	3 months	6 months	Type of test/activity
Water side	Check flanged joints and screwed piping connections		I				Immediately rectify any leakage.
	Briefly open the drainage on the water side and collect the water in a clean container.				I		If deposits are observed in the drainage water, the water quality must be checked at once for compliance with the specified values and chemical cleaning may be necessary. (Section 9.3.1)
	Check the water side to make sure that no deposits have formed on the tube sheet of the exhaust gas inlet side.						See section 9.3.1
Gas side	Check the functionality of the condensate drain.			I			The condensate drain must be cleaned at once in the event of deposits or condensate backup. (Section 9.3.2)
	Check the exhaust gas side heating surfaces. To do this, open the inspection cover of the exhaust gas chambers.					I	If any deposits are present, the heating surface should be cleaned at once. (Section 9.3.2)
	Check the back pressure on the exhaust gas side.				V		If the values are too high, the exhaust gas heat exchanger should be cleaned on the exhaust gas side. (Section 9.3.2)

Table 9.1: Overview of maintenance work

I = visual inspection
F = functional test
V = value check

9.5. Test schedule

	Item to be tested:	3 days	Week	1 month	3 months	6 months	Type of test/activity
Pressure	Safety valve				I+F		Venting
	Safety pressure switch				I+F		Adjustment of setpoint / test buttons
	Safety pressure limiter			I+F			Adjustment of setpoint / test buttons
	Manometer			I+F			Zero-point check
Tempera-ture	Safety temperature switch				I+F		Adjustment of setpoint / test buttons
	Safety temperature limiter			I+F			Adjustment of setpoint / test buttons
Flow rate	Vent valve			F			Venting
	Water level controller / flow con-troller			I+F			Drop to the switching point / reduction in flow rate
Water side	Circulating water		V				Values must comply with section 13; when-ever water is refilled, an extra value check must be carried out (after 24 h).
	Make-up water consumption	V					Make-up water con-sumption is observed. For consumption above the usual val-ues, leak detection on the system must be arranged.

Table 9.2: Overview of testing

I = visual inspection
F = functional test
V = value check

10. Overview of Spare Parts (recommended)

Recommended spare parts

- Complete set of seals water side
- Complete set of seals exhaust gas side
- Complete set of screws water side
- Complete set of screws exhaust gas side
- Nickel paste for screws

When placing orders, please always quote the serial number.

NOTE **To ensure safety of operation, we recommend only using original spare parts.**

11. Troubleshooting

Malfunction	Cause	Troubleshooting
Leakage at flanged joints	Defective seal	Replace seal
Leakage at flanged joints	Loose screwed connection	Tighten screwed connection in a depressurised state
Low output	Fouling water side	Clean water side
Low output	Fouling exhaust gas side	Clean exhaust gas side
Increase in pressure loss water side	Fouling water side	Clean water side
Increase in pressure drop exhaust gas side	Fouling exhaust gas side	Clean exhaust gas side
Water escaping at condensate drain when system not in operation	Leakage at pressure vessel	Immediately shut down exhaust gas heat exchanger and inform manufacturer at once

Table 11.1: Troubleshooting

12. Dismantling and Disposal

12.1. Preparations for dismantling

- Shut down the system
- Switch off units for water and supply of other media for the long term
- Discharge any residual energy and/or unload relevant systems and
- Secure units and plant from being switched back on accidentally.

12.2. Dismantling

DANGER

Falling components may cause serious injuries.

- Secure parts liable to fall when dismantling the system.

Dismantling is carried out in reverse order to assembly in agreement with the manufacturer.

12.3. Disposal

Responsibility of the operator

The operator is responsible for the disposal of materials, components and working materials.

DANGER

Risk to environment (hazardous to environment)

- Dispose of materials, components and working materials according to the information given in the applicable safety and/or hazardous substance data sheets for such materials.
- The local regulations and laws must also be observed.

Applicable EC safety data sheets

Make sure you update all EC safety data sheets and regulations.

Remove revised (invalid) safety data sheets and regulations from your documentation.

13. Requirements on the Quality of Circulating Water

For the requirements on the quality of circulating water, a distinction should be made between exhaust gas heat exchangers with heating surfaces made of stainless steel and exhaust gas heat exchangers with heating surfaces made of carbon steel (referred to below as steel).

NOTE Where drinking water heaters are heated with the circulating water, according to the requirements of the German drinking water regulations (TVO) dated 21 May 2001, the pH value must be limited to max. 9.5, and the phosphate concentration to 6.7 mg/l PO_4 (5 mg/l P_2O_5 or 2.2 mg/l P) or the regulations of other countries diverging from these specifications must be observed.

Suspended matter and limescale are deposited on the heating surfaces of the heat exchanger. This hinders the transfer of heat, resulting in damage from corrosion. Any kind of deposits on the heating surfaces must therefore be avoided.

NOTE **Deposits soon destroy heating surfaces!**

13.1st Requirements on the quality of circulating water for exhaust gas heated hot water generators with STAINLESS STEEL / components that come into contact with water (stainless steel heating sufaces

The operator must subject the filling and make-up water to special treatment and monitoring. Low salt desalinated water (e.g. permeate) or absolutely clean condensate should be used as filling and make-up water.

Trisodium phosphate (Na_3PO_4) must be used for basic alkalinisation.

We recommend, under consideration of the VdTÜV sheet TCh 1466, complying with the following values:

General requirements	colourless, clear and free of undissolved substances	
pH value (at 25°C)	9.0 - 10.5	
Conductivity (at 25°C)	< 250	µS/cm
Oxygen (O_2)*	< 0.05	mg/l
Chloride (Cl)	< 20	mg/l
Alkaline earths (total hardness)	< 0.02 (< 0.1)	mmol/l (°dH)
Phosphate (PO_4)	5 – 10	mg/l

* with the addition of an oxygen binding agent, if necessary

Table 13.1: Requirements on the quality of circulating water for exhaust gas heated hot water generators with STAINLESS STEEL components that come into contact with water (stainless steel heating surfaces)

Please note!

Where drinking water heaters are heated with the circulating water, according to the requirements of the German drinking water regulations (TVO) dated 21 May 2001, the pH value must be limited to max. 9.5, and the phosphate concentration to 6.7 mg/l PO_4 (5 mg/l P_2O_5 or 2.2 mg/l P) or the regulations of other countries diverging from these specifications must be observed.

Suspended matter and limescale are deposited on the heating surfaces of the heat exchanger. This hinders the transfer of heat, resulting in damage from corrosion. Any kind of deposits on the heating surfaces must therefore be avoided. There is a tendency for chloride to accumulate under deposits, hence there is a risk of pitting corrosion.

Additional note for the use of water/glycol mixtures or corrosion inhibitors:
When adding glycol, the above-mentioned requirements for the mixture of filling and make-up water apply.
Value deviations caused by the addition of glycol are not taken into account here.
APROVIS Energy Systems GmbH does not assume any liability for the incorrect selection and incorrect use of glycols or corrosion inhibitors.

Deposits soon destroy heating surfaces!

Created in cooperation with the German technical inspection association TÜV SÜD

13.2nd Requirements on the quality of circulating water for exhaust gas heated hot water generators (in STAINLESS STEEL / heating surfaces made of carbon steel / normal steel)

The operator must subject the filling and make-up water to special treatment and monitoring. At least softened water, preferably low salt desalinated water (e.g. permeate) or flawless condensate should be used as filling and make-up water.

Trisodium phosphate (Na_3PO_4) must be used for basic alkalinisation, if necessary adding small amounts of sodium hydroxide solution (NaOH) or caustic soda for saline operation.

We recommend, under consideration of the VdTÜV sheet TCh 1466, complying with the following requirements for saline operation when using softened water or for low salt operation when using desalinated water:

Mode of operation	saline	low salt	
General requirements	colourless, clear and free of undissolved substances		
pH value (at 25°C)	9.0 - 10.5	9.0 - 10.5	
Conductivity (at 25°C)	> 100 - 1500	< 100	µS/cm
Oxygen (O_2)*	< 0.02	< 0.05	mg/l
Alkaline earths (total hardness)	< 0.02 (< 0.1)	< 0.02 (< 0.1)	mmol/l (°dH)
Phosphate (PO_4)	5 – 15	5 - 10	mg/l

* with the addition of an oxygen binding agent, if necessary

Table 13.2: Requirements on the quality of circulating water for exhaust gas heated hot water generators (in STAINLESS STEEL / heating surfaces made of carbon steel / normal steel)

Please note!

Where drinking water heaters are heated with the circulating water, according to the requirements of the German drinking water regulations (TVO) dated 21 May 2001, the pH value must be limited to max. 9.5, and the phosphate concentration to 6.7 mg/l PO_4 (5 mg/l P_2O_5 or 2.2 mg/l P) or the regulations of other countries diverging from these specifications must be observed.

Suspended matter and limescale are deposited on the heating surfaces of the heat exchanger. This hinders the transfer of heat, resulting in damage from corrosion. Any kind of deposits on the heating surfaces must therefore be avoided.

Additional note for the use of water/glycol mixtures or corrosion inhibitors:
When adding glycol, the above-mentioned requirements for the mixture of filling and make-up water apply.
Value deviations caused by the addition of glycol are not taken into account here.
APROVIS Energy Systems GmbH does not assume any liability for the incorrect selection and incorrect use of glycols or corrosion inhibitors.

Deposits soon destroy heating surfaces!

Created in cooperation with the German technical inspection association TÜV SÜD

14. Technical Data

TYPE **N-30-500/3000-1H**

ORDER NO. **13180672**

Description		Unit
Type N-30-500/3000-1H		
Heat transfer surface	42	m^2
Thermal output	783	kW
Medium via tubes	Exhaust gas (wood gas)	
Flow rate	7834	kg/h
Inlet temperature	499	°C
Outlet temperature	180	°C
Design temperature	550	°C
Design pressure	0.1	barg
Pressure drop	18	mbar
Medium around tubes	Water	
Volume flow (operation at nominal rating)	60	m^3/h
Volume flow (minimum)	29	m^3/h
Inlet temperature	78,4	°C
Outlet temperature	90	°C
Design temperature	110	°C
Design pressure	6	barg
Pressure drop	110	mbar
Gross tare weight (incl. packaging)	850	kg
Net tare weight (without packaging)	840	kg
Content	261	litre
Material heating surfaces	316 Ti	

Table 14.1: Technical data

15. Manufacturer's Declaration

Kunde: **Customer:**	FILTER SIA 1006 Riga Latvia	**Herstellnr.:** **Serial No.:**	13180672
Bestell-Nr.: **Order No.:**	20130669, Wood gas project / AP-A131487	**Herstelljahr:** **Year built:**	2013
Hersteller: **Manufacturer:**	APROVIS Energy Systems GmbH Ornbauer Straße 10 D-91746 Weidenbach	**Zeichnungs-Nr.:** **Drawing No.:**	AP-30-7712-1
Typ: **Type:**	N-30-500/3000-1H		

Fertigung:
Wir bestätigen, dass der Wärmetauscher nach DGRL 97/23/EG, Art.3 Abs. 3 in Verbindung mit der Prüfnorm AD2000 ordnungsgemäß hergestellt wurde. In Anlehnung an DGRL 97/23/EG, Anh.I, Art. 3.2 wurde er einer Bau- und Druckprüfung unterzogen.

Manufacturing:
We hereby certify that the heat exchanger is manufactured in conformity to PED 97/23/EC, Art.3 Par. 3 in association with the test standard AD2000. Following PED 97/23/EC, Annex I, Art. 3.2 it was subject to a design and pressure test.

Die Druckprüfung erfolgte bei einem
The pressure test has been effected at a

	Prüfdruck (barü) **Test pressure (barg)**	**Prüfmittel** **Test medium**	**Prüfmitteltemperatur (°C)** **Temperature of test medium (°C)**
Rohrseite **Tube side**	---	---	---
Mantelseite **Shell side**	8.6	Emulsion emulsion	20

Prüfergebnis:
Die Druckprüfung ergab keine Beanstandung.
Test results:
The pressure test has shown no objections.

Weidenbach, 04.09.2013

APROVIS ENERGY SYSTEMS

i.A. D Boos

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