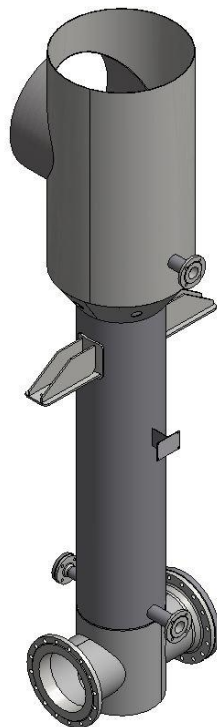


Operating and Maintenance Instructions

Exhaust Gas Heat Exchanger

used with thermal oil as the heat transfer medium



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2. About These Instructions



These operating instructions apply to the exhaust gas heat exchanger used with thermal oil 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 max. design temperature (thermal oil side) up to and including the flash point of the respective thermal oil and depending on the product of the pressure and volume
 - Manufacturer's Declaration
- Or for exhaust gas heat exchangers with a max. design temperature (thermal oil side) greater than the flash point of the respective thermal oil and depending on the product of the pressure and volume
 - Declaration of conformity and, if appropriate, certificate of conformity of a 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 listed 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 the 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.



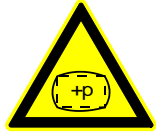
Warning about suspended loads

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



This section describes 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 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.

The corresponding certificates form part of the scope of supply.

Inspections

The exhaust gas heat exchanger is subject to certain inspections prior to commissioning as well as to periodic inspections during standard operation.

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

Hazards can be avoided by complying with the specific warning instructions in the technical documentation itself.

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
4. the proper mounting of the heat protection shield
5. the proper mounting of the abrasion protection shield
6. a suitable insulation / brick lining to protect the inlet section against thermal load

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 flows through the smoke tubes. The cooling medium (thermal oil) flows 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

Compliance with 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 must not be allowed to accumulate in the exhaust gas heat exchanger. The functionality of the condensate discharge should be checked at regular intervals.

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

The minimum working pressure on the thermal oil side in the exhaust gas heat exchanger should be at least 2 bar overpressure.

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.

- DIN 4754

NOTE The safety equipment does not have to be included in the manufacturer's scope of supply for the exhaust gas heat exchanger. It is the responsibility of the operator to procure this.

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 design temperatures
- operation above/below the design pressures
- operation following the removal of safety devices
- failure to comply with the minimum thermal oil 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
- failure to perform maintenance or repair work in the proper manner
- performing defective maintenance or repair work
- operation without the purpose-built heat protection shield
- operation without the purpose-built abrasion protection shield

- operation without a suitable insulation / brick lining to protect the inlet section against thermal load.
- 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 the 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 life cycle 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	<p>A risk to human life may result at the exhaust gas heat exchanger from:</p> <ul style="list-style-type: none"> • misuse • improper handling, especially operation not conforming with the performance data specified in the technical data • missing safety devices • defective or damaged mechanical, electrical or pneumatic components
Risk of injury	<p>A risk of human injury may result at the exhaust gas heat exchanger from:</p> <ul style="list-style-type: none"> • improper handling, especially at the blow-off pipe or condensate discharge • transportation • defective or damaged mechanical, electrical or pneumatic components
Risk to the environment	<p>A risk to the environment may result at the exhaust gas heat exchanger from:</p> <ul style="list-style-type: none"> • improper handling • working materials (lubricants, etc.) • escaping media presenting a risk to the environment (e.g. thermal oil) • noise emission
Material damage to the exhaust gas heat exchanger	<p>Material damage to the exhaust gas heat exchanger may result from:</p> <ul style="list-style-type: none"> • improper handling • failure to comply with specifications for operation and maintenance • unsuitable working materials
Material damage to other tangible assets	<p>Material damage to other tangible assets in the operating area of the exhaust gas heat exchanger may result from:</p> <ul style="list-style-type: none"> • improper handling
Restrictions on performance or functionality	<p>Restrictions on the performance or functionality of the exhaust gas heat exchanger may result from:</p> <ul style="list-style-type: none"> • 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 the section "General Safety Provisions" (section 3).
- be able to apply and put the contents of the 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 event 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 capable of using them.

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 Only lift and transport the exhaust gas heat exchanger with adequately dimensioned transport devices.

Only lift the exhaust gas heat exchanger 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.

Transport the exhaust gas heat exchanger no more than 10 cm above the ground, where possible.

Lift and set down the exhaust gas heat exchanger evenly.

Assembly Only set up the exhaust gas heat exchanger in a sufficiently stable frame.

Only mount the exhaust gas heat exchanger at the provided support brackets

When assembling 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 beforehand.

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 use a fully operational exhaust gas heat exchanger that is safe to operate.

Immediately shut down the exhaust gas heat exchanger in the event 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. The Exhaust Gas Heat Exchanger



This section describes the components and functionality of the exhaust gas heat exchanger.

4.1st Components of the exhaust gas heat exchanger

The main components of the exhaust gas heat exchanger are:

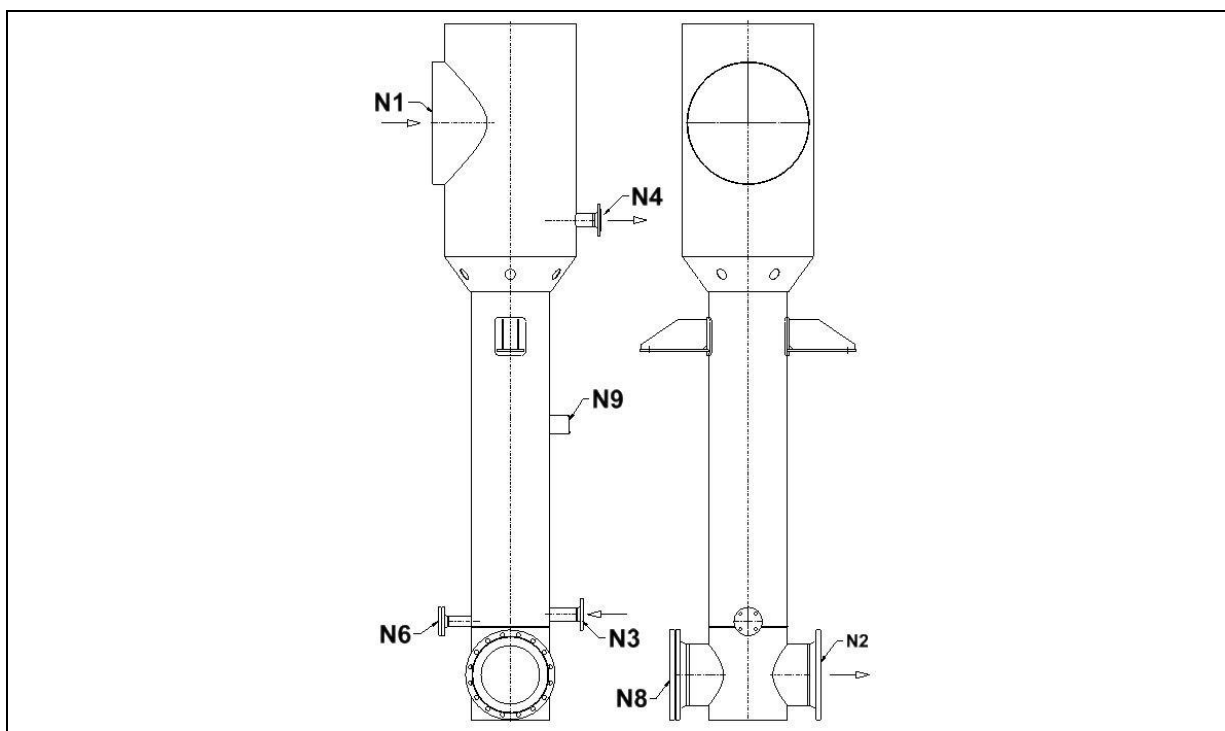


Fig. 4.1: Components of the exhaust gas heat exchanger

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

NOTE If it is not clear which connections to use correctly from the diagram, it is essential that you contact the manufacturer. 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 13).

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 thermal oil volume specified (minimum) on the thermal oil side must be observed.

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

5. Transportation



This section describes how to transport 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:

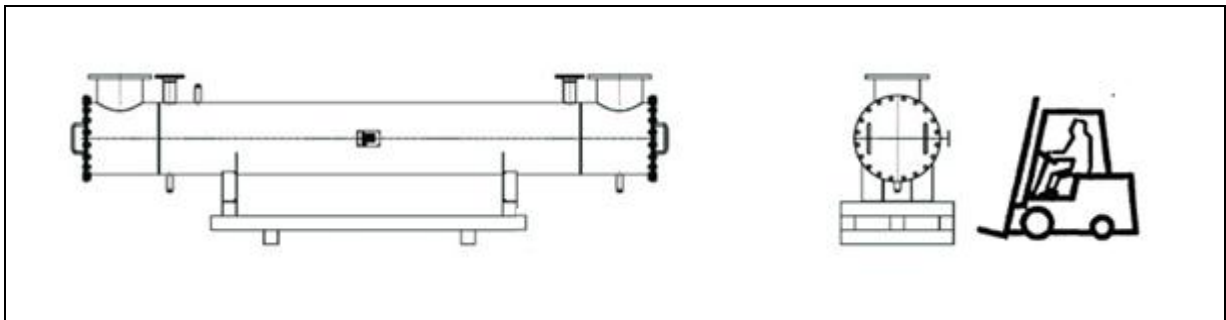


Fig. 5.1: Transportation on factory-assembled wooden pallet

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:

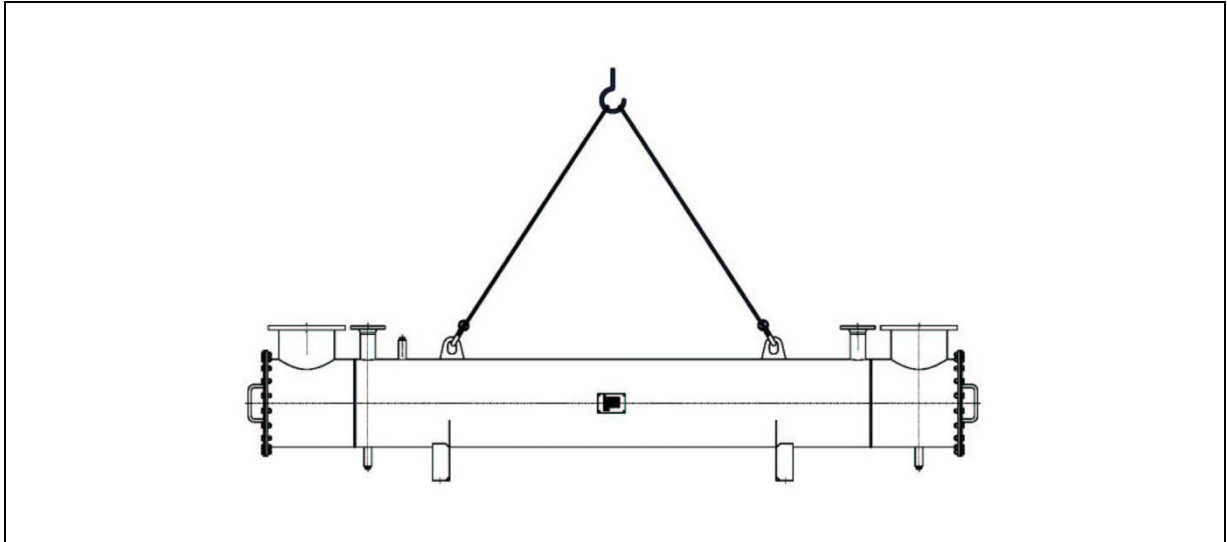


Fig. 5.2: Transportation with ropes using lifting lugs

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:

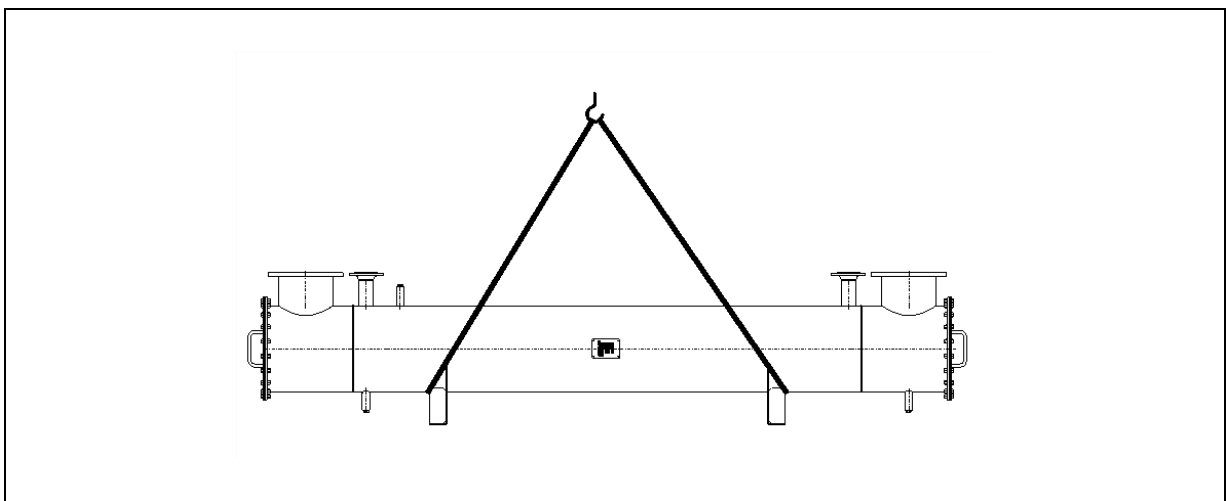


Fig. 5.3: Transportation with ropes on heat exchanger shell

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 13 "Technical Data".
 - Watch out for any shift in the centre of gravity.
 - Secure components from slipping/tilting.
 - Transport components no more than 10 cm above the ground, where possible.
 - Lift/set down components 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, make sure that all surfaces are kept dry over the entire period to avoid damage from corrosion.

6. Assembly and Installation

The national regulations and laws must be observed for installation and operation of the exhaust gas heat exchanger.

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 assembly using fixed and floating supports.

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 thermal oil 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.

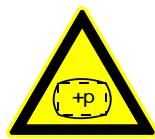
When installing the system, make sure that the inspection openings are accessible.

When aligning the system, ensure that full venting on the thermal oil 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 thermal oil circuit

The exhaust gas heat exchanger may only be operated with the media specified in section 13 "Technical Data".

Only use water for flushing. Only use the medium specified in section 13 "Technical Data" for filling. Only use other media following written approval by APROVIS Energy Systems GmbH.

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.

Rectify any transportation-related leakage.

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.
- No exhaust gas must flow through the exhaust gas heat exchanger before it is filled and the thermal oil pumped. Failure to comply with this condition will cause irreparable damage to the exhaust gas heat exchanger.

8. Operation

The national regulations and laws must be observed for installation and operation of the exhaust gas heat exchanger.

8.1. Commissioning and trial operation

Commissioning requires specialist staff members 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 meet these requirements, at the latest by the start of trial operation.

Starting up with cold thermal oil 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

Proceed as follows when commissioning the exhaust gas heat exchanger:

Procedure for commissioning:

1. Ensure that the entire system is vented on the thermal oil side.
2. Start up the circulating pump and check that the circulating thermal oil 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 13).
The thermal oil must always circulate at the minimum amount during heating.
3. Test all safety equipment (safety valve, 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, hot thermal oil or hot exhaust gas may escape!



HAZARD!

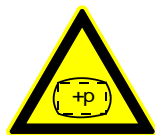
Serious burns may be caused by escaping thermal oil or hot exhaust gas.

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

When commissioning the exhaust gas heat exchanger, the system must be vented.

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

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



MATERIAL DAMAGE!

Material damage through gas or steam cushions.

- Failure of the circulating pump may result in the decomposition of the thermal oil in the exhaust gas heat exchanger. This can lead to the destruction of the thermal oil and can cause irreparable damage to the exhaust gas heat exchanger.
 - Operation of the exhaust gas heat exchanger without thermal oil is not permitted and leads to the exhaust gas heat exchanger being immediately damaged beyond repair.
-

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.

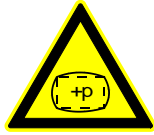
The operating instructions must be posted or displayed in a clearly visible place in the boiler room.

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

When starting up the system, an authorised member of staff must be present in the boiler room. Start-up 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 start-up.

8.3. Bypass mode



MATERIAL DAMAGE!

Irreparable damage to the exhaust gas heat exchanger.

- Operation of the exhaust gas heat exchanger without thermal oil and/or failure to adhere to the minimum flow rate on the thermal oil 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 must not be operated without thermal oil and below the minimum flow rate at any time, including in bypass mode (medium around the tubes, see section 13 "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 heating (as a rule the engine), observe the following:

The exhaust gas heat exchanger must be filled on the thermal oil 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

Proceed as follows 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 in the case of a CHP plant) in order to rule out any flow through the exhaust gas heat exchanger on the exhaust gas side.
3. Continue the flow on the thermal oil side for at least 10 minutes.



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 thermal oil side, if necessary by means of external heating.
2. To avoid burns, ensure before drainage that the thermal oil side is not pressurised (check using manometer provided by the customer) and that the thermal oil 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, check that all surfaces are kept dry over the entire period to avoid damage being caused by 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

Inspections 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 9.4) 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. 24 operating hours after initial commissioning

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

9.2. Regular inspections

Necessary tests and maintenance work can be found in the checklists in section 9.4 "Maintenance schedule" and section 9.5 "Test 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.
- Test the functionality 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.
- Check the thermal oil quality.
- Inspect the exhaust gas side heating surfaces of the exhaust gas heat exchanger. If any deposits are present, clean the heating surface at once.
- Check the back pressure on the exhaust gas side. If the values are too high, clean the exhaust gas heat exchanger on the exhaust gas side.
- Check the functionality of the condensate drain.

Note	After opening inspection openings and measuring nozzles, new seals must be fitted.
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9.3rd General information on maintaining exhaust gas heat exchangers

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

9.3.1. Thermal oil side

Monitoring of the thermal oil circuit is extremely important.

We recommend carrying out the first inspection of the thermal oil quality 3 months after commissioning at the latest.

If no irregularities are found, further inspections can be performed at intervals of between 6 – 12 months.

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 performed by specialist contractors only.

We recommend the following authorised contractor:

ABX Energy Services GmbH
Branch for south of Germany
Tel. + 49 (0)9826 / 65 59 981

ABX Energy Services GmbH
Branch for north of Germany
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
Thermal oil side	Check flanged joints and screwed piping connections.		I				Immediately rectify any leakage.
Gas side	Check the functionality of the condensate drain.			I			Clean the condensate drain 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, clean the heating surface at once. (Section 9.3.2)
	Check the back pressure on the exhaust gas side.				V		If the values are too high, clean the exhaust gas heat exchanger 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 set-point/test buttons
	Safety pressure limiter			I+F			Adjustment of set-point/test buttons
	Manometer			I+F			Zero-point check
Temperature	Safety temperature switch				I+F		Adjustment of set-point/test buttons
	Safety temperature limiter			I+F			Adjustment of set-point/test buttons
Flow rate	Flow control instrument			I+F			Drop to the switching point/reduction in flow rate
Thermal oil side	Circulating medium					V	

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 thermal oil side
 - Complete set of seals exhaust gas side
 - Complete set of screws thermal oil 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 of the thermal oil side	Check oil quality
Low output	Fouling exhaust gas side	Clean exhaust gas side
Increased pressure drop on the thermal oil side	Fouling of the thermal oil side	Check oil quality
Increase in pressure drop exhaust gas side	Fouling exhaust gas side	Clean exhaust gas side
Oil escaping at condensate nozzle 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 thermal oil and supply of other media for the long term.
- Discharge any residual energy and/or unload relevant systems.
- Secure units and system from being switched back on accidentally.

12.2. Dismantling



HAZARD

Falling parts may cause serious injury.

- 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.



HAZARD

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. Technical Data


TYPE N-33,7-450/2400-1V

SERIAL NO. 14180258

Description		Unit
N-33,7-450/2400-1V		
Heat transfer surface	23	m ²
Thermal output	315	kW
Medium through tubes	Woodgas (free of particulate material) 20% H ₂ , 25% CO, 12% CO ₂ , 2% CH ₄ , 3% H ₂ O, 36% N ₂	
Flow rate	2072 (according to 700m ³ /hr at 750 °C)	kg/h
Inlet temperature	750	°C
Outlet temperature	370	°C
Max. design temperature	800	°C
Max. design pressure	0.1	bar
Pressure drop	9 (5 HE + 4 heat protection plate)	mbar
Medium around tubes	Therminol 66	
Volume flow (operation at nominal rating)	27,4	m ³ /h
Volume (minimum)	25	m ³ /h
Inlet temperature	260	°C
Outlet temperature	280	°C
Max. design temperature	300	°C
Max. design pressure	10	barg
Pressure drop	70	mbar
Gross tare weight (incl. packaging)	1150	kg
Net tare weight (without packaging)	1100	kg
Contents	164	L
Material heating surfaces	Steel	

Table 13.1: Technical data

14. Manufacturer's Declaration

Kunde: Customer:	FILTER SIA 1006 Riga Latvia	Fabrikationsnr.: Serial No.:	14180258-WT
Bestell-Nr.: Order No.:	20140230, Wood gas cooler	Herstelljahr: Year built:	2014
Hersteller: Manufacturer:	APROVIS Energy Systems GmbH Ornbauer Strasse 10 D-91746 Weidenbach	Zeichnungs-Nr.: Drawing No.:	AP-30-8743-1
Typ: Type:	N-33,7-450/2400-1V		
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 has been manufactured according to PED 97/23/EC, Art.3 para. 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	0,5	Luft Air	20
Mantelseite Shell side	21.5	Emulsion Emulsion	20
Prüfergebnis: Die Druckprüfung ergab keine Beanstandung.			
Test results: The pressure test has shown no objections.			
Weidenbach, 09.06.2014			
 <i>iADBoos</i> Ornbauer Straße 10 / D-91746 Weidenbach Tel.: +49 (0)9826 65 83-0 / Fax: +49 (0)9826 65 83-110			
APROVIS Energy Systems GmbH			