TPL, GPL, NPL

Brazed plate heat exchangers

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Applicable to:

- TPL
- GPL, GPLV, GPLS,
  GPLI, GPLIV, GPLK, GPLKS
- NPL, NPLV, NPLK

Operating and maintenance instructions

FUNKE

EN

Translation / original language: German

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1. About this document

These instructions provide you with important information on the function, safety and application of your product.

Read through these instructions carefully before using the product for the first time. Observe the instructions and safety specifications during all work.

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1.1 Scope of application

These instructions apply to the following FUNKE products:

- TPL
- GPL, GPLV, GPLS
  GPLI, GPLIV, GPLK, GPLKS
- NPL, NPLV, NPLK

1.2 Content, purpose and target groups

These instructions contain important information on the following topics:

- Product design and function
- Safe handling of the product
- Technical data
- Explanations, guidelines and recommended action for handling the product during its various stages of life (e.g. transport, operation, maintenance)

Target groups

These instructions are intended for:
System operators, assembly and commissioning personnel, operators, maintenance personnel

If you intend to carry out work with and on the product with the help of these instructions, you may need special prior knowledge and special technical qualifications ("Personnel qualifications" [▸Sec. 2.3]).

Function of the document

The product described here is a component for installation in a system. These instructions only describe this component. They are not a substitute for the documentation of the system and its other components.

1.3 Further applicable documents and additional information

You will need the following additional documents and sources of information to fully understand the contents of these instructions and to completely and safely carry out the work steps described:

- Specification sheet from the tendering phase
- Technical drawing or dimensional drawing

The technical drawing / dimensional drawing and the specification sheet are handed over to the customer during the tendering phase. Contact your sales partner if you need the drawings or the specification sheet to be provided to you again.

Observe the documents and papers included in the product's scope of delivery (▸Sec. 3.4 "Scope of delivery").

1.4 Presentation of warnings

Information that draws your attention to specific or potential hazards is presented as warnings in these instructions.

Function of warnings

Warnings serve to protect you from accidents and injuries when handling the product and to prevent material and environmental damage.

Read and observe the warnings carefully and follow the specified steps precisely.

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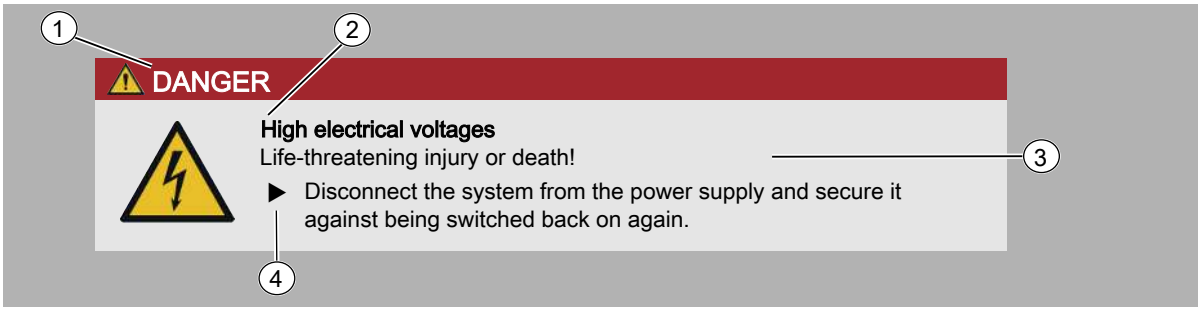
Warnings visually highlighted in boxes

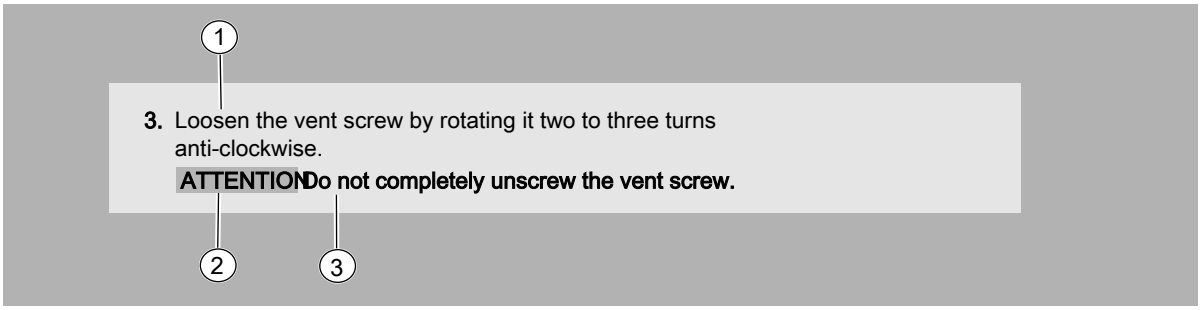
Warnings visually highlighted in boxes provide the following information in connection with a hazard:



1	**Warning level** How high is the risk potential? (▸Tab. 1, p. 7)	2	**Type and source of the hazard** What is the specific danger? What is the source of the danger?
3	**Consequences if not observed** What are the consequences if you fail to observe the instructions given in the warning (**4**)?	4	**Actions to be taken** What do you have to do specifically to safely eliminate the hazard?

Warnings integrated into the text

Warnings are sometimes integrated into the body of the text to keep the content easy to read. Example:



1	**Context** An action step in this example	2	**Warning level** How high is the risk potential? (▸Tab. 1, p. 7)
3	**Safety information** What do you have to do specifically to safely eliminate the hazard?		

Warning levels

The warning level in a warning gives you information on the risk potential associated with a hazard and failure to observe the appropriate warning.

Warning level	What this means for you
⚠ DANGER	Warns of dangers for **people** with a **high risk potential**. Failure to observe this warning is highly likely to result in serious injury or even death.
⚠ WARNING	Warns of dangers for **people** with a **medium risk potential**. Failure to observe this warning may result in serious injury or even death.
⚠ CAUTION	Warns of dangers for **people** with a **low risk potential**. Failure to observe this warning may result in minor to moderate injury.
ATTENTION	Warns of **property damage** with a **high risk potential**. Failure to observe this warning may result in serious property and environmental damage.

Tab. 1: Depiction of the warning levels

1.5 Terminology and abbreviations used

Designation	Meaning
Cavitation	A sudden drop in pressure and/or sudden change in the flow velocity causes very small vapour bubbles that formed in pumps or on rapidly rotating parts to implode. The local jet of fluid (microjet) collides with the pipeline wall at high speed. The abrupt pressure load causes crater-like material abrasion / damage.
PHE	Plate heat exchanger
HE plates	Heat exchanger plates
NDT	Non-destructive testing
PUR	Polyurethane as insulation material

2. Safety information

This section gives you important information on the safe handling and use of your product.

2.1 Intended use

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Unless otherwise specified in relation to the order, the product is designed and produced for the specific operating conditions and materials as named by the owner in terms of temperature, pressure, flow rate and flow media.

Permitted areas of application

The product is designed for stationary use. Mobile use, for example on ships, is only permitted if explicitly named on the specification.

Furthermore, intended use includes:

- The product is governed by the Pressure Equipment Directive 2014/68/EU of 15 May 2014 or other international standards.
- Operation only with accessories and spare parts authorised by the manufacturer
- Operation only with permitted media in accordance with the dimensioning (specification sheet from the tendering phase) (▸Sec. 1.3 "Further applicable documents and additional information")
- Operation indoors
- Operation outdoors only permitted where specified (▸Sec. 1.3 "Further applicable documents and additional information")

Improper use and foreseeable misuse

Any other use, or use that goes beyond that indicated, is not permitted and is therefore considered improper use.

Improper use or use deviating from intended use includes in particular:

- Operation with a non-approved fluid
- Operation in a mobile application
- Operation in potentially explosive atmospheres
- Operation under non-permitted conditions
- Operation under fatigue load
- Operation with defective or removed safety devices
- Unauthorised modifications being made to the product
- Inadequate monitoring of parts that are subject to wear

Claims for defects or liability

Claims for defects or liability, regardless of the legal foundation, do not apply with incorrect or improper installation, commissioning, usage, handling, storage, maintenance, repair, use of unsuitable components or other circumstances, which the manufacturer is not responsible for.

The manufacturer assumes no responsibility for determining the interfaces for installation in a system or the installation, use or functionality of the product in this system.

2.2 Obligations of the owner

As the owner, you have the following obligations in relation to the use of our product:

Instruction and training

- Provision of these instructions
  The owner must ensure that all employees who are assigned work on the product have read and understood these instructions.
- Regular training on correct use of the product and on the residual hazards associated with the product (▸Sec. 2.4 "General safety precautions")
- Readability of the warning signs on the product
  Warning signs that have become illegible must be replaced by the owner.
- Legibility of the product's type labels
  Type labels that have become illegible must be replaced by the owner.

Occupational health and safety

- Creation of own risk assessment and implementation of required measures
  The owner must determine in their own risk assessment the sources of danger arising from the product being used in their machine or system. On this basis, the owner must independently define appropriate measures for safety of the machine or system and must put together the documentation of their product accordingly.
- Application of the occupational health and safety and accident prevention regulations applicable in the country of use
- Clear regulation of which people are responsible for the various types of activities (e.g. assembly, operation, troubleshooting, maintenance) and what qualifications they need to have
- Provision of personal protective equipment (▸Sec. 2.6 "Personal protective equipment")
- The owner is responsible for the product only being operated with media provided for in line with intended use.
- The owner is responsible for the media used and the materials of the product being compatible.

Compliance with standards and regulations

- Observance of the statutory inspection intervals for the system
  The owner must document the results of inspection in an inspection certificate and retain this certificate until the next inspection.
- Compliance with the environmental protection regulations applicable in the country of use
- Observance of national and international regulations regarding pressure vessels, hazardous liquids and gases.

2.3 Personnel qualifications

The activities described in this manual must only be performed by persons with specific specialist knowledge in the areas named below:

Activity	Qualified individuals	Knowledge
Transport / storage	Specialists	• Proof of load securing training • Safe handling of lifting equipment, lifting accessories and industrial trucks
Assembly	Specialists	• Product-specific knowledge • Safe handling / use of tools • Safe handling / operation of lifting equipment and accessories
Initial startup		
Maintenance		
Troubleshooting		
Repair		

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Activity	Qualified individuals	Knowledge
Shutdown		
Disassembly		
Handling, operation, operation monitoring	Operating personnel	• Product-specific knowledge • Knowledge of how to handle operating media
Disposal	Specialists	• Proper and environmentally friendly disposal of materials and substances • Decontamination of pollutants • Knowledge of recycling

Qualified individuals

- **Auxiliary personnel:**

  These individuals do not require any special knowledge.
- **Operating personnel:**

  These individuals have received product-related instruction from the owner and have been informed of potential hazards arising from improper conduct.
- **Specialist / qualified electrician:**

  These individuals have appropriate specialist training and several years of work experience. They are able to assess and perform the work assigned to them and to recognise potential hazards.

2.4 General safety precautions

We develop our products in accordance with the latest technological developments. Nevertheless, it is impossible to design products in a way that eliminates all residual risks. An overview of the potential sources of danger is provided below.

2.4.1 Product-specific hazards

The following hazards may occur in general while operating the product:

Risks of injury

- Risks of injury arising from operating media leakage:
  - If the limits of the product are not observed, the product may be damaged and leakage may occur.
  - If media are used that are hazardous to health, e.g. fluids of group 1 (Pressure Equipment Directive 2014/68/EU), life-threatening injuries are possible.
  - If media are used that are not hazardous to health, severe injuries are possible.
- Risk of injury arising from burns and freezing:
  - High (>50°C) or low (<0°C) temperature of components and surfaces
  - High media temperature
- Injuries caused by spilt or leaked operating and auxiliary materials

Risk of harm to material and the environment

- Damage to the product caused by the use of non-permitted fluids
- Damage to the product or leakage caused by maximum or minimum limits being breached
- Environmental damage arising from operating media leakage

Hazard prevention

To prevent these hazards, observe the following safety measures:

- When using hazardous fluids, take additional safety precautions.
- Wear personal protective equipment.
- Do not operate the product in potentially explosive atmospheres.
- Ensure that the specified limits are observed (see ▸Sec. 12 "Technical data" und ▸Sec. 3.3 "Type label").
- Only use permitted fluids.
- Ensure that safety devices are used.
- Any spilt or leaked operating and auxiliary materials must be removed and disposed of.
- Keep containers filled with flammable substances away from heat sources.
- Avoid sudden temperature changes and pressure impacts.

2.4.2 Hazards at maintenance, inspection and installation work

When carrying out maintenance, inspection and installation work, the following hazards may occur:

Risks of injury

- Life-threatening injuries arising from the product tipping over or falling.

Hazard prevention

- Before all maintenance, inspection and installation work, drain and depressurise the product.
- Before all maintenance, inspection and installation work, allow the product to cool down.
- Only have work performed by qualified and trained specialist personnel (▸Sec. 2.3 "Personnel qualifications").
- Observe the safety regulations of the fluid manufacturers precisely, in particular the safety data sheets.
- Take the weight of the product into account in the planning of all work (see drawing / technical drawing or specification sheet, ▸Sec. 1.3 "Further applicable documents and additional information").
- Cordon off the hazard zone.
- Do not stand underneath hoisted loads.
- After maintenance, inspection and installation work has been concluded, fit all safety and protection devices and put them into operation.

2.5 Safety devices

Safety devices that must be provided by the owner:

- Switch-off of the product via the machine’s or the system’s emergency stop chain (see ▸Sec. 2.7 "Shutdown in an emergency")

Your product must be equipped with the following safety devices in accordance with the operating media used:

Characteristics of the operating medium	Earthing strap	Insulation	Warning sign
Highly explosive	X		
Flammable	X		
High pressure			

Characteristics of the operating medium	Earthing strap	Insulation	Warning sign
Temperature <0 °C		X	X
Temperature >50 °C		X	X
Corrosive, toxic, environmentally hazardous			

2.6 Personal protective equipment

Personnel are required to wear protective equipment for certain activities.
The specific protective equipment required in each case is identified in the corresponding sections.

Required protective equipment – an overview

	Eye protection
	Protective gloves
	Close-fitting protective clothing
	Safety boots
	Head protection
	Respiratory protection

Additional protective measures

- Do not wear loose-fitting clothes or jewellery. Tie back long hair.
- Clothing that has been soiled with flammable substances must be changed immediately.
- Avoid contact with poisonous fluids, gases, mists, vapours and dusts.

2.7 Shutdown in an emergency

1. Shut down the system.
2. Close the shut-off valve.
3. Remove from the danger zone.

4. Secure the danger zone.
5. Report the emergency situation to the responsible officer.
6. Alert the emergency services / a doctor if necessary.

3. Product information

3.1 Function and design

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Function

The product is an unfired pressure vessel composed of two separate pressure chambers. The product transfers heat from a medium that gives off heat to a medium that absorbs heat. The fluids are not mixed. Unless otherwise specified in relation to the order, the product is designed and produced in accordance with the Pressure Equipment Direct 2014/68/EU for the specific operating conditions as named by the owner in terms of temperature, pressure, flow rate and flow media.

Design

Brazed PHEs are made up of multiple stamped stainless steel plates that are inserted into each other and brazed with copper, nickel or non-ferrous-metal-free brazing solder in a special vacuum procedure to form a compact and pressure-resistant unit. An individual plate is referred to as an HE plate in this document. When they are joined, every other plate is rotated by 180°, which creates two separate flow chambers that the media involved in the exchange of heat can flow through in opposite directions. The product may be equipped with one or more earthing straps (optional). The position and design of the earthing straps are order-specific.

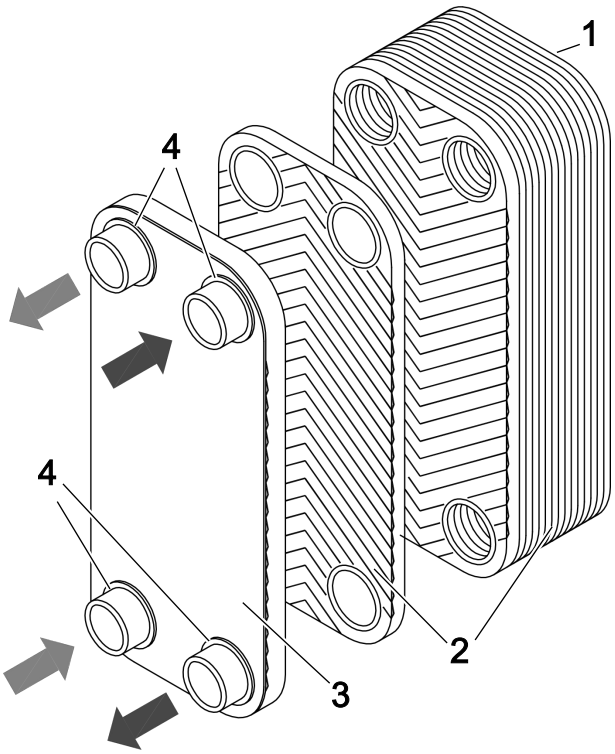

Fig. 1: Depiction of PHE operating principle

1	End plate	2	HE plates
3	Inlet plate	4	Connections

Field of application

The heat created by internal losses can be channelled away very effectively by fluid cooling. The following applications are possible:

- Fluid-cooled drives: motor spindles, torque motors, servomotors, linear motors
- Inverter cooling or other liquid-cooled electrical components
- Gearbox cooling and lubrication
- Bearing cooling
- Mould cooling

- General machine and system cooling
- Process cooling/heating
- Heat recovery in all industries/processes
- Heat transfer stations
- District heat/district cooling

3.2 Versions

The normal version has a one-way design. All ports are on one side. Special designs include the following, for example:

- One-way: Warm side connections at front, cold side connections at back
- Two-way: Connections at front and back

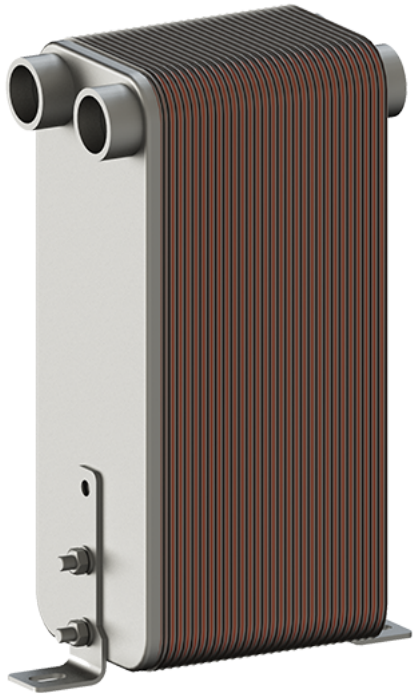

Fig. 2: 2-way version

3.2.1 Series TPL

- Consist of profiled stainless steel plates inserted into each other
- Flow through the plate: diagonal, in opposite direction
- Connection: on front plate or on front and end plate (order-specific)

The flow chambers contain special stamped stainless steel turbulence installations designed for high thermal effectiveness. They are brazed to the subplates in a vacuum procedure to form a compact and pressure-resistant unit.

Fig. 3: Diagonal flow TPL

F1	Hot side ON	F2	Cold side OFF
F3	Hot side OFF	F4	Cold side ON

3.2.2 Series GPL, GPLK/GPLV, GPLI, GPLIV

- Consist of profiled stainless steel plates inserted into each other
- GPL / GPLK: universal use
- Flow through the plate: parallel, in opposite direction

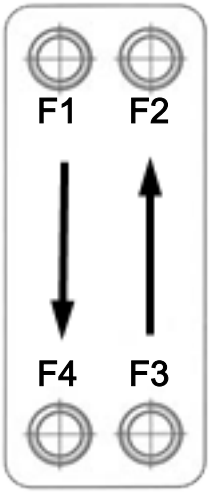

Fig. 4: Parallel flow GPL/NPL

F1	Hot side ON	F2	Cold side OFF
F3	Cold side ON	F4	Hot side OFF

GPLI

- Design: similar to GPL series
- Brazing: free from non-ferrous-metals
- Flow through the plate: parallel, in opposite direction

GPLIV

- Used as evaporator
- Brazing: free from non-ferrous-metals
- Flow through the plate: parallel, in opposite direction

GPLV

- Used as evaporator
- Brazing: copper brazing
- Flow through the plate: parallel, in opposite direction

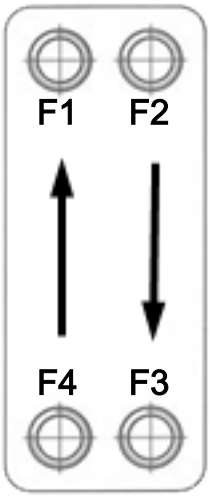

Fig. 5: Parallel flow, evaporator GPL/NPL

F1	Refrigerant side OFF	F2	Secondary side ON
F3	Secondary side OFF	F4	Refrigerant side ON

3.2.3 Series GPLS/GPLKS

- Standard safety heat exchanger with double wall
- Flow through the plate: parallel, in opposite direction (see ▸Fig. 4, p. 16)

A safety heat exchanger is made up of two plates lying on top of each other with no brazing around the outer edge. This means that leakage can escape on all sides of the device.

3.2.4 Series NPL, NPLV/NPLK

- Brazing: Nickel
- Flow through the plate: parallel, in opposite direction
- Observe limits (see ▸Sec. 12 "Technical data")
- Can be designed for operation with ammonia, demineralised water, synthetic oils etc. (see specification sheet and ▸Sec. 3.4 "Scope of delivery")
- NPLV: Used as evaporator

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3.3 Type label

Every product is delivered with a type label. The type label is located on the product. The type label must be accessible and legible at all times.

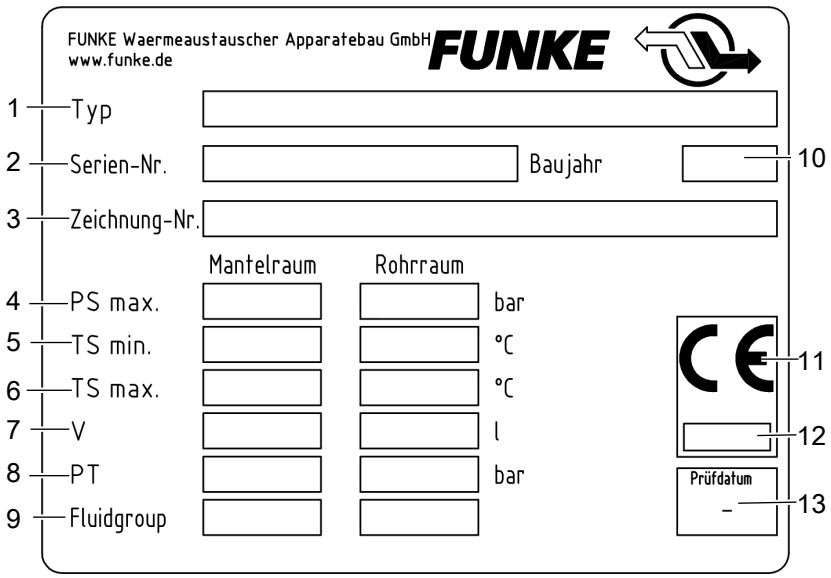

Fig. 6: Labelling – type label

1	Type/series	2	Serial number
3	Drawing number	4	Maximum operating pressure PS max.
5	Minimum operating temperature TS min.	6	Maximum operating temperature TS max.
7	Volume V	8	Test pressure PT
9	Fluid group, acc. to EU Pressure Equipment Directive 2014/68/EU	10	Year of manufacture
11	CE mark	12	ID number of “notified body” in acc. with Pressure Equipment Directive
13	Test date		

3.4 Scope of delivery

- Plate heat exchanger
- Operation and maintenance instructions
- Declaration of conformity

4. Transport & storage

4.1 Storing the product

NOTICE

Negative temperatures/frost

Damage to the product

Even a small amount of water in the plate heat exchanger can result in fracture of the HE plates at below-zero temperatures.

▶ Drain product carefully.

The product is generally delivered for immediate installation. The product should remain in its transport packaging until it is installed.

For storage up to 1 month, no special precautions need to be taken.

Indoor storage

✓ Product must be fully drained, cleaned and dry.

✓ The storage place must be flat and weight-bearing to ensure stability.

1. Leave product in the packaging provided.
2. Observe limits (see ▸Sec. 12 "Technical data").
3. Do not operate any ozone-releasing processes or machines in the vicinity of the product.
4. Do not store any acids or alkalis in the vicinity of the product.
5. Protect from direct sunlight and intense heat.
6. The ambient air must be free from aggressive substances and dust.
7. Avoid major temperature changes.
8. The ambient atmosphere must have a low humidity (<70%).
9. Close up connection openings, e.g. with metal end caps.
10. Plate heat exchangers with upright orientation must be stored upright.
11. Plate heat exchangers with horizontal orientation must be stored horizontally.

Outdoor storage

1. Observe specifications for indoor storage.
2. Protect from cold and weather exposure.
3. Every three months, check the following points:
   - Covering of the connections
   - Closure of the packaging

4.2 Preserving the product

If the product is taken out of operation for longer than 60 days, preservation measures must be taken.

Prepare preservation

1. Take product out of operation (see ▸Sec. 8.2 "Decommissioning").
2. Check for dirt and clean.
3. Fully dry product (max. 30% humidity).
4. Flush out oxygen. If the product is designed for vacuum operation, a vacuum pump may also be used for vacuum drying (see ▸Sec. 3.3 "Type label" or specification sheet).
5. Fill nitrogen on both media sides up to a pressure of min. 0.2 bar to max. 0.5 bar on both sides.
6. Close up product on both media sides.
7. Equip both sides with a test pressure gauge to guarantee positive pressure.

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4.3 Unpacking the product

NOTICE

Damage to the sealing surfaces when the dispatch packaging is removed

Removing the dispatch packaging incorrectly may cause damage to the sealing surfaces.

▶ The dispatch packaging must only be removed by trained personnel.

The product is function-tested at the factory prior to delivery. When unpacking the product, check it for any damage caused in transit.

1. Observe notices provided on the packaging.
2. In the case of visible damage, example the product in more detail. In the case of uncertainty, contact HYDAC.
3. Note the scope and the type of damage on the bill of lading.
4. Have bill of lading acknowledged by the supplier.
5. Check scope of supply for completeness (▸Sec. 3.4 "Scope of delivery").

Procedure

1. Remove the transport packaging.
2. Leave transport closures on the pipe connections.
3. If the product is delivered filled with compressed air or inert gases: Before loosening the transport flange, reduce the pressure at the corresponding drain valve.
4. Carefully remove the drying agent packages from the distributor channels without damaging them.
5. NOTICE **Environmental damage resulting from incorrect disposal**

   When disposing of packaging materials specially treated and preserved for overseas transport, ensure that they are handled or recycled appropriately.
6. Dispose of the transport packaging in accordance with the applicable regulations.
7. Any packaging marked as reusable, such as pallets, must be returned for reuse.

4.4 Transporting the product

4.4.1 Safety notices

DANGER

The product tipping over or falling during transport

Life-threatening injuries!

▶ Perform transport and installation exactly as described below.

WARNING

Risk of crushing arising from moving load

Uncontrolled movements of the load can cause severe injury.

▶ Ensure that appropriate load-securing equipment is used.

▶ Do not lift the load when there is strong wind.

CAUTION

Risk of injury arising from sharp parts

Threaded connections, burrs and heat exchanger plates may have sharp edges and cause cutting injuries.

▶ Wear personal protective equipment.

4.4.2 Transporting horizontal product with forklift truck

Depending on the design, weight and size of the product, the product is delivered upright or horizontal (see ▸Fig. 7, p. 21). The connections for the pipelines are always closed up.

- Horizontal: The product is fastened safe for transport on pallets with the fixed plate at the bottom.
- Upright: The product is fastened on wooden planks or pallets.

Smaller, lighter products may also be delivered in a cardboard box and transported by hand.

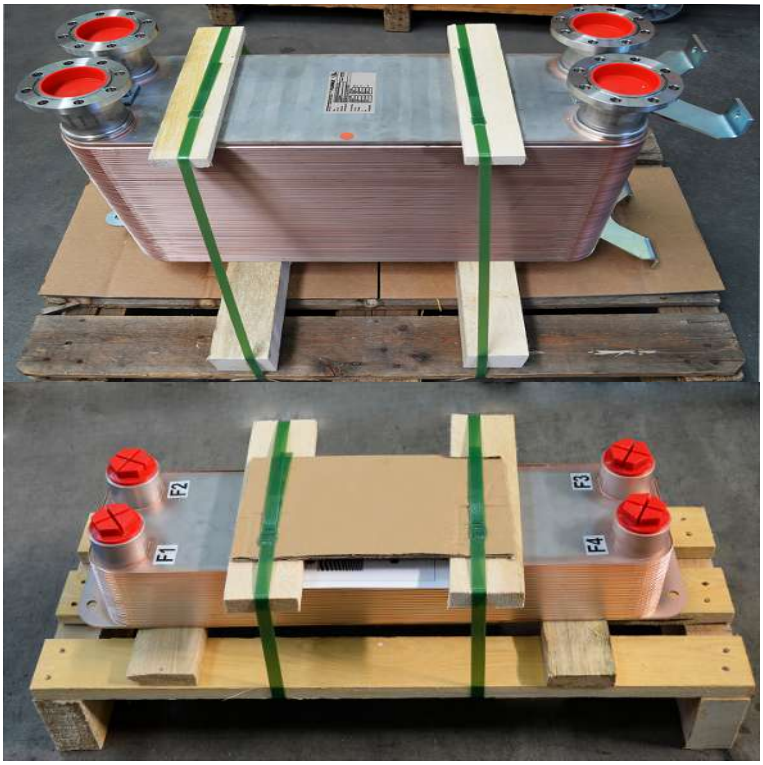

Fig. 7: PHE delivery options

1. Do not make any changes to transportation belts.
2. Transport the product horizontally on the pallet to the place of installation with a forklift truck.

4.4.3 Attaching lifting gear

Basic guidelines

- Attachment angle α: 5° to 30°
- Observe centre of gravity. Two individual round slings need to be of different lengths to enable the product to be suspended horizontally.
- Chains and steel ropes are only permitted if they do not touch the product directly.
  NOTICE Damage arising from direct contact between product and chains or steel ropes
- Do **not** loosen the product from wooden planks.
  Leave the product screwed to the wooden planks until it has been transported to its final place of installation.

Options for attaching the lifting gear

Dependent on the product version, the following attachment options are permitted:

- Attaching at lifting eyes
- Attaching with round slings

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Attaching at lifting eyes

Fig. 8: Fig. 6 Variants, transport_1

1. Mount one round sling to each lifting eye with shackles.

Attaching with round slings

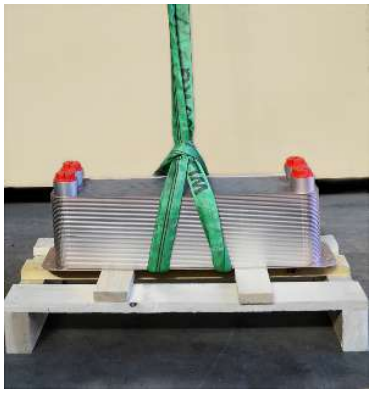

Fig. 9: Attaching product with round slings

1. Place the first round sling on the fixed plate around the top outer pairs of clamping nuts. For clamping nuts with slight protrusion: Place round slings fully around the fixed plate.
2. Place the second round sling on the loose plate over the carrier and around the top outer pair of clamping nuts.

4.4.4 Transporting upright product with crane

1. Cordon off the hazard zone.
2. Prepare appropriate lifting gear
3. Fasten lifting gear to the product in accordance with the product design.
   Detailed instructions: ▸Sec. 4.4.3 "Attaching lifting gear"
4. DANGER **Product falling during transport**
   Ensure that the lifting gear has been applied correctly.
5. Transport the product to the place of installation suspended by a crane.
6. Do not stand underneath hoisted loads.

5. Installation

5.1 Safety notices

⚠ DANGER

Product tipping over and falling

Life-threatening injuries!

Requirements for safe transport:

▶ Perform transport and installation exactly as described below.

⚠ CAUTION

Risk of injury arising from leakage caused by inappropriate installation

Inappropriately welded/brazed products can cause leakages and load reversals on all three planes of the connection and/or corrosion of the product.

▶ Do not allow connection to become too hot.

▶ Avoid annealing colours darker than straw yellow.

5.2 General guidelines

Environmental conditions

- Minimum distances from other objects: Width of product × 1.5 or min 0.6 m
- Mount the product on a flat and weight-bearing surface.
- Observe limits (see ▸Sec. 12 "Technical data").
- Mount the product in a place where it is protected from UV exposure.
- Do not operate the product in the vicinity of ozone-releasing devices.
- Mount seals in a way that protects them from mechanical influences and aggressive substances.
- For use in humidities > 70 %:
  - Mount the product in an appropriate cover.

Required tools

- Crane with appropriate hook height and lifting capacity
- Lifting straps, slings, beams and other load-securing equipment for hoisting equipment with corresponding safety approval
- Measuring tools (tape measures, gauges)
- Angle grinder with cutting disc for removing welded closures, e.g. for preserved devices
- Angle grinder with grinding disc for preparing welds in case of welding flanges
- Seal material for threaded connections, e.g. Teflon tape or hemp
- Ohmmeter
- Approved welding device for product variants with welding flanges
- Approved brazing device for product variants with brazed connections

5.3 Setting horizontal product upright

Prepare for setting upright

1. Cordon off the danger zone.
2. Remove all transport belts (see ▸Fig. 7, p. 21).
3. Set horizontal product upright by means of shackles (see ▸Sec. 4.4.3 "Attaching lifting gear").
4. Attach lifting gear to crane.

EN

Set product upright

1. DANGER **Product falling**
   Ensure that the lifting equipment is positioned correctly.
2. Attach to shackles.
3. Lift slowly until round slings are equally tensed.
4. Slowly raise product to upright position.
5. Align product.

Mount

1. Anchor product to the floor, to a bracket or to a wall.
2. Do not anchor smaller product variants. Instead suspend the pipeline directly.
3. Remove lifting gear.

5.4 Mounting the product

NOTICE

Restrictions to functionality arising from inappropriate installation position and mounting

Inappropriate installation positions and mounting reduce functionality and lead to performance losses.

- ▶ Provide appropriate venting and draining in the pipeline.
- ▶ A horizontal installation position may lead to performance loss.
- ▶ Mounting is only permitted at the connections.

5.4.1 Preparing installation

Before installing the product in the system, check the following:

1. Media routing is complied with.
2. Install filters in the product's media inlets:
   Mesh size 0.5mm for closed plants/systems.
   Mesh size 0.1mm for open plants/systems.
3. Remove screwed-on dispatch caps, transport closures and plugs from flanges and pipe connectors. Store these parts for future use.
4. Cut off any welding closures with a cutting disc in the centre of the seam root.
5. Prepare cut-off welding closures for the connection of pipelines in accordance with the welding diagram.

5.4.2 Mounting the product

✓ The product has been taken to its final position.

1. Never mount the product with its connections on the bottom.
2. Anchor product in the foundation or the substructure.
3. For the positions of the connection points, please refer to the drawing.
4. Use a tape measure to check that the centre distances of the fixing holes in the legs correspond to the specification in the drawing. (The distances are predefined either in the form of a drilling pattern or as dimensions.)
5. Take into account the equipotential bonding system. Integrate the product into the plant's system as applicable.
6. Bore a corresponding number on anchoring holes into the foundation or the substructure.
7. Use screw connection or composite anchor (not included in scope of supply).
8. Place washers and nuts on anchor head.
9. Tighten nuts with the torque specified in the plant plan (see ▸Tab. 2, p. 25).
10. Mount any additional anchors that are planned. (Mounting elements are not included in the scope of supply.)

Mounting to a wall/bracket

1. Connect product with the wall/bracket with a corresponding number of bolts with nuts and washers through the holes in the leg constructions or mounting features of the product.
2. Ensure that the product is connected and mounted in a way that exposes the connectors to very little or no stress during subsequent operation of the product.

Bolts	M6	M8	M10	M12
M_B (Nm)	10	20	25	30

Tab. 2: Maximum tightening torques, fastening screws

5.5 Connecting the product

NOTICE

Risk of damage arising from inappropriate assembly of the pipelines

Mounting pipelines incorrectly can cause fluids to escape and load reversals on all three planes of the connection.

- ▶ When installing the connections, observe the drawing.
- ▶ Please note maximum permitted nozzle connection loads according to EN ISO 15547-1 Table 1, unless other loads have been agreed.
- ▶ Observe max. pressures on the type label.
- ▶ Use vibration absorbers.
- ▶ The pipes must be routed and the valves arranged in a way that ensures that the product cannot run dry if it is briefly switched off for operational reasons, in order to prevent pressure shocks when it is started back up.

NOTICE

Damage arising from excess forces, torques and vibrations

If excess forces, torques and vibrations can be transmitted to the connections via the pipes, this may damage the product.

- ▶ Observe specification.
- ▶ Observe limits.
- ▶ Please note maximum permitted nozzle connection loads according to EN ISO 15547-1 Table 1, unless other loads have been agreed.
- ▶ Mount vibration absorbers between the product and conveyors with piston technology.
- ▶ Do not use quick-action valves.

5.5.1 Preparing the connection

- Avoid the use of quick-action valves.
- Avoid vibrations, tension, impacts and pulsation in the pipelines.
- Use suitable control valves (size).
- Avoid using control valves with long reaction times.
- Avoid incorrect controlled positions.
- Avoid excessive pressure changes.
- Note that installation of the distributor pipeline requires specific connectors at the product's refrigerant inlet (see ▸Tab. 3, p. 26).

EN

Diameter of banjo connector (mm)	Required connector types for the PHE	Diameter, copper pipe (mm)	Suitable for PHE type
28.70	IA	18	GPL 6
42.10	LZ	22	GPL 7
35.10	K	28	GPL 8, GPL 9

Tab. 3: Distributor pipe dimensions and connections

Pipelines, instruments and threaded connections are assigned to the connections in accordance with the specific order. This is specified precisely in the order documentation.
If provided for by the plant plan (e.g. structural explosion protection in accordance with ATEX operational directive 1999/92/EC or other regulation), the plate heat exchanger must be integrated into the plant's equipotential bonding system. For this purpose, earthing points may need to be provided for on the design side.

5.5.2 Devices with brazed connection

For PHEs with brazed connections, the same procedure as described under ▸Sec. 5.5.1 "Preparing the connection" fundamentally applies. However, item 1 for connecting the pipeline system differs as follows:

1. Use a wet cloth (see ▸Fig. 10, p. 26). The cloth serves to absorb heat and prevent excess heat from entering the product and melting the copper.
2. Fill the device with nitrogen as protective gas.
3. Do not aim flame in the direction of the device.
4. Clean, degrease and polish the surfaces of the connections.
5. Remove oxide layer.
6. Apply flux.
7. Fix connection pipe and braze to the connection with max. 650°C (brazing material 45–55% silver brazing solder).

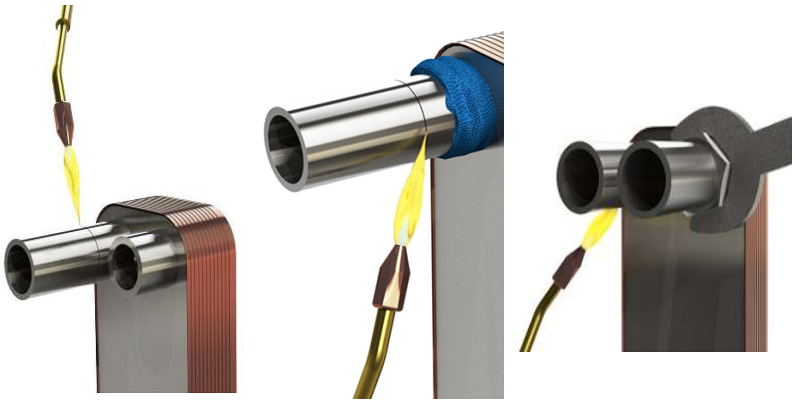

Fig. 10: Brazed connections

5.5.3 Devices with welded connection

For PHEs with welded connections, the same procedure as described under ▸Sec. 5.5.1 "Preparing the connection" fundamentally applies. However, item 1 for connecting the pipeline system differs as follows:

1. Use exclusively TIG welding.
2. Clean, degrease and polish the surfaces of the connections.
3. Remove oxide layer.
4. Weld in accordance with the plant planner's welding plan.

5.5.4 General procedure

1. Tighten all assembly screws with the corresponding torque / weld or braze all seams in accordance with the welding plan.
2. Perform prescribed NDT.
3. Connect the product to the neighbouring sections in the pipeline by means of equipotential bonding conductors (single leads or conductors made from solid material; not included in scope of supply).
4. **NOTICE Damage to the product arising from inadequate equipotential bonding**
   Ensure that the product is connected in the plant's equipotential bonding system in accordance with the plant planning and that its functionality is secured.
5. Measure electrical resistance between the connected parts using a suitable test device in accordance with DIN VDE 0413. Unless a higher resistance value is required because of the length of the equipotential bonding conductor, the measured value should not exceed 0.1 ohms.
6. If corresponding connectors are provided for in the design for the product's fluid circuit or circuits: Install one or more vent valves (not included in scope of supply) at the highest point in each case.
7. For the positions, required number and connection sizes of the valves, refer to the drawing as applicable.
8. For devices without valve connectors, apply the vent to another point in the pipeline.
9. Unscrew and remove locking screws from all valve connectors and remove the sleeves along with seal.
10. Store individual parts for future use (e.g. for closing up pipes in the event of maintenance).

5.5.5 Connection loads

Mounting only at the connections is not permitted. The real pipe connection loads from operation, the tested pipe connection loads in relation to the connectors, the flange connections and the bearing elements must not be exceeded. Please note maximum permitted nozzle connection loads according to EN ISO 15547-1 Table 1, unless other loads have been agreed.

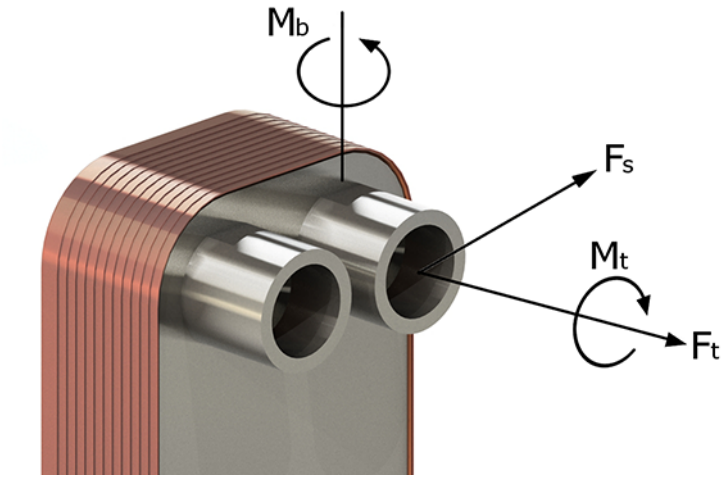

Fig. 11: Connection loads

EN

5.5.6 Distributor pipes

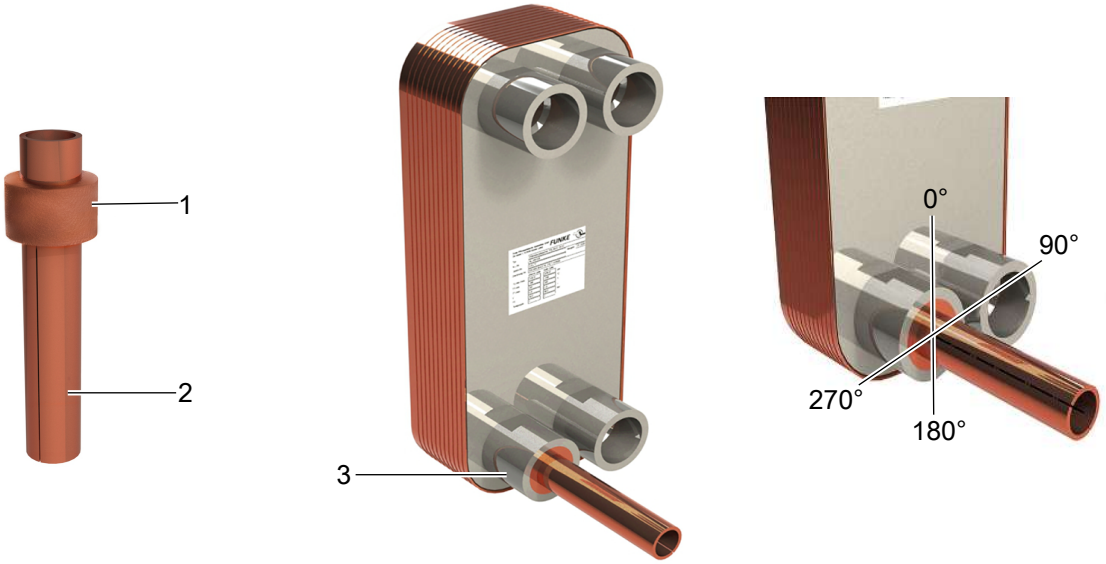

Fig. 12: Installation position, distributor pipes

1	Ring	2	Lance
3	Primary side		

The distributor pipe is made up of a lance (2), the length of which is determined by the number of heat exchanger plates, and a ring (1), the circumference of which is determined by the product type. The two parts are firmly joined on delivery. The lance is equipped with a slit.

1. Install the supplied distributor pipe into the refrigerant inlet channel if the product is used as an evaporator.
2. The slit of the lance must be directed downwards (approx. 195° – see ▸Fig. 12, p. 28).
   ⇨ The slit feeds the refrigerant into the heat exchanger while it is still in a liquid state and distributes it into the primary channels.
3. Hard-braze the ring of the distributor pipe into the connection of the primary side (3) of the product with silver brazing solder AF 319.
4. Note that installation of the distributor pipeline requires specific connectors at the heat exchanger's refrigerant inlet (see ▸Tab. 3, p. 26).

5.5.7 Mounting the insulation

PUR hard form insulation

✓ The heat exchanger is connected to the pipe grid.

1. Apply PUR hard form insulation.
2. Use retaining clips to join the two half-shells.
3. Observe limits (see ▸Sec. 12 "Technical data").

Fig. 13: PUR hard form insulation

Diffusion-resistant insulation

All parts are cut to size in accordance with the particular heat exchanger and given an adhesive layer.

Fig. 14: Diffusion-resistant insulation

1	End cap	2	Heat exchanger
3	Shell	4	Front cap

✓ All brazing and welding work has been completed.

✓ The product has cooled down.

1. Check that insulation corresponds to product type.
2. Remove adhesive film from the front cap (4).
3. Adhere front cap to the front plate of the heat exchanger (2).
4. Remove adhesive film from the end cap (1).
5. Adhere end cap to the end plate of the heat exchanger.
6. Remove adhesive equipment carrier film from the shell (3).
7. Adhere shell around the plate package of the heat exchanger, with slight tension.
8. Remove adhesive film from the abutting edge of the shell and glue the two ends together.
9. Remove synthetic rubber strap from the packaging and adhere it around the connections at the seams and at the shell joint.
10. Observe limits (see ▸Sec. 12 "Technical data").

5.6 Earthing the product (optional)

▶ If the product has one or more earthing straps: Attach earthing cable to each earthing strap.

6. Start-up

6.1 Safety notices

DANGER

Danger of death arising from operating media leakage

If the product is damaged, operating media may escape. Leaking hazardous substances or fluids harmful to health may cause life-threatening injuries. Leakage of other operating media may cause severe injuries. At very low ambient temperatures, cold leakages may cause injuries.

- ▶ Observe safety data sheets for operating materials.
- ▶ Wear personal protective equipment.
- ▶ Perform start-up exactly as described below.

6.2 Switching on the product

- ✓ The product has been installed.
- ✓ All pipeline connections have been implemented correctly (see ▸Sec. 5.5 "Connecting the product").
- ✓ All pipelines are connected correctly.
- ✓ Feed valve between product and pump is closed.

1. Check the product's order and operating documents for any specific start-up sequence.
2. Check all connections for tight fit and leakage.
3. Observe limits regarding filling quantities.
4. Fully open valve at outlet connector.
5. Open each vent valve at the highest point in the fluid circuit.
6. Start pump.
7. Fill the product first with cold medium and then with warm.
8. Vent product and fluid circuits during start-up (several times if necessary).
9. Slowly apply pressure to the product. Pressure and process heat must be applied gently and continuously rather than abruptly, to avoid damaging the product.
   - ⇨ Operating pressure has been reached.
10. Closed vent valve.
11. Check all flange and screw connections for leaks.

- If the product is leaktight, the start-up process is complete.

7. Operation

7.1 Safety notices

EN

DANGER

Danger of death arising from operating media leakage

If the product is damaged, operating media may escape. Leaking hazardous substances or fluids harmful to health may cause life-threatening injuries. Leakage of other operating media may cause severe injuries.

- ▶ Observe safety data sheets for operating media.
- ▶ Observe limits (see ▸Sec. 3.3 "Type label").
- ▶ Use appropriate process control to avoid pressure peaks and cavitation.
- ▶ Wear personal protective equipment.

NOTICE

Risk of damage to plate heat exchanger as result of corrosion

Corrosion in the device results in destruction of the plate heat exchanger.

- ▶ Avoid the use of deionised water in devices brazed with copper. This medium can chemically impair the copper braze.
- ▶ Do not use devices in plants with zinc-plated pipelines. A chemical or electro-chemical reaction involving the stainless steel plates and the copper brazing can lead to mutual damage.
- ▶ Copper in plants with mixed materials can lead to corrosion.
- ▶ Avoid ammonia or other media that could have a corrosive effect on stainless steel and copper.
- ▶ Avoid high chloride ion content in the media as this can cause corrosion (see ▸Sec. 12 "Technical data").
- ▶ Do not use halogens, such as bromide or fluoride, as they can cause corrosion.

7.2 General guidelines

Inspection during operation

1. Perform regular visual checks.
2. Regularly record operating data (temperature, pressure).

- Open valves slowly.
- Observe limits for the max. pressure on the type label.
- Observe limits for the max. temperature on the type label.
- Avoid excessively slow flow velocities as the lower turbulence makes clogging more likely.
- Fundamentally circulate media with the largest possible flow rate (in accordance with device specification).
- Regularly monitor and record pressure drop, temperature, flow rate and load reversal.
- Avoid sudden evaporation and condensation.
- Avoid pressure shocks, pressure peaks and cavitation.
- Avoid the formation of ice by using appropriate antifreeze agents at operating temperatures below 5°C and/or evaporation temperatures below 1°C.
- Media with antifreeze agents must be specified in the specification sheet as subsequent use of antifreeze agents will reduce the performance of the plate heat exchanger (see ▸Sec. 2.1 "Intended use").

Restrictions for media

- The compatibility of the media is the responsibility of the owner (see ▸Sec. 2.2 "Obligations of the owner").
- Operate the product exclusively with media for which it was designed (see specification sheet from the tendering phase).

▶ Observe order-specific specification.

7.3 What to do in an emergency

Inspection during operation

1. Perform regular visual checks.
2. Regularly record operating data (temperature, pressure).

If a direct emergency situation arises during normal operation, for example as the result of an unforeseen pressure increase, reaction process or a dangerous external influence:

1. Take countermeasures immediately (see ▸Sec. 2.7 "Shutdown in an emergency").
2. Take plant out of operation as applicable (see ▸Sec. 8 "Decommissioning").

7.4 What to do in the event of malfunctions

A malfunction has occurred if one of the following conditions is fulfilled:

- The permitted pressure has been exceeded by more than 10 %.
- The operating temperature is significantly higher or lower than the permitted range as stated on the type label.

1. In the event of a malfunction, perform special testing.
2. If the product is found to be damaged: Take product out of operation immediately (see ▸Sec. 8 "Decommissioning").

8. Decommissioning

8.1 Safety notices

EN

DANGER

Danger of death arising from operating media leakage

If the product is damaged, operating media may escape. Leaking hazardous substances or fluids harmful to health may cause life-threatening injuries. Leakage of other operating media may cause severe injuries. At very low ambient temperatures, cold leakages may cause injuries.

- ▶ Observe safety data sheets for operating materials.
- ▶ Wear personal protective equipment.
- ▶ Absorb escaping fluids immediately.
- ▶ Perform decommissioning exactly as described below.

8.2 Decommissioning

Short-term decommissioning

1. Switch off pumps, blowers, compressors and other pressure generators.
2. Close shut-off valves upstream and downstream from the heat exchanger. Start on the side with higher pressure.
3. Safely release pressure.
4. Cool product down to <40°C.
5. Remove and collect media that are explosive, harmful to health or harmful to the environment.
6. Loosen pipeline connections.
7. In the case of gases or gas mixtures that are explosive or harmful to health: Flush product with a chemically compatible medium or neutralising agent.
8. Open product.
9. Ensure that no flow media can escape during downtime.
10. NOTICE **Damage arising from corrosion**
    If the operating medium is left inside the product for a prolonged downtime period, the HE plates could corrode.
    Vent product and fully drain flow chambers.
11. Switch off pump.
12. Close any valves in the outlet pipes.
13. Place product in interim storage, as applicable (see ▸Sec. 4.1 "Storing the product").

Long-term decommissioning

If the product is taken out of operation for longer than 60 days, preservation measures must be taken (see ▸Sec. 4.2 "Preserving the product").

1. Ensure that all steps mentioned in the section “Short-term decommissioning” are carried out (see ▸Sec. 8.2 "Decommissioning").
2. Flush product and allow to dry completely.
3. Close up pipe connections with blind plugs.
4. Clean product and plate package (see ▸Sec. 9.2 "Cleaning").
5. Store product in a protected place (see ▸Sec. 4.1 "Storing the product").

9. Maintenance & repair

9.1 Safety notices

⚠ WARNING

Risk of injury arising from aggressive cleaning agents and released gases

Using aggressive cleaning agents can lead to poisoning, burns and chemical burns.

- ▶ Check the resistance of the materials to the cleaning agents.
- ▶ Provide adequate ventilation.
- ▶ Wear protective clothing (incl. respiratory protection).
- ▶ Keep the safety data sheets of the cleaning agents close to hand.
- ▶ Fully remove any cleaning agent residues.

EN

9.2 Cleaning

Cleaning intervals are dependent on how the product is used. If a coating can be expected to form in the flow gaps because of the water or media quality (e.g. higher water hardness or contamination), clean the product at regular intervals. The resistance of the materials only applies if the specified limits are observed (see ▸Tab. 4, p. 35).

1. Observe limits for max. temperature and max. pressure (see ▸Sec. 3.3 "Type label").
2. Only use chloride-free or low-chloride water with low hardness.
3. Clean channels by flushing them in the reverse direction (opposite to their main direction of flow).
4. Collect cleaning agents and dispose of them correctly.
5. Flush with sufficient water until the cleaning agent has been fully flushed from the product and the adjoining pipelines.

	Limescale or other encrustations	Oils, greases, biological contamination (e.g. algae, bacteria)
Cleaning agents	Phosphoric acid	Caustic soda
Concentration	Max. 2%	Max. 4%
Temperature	Max. 20°C	85°C
Recommended exposure time	Approx. 1h	Up to 24h

Tab. 4: Cleaning work for various contamination types

Cleaning by means of back-flushing

1. Perform back-flushing with high flow rate (1.5 times the 100 % design flow rate).

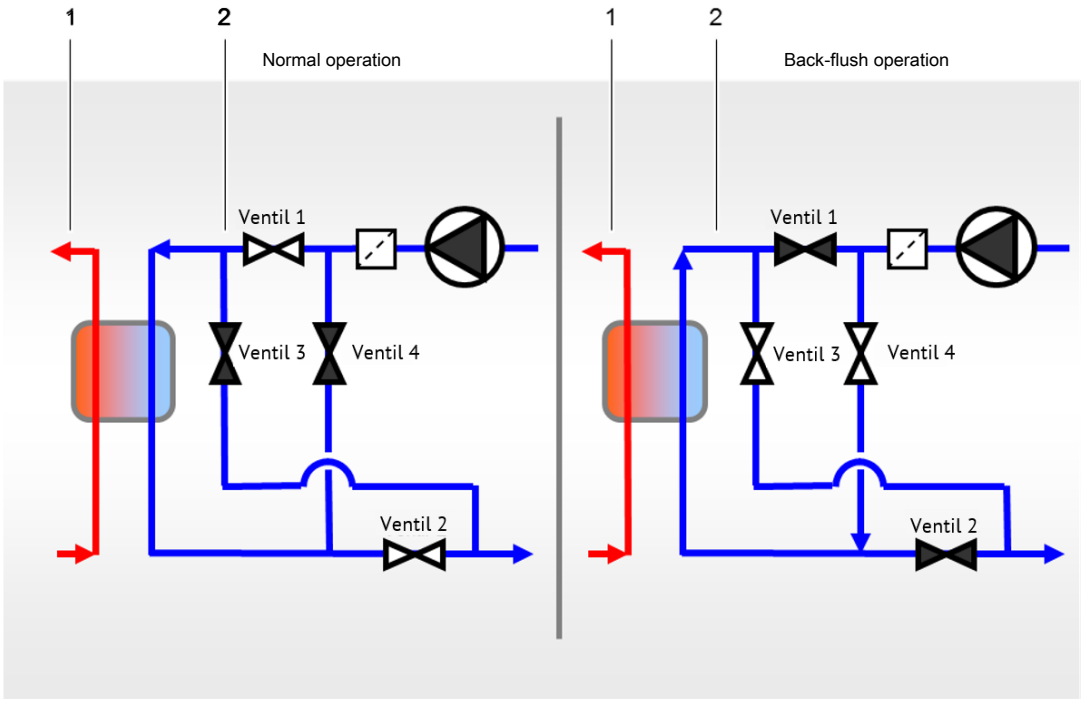

Fig. 15: Back-flushing diagram

1	Fluid side A	2	Fluid side B

Cleaning by means of CIP (cleaning in place)

The product can be cleaned chemically in a CIP process without having to be opened.
The CIP system is not part of the scope of supply.

1. Perform CIP cleaning in accordance with the specifications of the CIP cleaning method manufacturer.

10. Disposal

NOTICE

Non-permitted disposal

Environmental damage

- ▶ Water-polluting liquids must not be allowed to enter the soil, water courses or sewer systems.
- ▶ Ensure safe and environmentally friendly disposal.
- ▶ Observe the relevant groundwater impact and waste disposal regulations.

Observe national regulations and provisions for the disposal of the following components:

- Plate heat exchangers and associated components
- Operating materials, especially oils and greases (observe valid safety data sheets)
- Waste generated during maintenance and repair work

Procedure

1. Dismantle the product into transportable components.
2. Collect operating liquids separately.
   Collect liquid waste as substances that are hazardous to groundwater (as per the Federal Water Act) in authorised containers.
3. Empty and clean the pipework and containers properly.
4. Only remove completely drained pipework.
5. Dispose of the product in an environmentally friendly manner once the product has been dismantled and all of the parts and operating materials have been separated by type.

11. Troubleshooting

EN

Malfunction	Cause	Action
Product performance dropping rapidly	If pressure losses significantly increase or if there is a strong decline in heat output, check whether this error is the result of the overall system (e.g. insufficient media quality, altered input temperature and/or flow rate non-conformity).	If this does not result in any improvement, check whether any foreign bodies are hindering flow into the connection pipes. Then shut down the product and clean it.

Tab. 5: Malfunction table

12. Technical data

The recommended installation for the product is vertical. For evaporators, a vertical position is a mandatory specification.

General information

	Specification
Plates	Stainless steel 1.4404 / AISI 316
Max. humidity	70%

Operation

	Specification
Ambient temperature / operating temperature	See the name plate on the product; frost-free
Media temperature	See the name plate on the product
Max. / Min. operating pressure	See the name plate on the product

Operating medium

The product must only be operated with media that it was designed for (see the specification sheet from the quotation stage). The compatibility between the medium and the product's materials is the owner's responsibility. The system owner decides which medium is suitable for operating the product.

Operating medium: Water

If water has been specified as a permitted medium, you will find a table with limit values below. This table is not complete and is for information purposes only. Please consider the table as a non-binding recommendation. Warranty claims cannot be derived from the table.

NOTICE **Poor water quality leads to increased susceptibility to corrosion**

Brazed PHEs are fundamentally not suitable for seawater. The same applies (with the exception of series NPL/NPLK) for operation with ammonia and demineralised water. Synthetic oils (e.g. silicone oils) may only be used for PHEs with nickel brazing (series NPL/NPLK).

Substance in water / key values	Unit	Copper-brazed PHE	Nickel-brazed PHE
pH value		7–9 (in accordance with SI Index)	6–10
Saturation index SI (delta pH value)		-0.2 < 0 < +0.2	No specification
Oxygen	mg/l	2.0	No specification
Total hardness	°dH	6–15	6–15
Conductivity	µS/cm	> 50	No specification
Substances removable by filter	mg/l	< 30	< 30
Chlorides	mg/l	No chlorides permitted above 100°C	
Free chlorine	mg/l	< 0.5	< 0.5
Hydrogen sulphide	mg/l	< 0.05	No specification

EN

Substance in water / key values	Unit	Copper-brazed PHE	Nickel-brazed PHE
Ammonia	mg/l	< 2.0	No specification
Sulphate	mg/l	< 60	< 300
Hydrogen carbonate	mg/l	< 300	No specification
Hydrogen carbonate/sulphate	mg/l	> 1.0	No specification
Sulphide	mg/l	< 1.0	< 5.0
Nitrate	mg/l	< 100	No specification
Nitrite	mg/l	< 0.1	No specification
Iron	mg/l	< 0.2	No specification
Manganese	mg/l	< 0.1	No specification
Free aggressive carbonic acid	mg/l	< 20	No specification

Tab. 6: Maximum substances in water

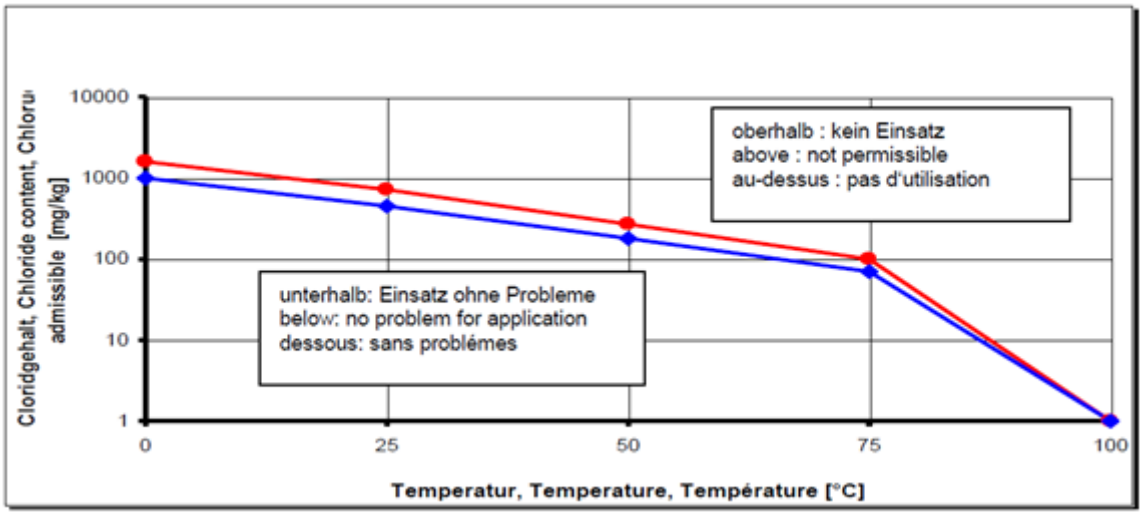

Fig. 16: Permitted chloride content in relation with temperature (1.4404-SA240 316L)

Insulation

- The long-term thermal resistance of the PUR hard foam insulation is 130°C.
- Diffusion-resistant insulation is made up of 10/20 mm-thick closed-cell synthetic NBR-based rubber. The long-term thermal resistance of the insulation is 105°C.

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