FP/BG, FPDW/BGDW

Gasketed plate heat exchangers

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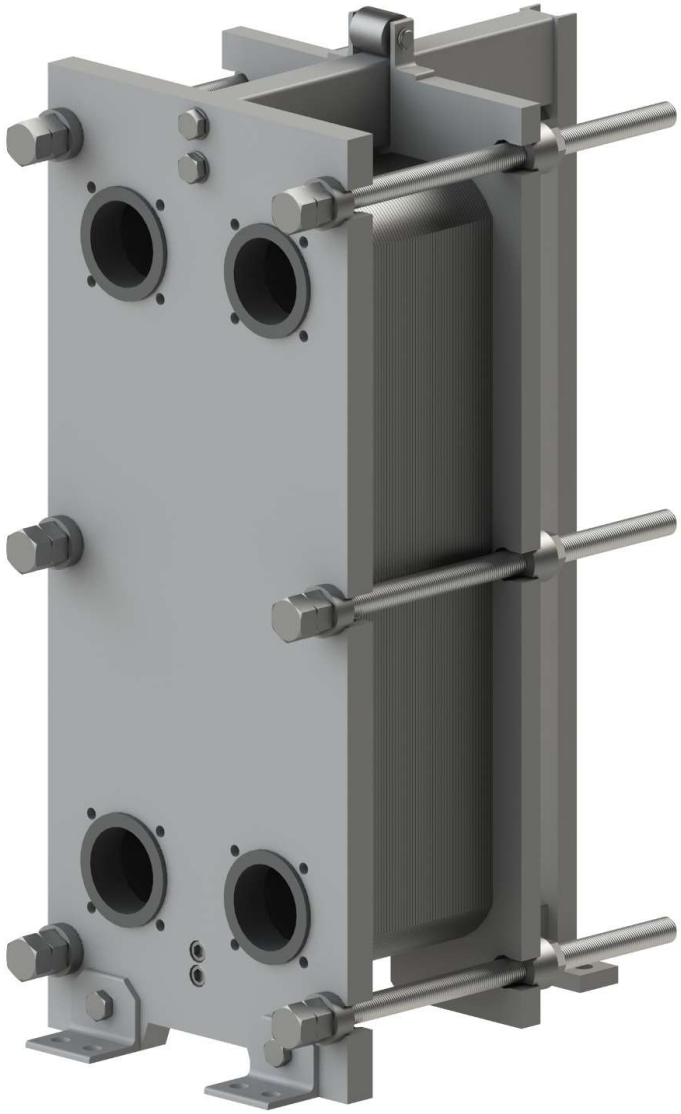
Applicable to:

- FP, FPDW
- FPX, FPQ, FPC
- BG, BGDW



Operating and maintenance instructions

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FUNKE

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Translation / original language: German

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Documentation Representative:
Mario Reiss, FUNKE Wärmeaustauscher Apparatebau GmbH, Zur Dessel 1, D-31028 Gronau/Leine, info@funke.de

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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.

1.1 Scope of application

These instructions apply to the following FUNKE products:

- FP, FPDW
- FPX, FPQ, FPC
- BG, BGDW

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 Other applicable documents and further information

You will need the following additional documents and information sources to fully understand the content of these instructions and to perform the action steps described fully and safely:

- Technical dimension sheet or drawing
- Specification sheet

The technical dimension sheet or drawing and the specification sheet are provided to the customer during the quotation stage. Contact your sales partner if you need the drawings or the specification sheet 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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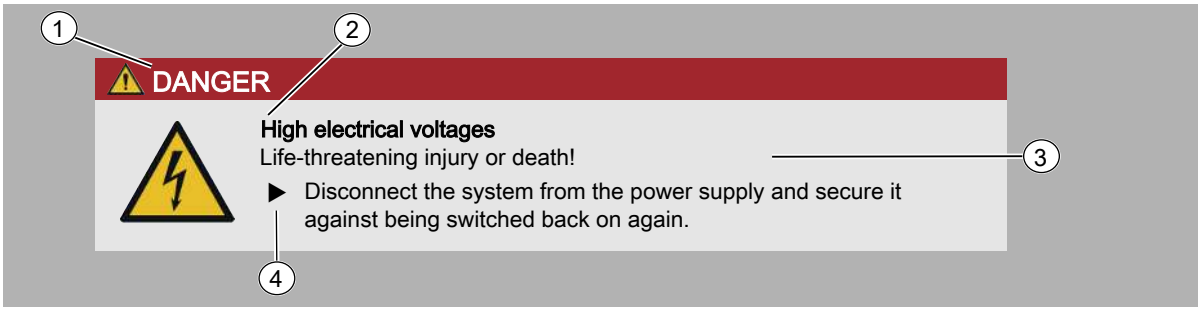
Warnings visually highlighted in boxes

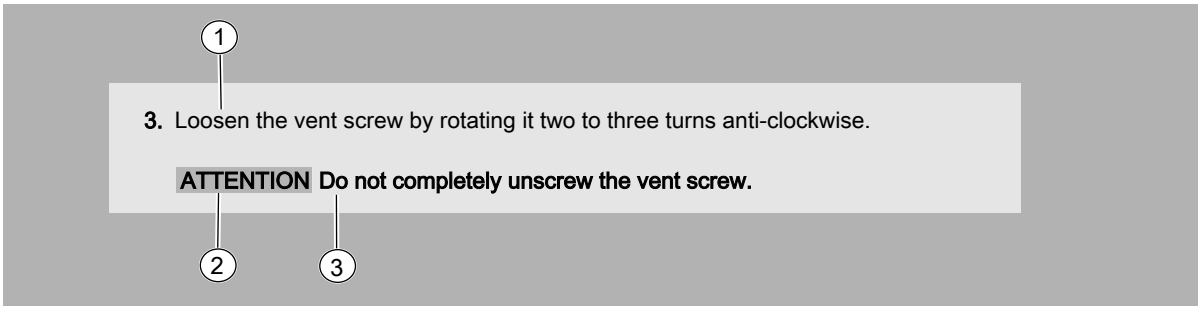
Warnings visually highlighted in boxes provide the following information in connection with a hazard:



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.
NOTICE	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
Bolted / gasketed plate heat exchanger	Appliance with heat exchanger plates that are evenly clamped between two frame plates by means of clamping nuts and threaded bolts. A gasket is either glued on or tied in each HE plate (see ▸Sec. 3.1 "Function and design"). Gasketed plate heat exchangers are also referred to as bolted plate heat exchangers.
Fixed plate	Front frame plate; permanently attached to the rack and the lower plate guide (see ▸Sec. 3.1 "Function and design").
Frame plates	Movable plate and fixed plate
Cavitation impacts	A sudden drop in pressure and/or a sudden change in flow velocity causes very small vapour bubbles that have formed in pumps or on rapidly rotating parts to implode. The localised jet of liquid (microjet) hits the wall of the pipe at high speed. The sudden pressure load causes crater-shaped material erosion or damage.
Movable plate	Rear frame plate; moves on a roller on the rack (see ▸Sec. 3.1 "Function and design").
PP	Clamping dimension
PP min	Minimum clamping dimension
PP max	Maximum clamping dimension
PHE	Plate heat exchanger
HE plates	Heat exchanger plates

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 specified otherwise in the order, the product is designed and manufactured for the specific operating conditions and materials specified by the owner with regard to temperature, pressure, volume flow and flow media.

Permitted areas of application

The product is intended for stationary use. Mobile use – e.g. on ships – is only permitted if explicitly stated in the specification.

Intended use also includes:

- The product is subject to the Pressure Equipment Directive 2014/68/EU of 15 May 2014 and other international standards.
- Operation only with accessories and spare parts authorised by the manufacturer
- Operation only with permitted media according to the design (see the specification sheet from the quotation stage) (▸Sec. 1.3 "Other applicable documents and further information")
- Indoor operation
- Outdoor operation only permitted if specified (▸Sec. 1.3 "Other applicable documents and further information")

Improper use and foreseeable misuse

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

Improper use particularly includes:

- Operation with a non-permitted medium
- Operation in a mobile application
- Operation in potentially explosive atmospheres
- Operation under non-permitted operating conditions
- Operation under fatigue stress (▸Sec. 12 "Technical data")
- Operation when safety devices are dismantled or defective
- Unauthorised modifications to the product
- Inadequate monitoring of device parts that are subject to wear and tear

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 The owner’s obligations

As the operator, 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 instructions")
- Readability of the warning signs on the product
  Warning signs that have become illegible must be replaced by the operator.
- Legibility of the name plates on the product
  The owner must replace name plates that have become illegible.

Occupational health and safety

- Creation of own risk assessment and implementation of required measures
  The operator must determine in their own risk assessment the sources of danger arising from the product being used in their machine or system. Based on this, the operator must independently derive suitable measures for the safety of the machine or system and design the documentation for his 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")
- Operation of the product only with the prescribed safety devices (▸Sec. 2.5 "Safety devices").
- The owner is responsible for ensuring that the product is only operated with media as specified in the intended use.
- The owner is responsible for ensuring that the media used and the product’s materials are compatible.

Compliance with standards and regulations

- Observance of the statutory inspection intervals for the system
  The operator 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
- Compliance with national and international regulations on pressurised equipment, hazardous liquids and gases.

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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		
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 instructions

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 using the product:

Risks of injury

- Risk of injury due to leakage of operating media:
  - If the product's limit values are not complied with, the product may be damaged and leaks may occur.
  - Life-threatening injury is possible when using operating media that are harmful to health – e.g. Group 1 fluids (Pressure Equipment Directive 2014/68/EU).
  - Serious injury is possible when using operating media that are not harmful to health.
- Burns:
  - High or low component temperatures
  - High media temperature
- Injury caused by fire if the product is not used as intended, e.g.:
  - Unauthorised use in potentially explosive atmospheres
  - Use of non-permitted media
- Injury due to spilt or leaked operating and auxiliary materials

Risk of material and environmental damage

- Damage to the product due to use of non-permitted media
- Damage to the product or leakage due to exceeding or falling short of limit values
- Environmental damage due to leakage of operating media

Hazard prevention

Observe the following safety measures to safely prevent these hazards:

- Take additional safety precautions when using hazardous fluids.
- Wear personal protective equipment.
- Do not operate the product in potentially explosive atmospheres.
- Ensure that the specified limit values are observed (▸Sec. 12 "Technical data", "name plate" [▸Sec. 3.3]).
- Only use permitted media.
- Fit thermal insulation protection or a shut-off device in case of operating temperatures > 90°C.
- Ensure that safety devices are used.
- Clean up and dispose of spilt or leaked operating and auxiliary materials.
- Keep containers with flammable substances away from sources of heat.
- Avoid large temperature jumps and pressure surges.

2.4.2 Hazards during maintenance, inspection and assembly work

The following hazards occur during maintenance, inspection and assembly work:

Risks of injury

- Risk of life-threatening injury if the product topples over or falls.

Risk of material and environmental damage

- Environmental damage due to incorrect disposal of water-polluting liquids.

Hazard prevention

- Empty and depressurise the product before carrying out any maintenance, inspection and assembly work.
- Allow the product to cool down before carrying out any maintenance, inspection or assembly work.
- Only allow qualified and trained specialists to carry out work (▸Sec. 2.3 "Personnel qualifications").

  Any work on the electrical system may only be carried out by qualified electricians.
- Precisely observe the media manufacturers' safety regulations, in particular the safety data sheets.
- Take the weight of the product into account when planning all of the work (see the technical dimension sheet / drawing or specification sheet, ▸Sec. 1.3 "Other applicable documents and further information").
- Cordon off the danger zone.
- Do not stand under suspended loads.
- During disposal, observe the groundwater impact and waste disposal regulations valid in the specific country.
- After maintenance, inspection and assembly work:
  - Refit and put back into operation all safety and protection devices immediately after the work is completed.
  - Follow the startup procedure exactly (▸Sec. 6 "Startup").

2.5 Safety devices

Safety devices that the owner must provide

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

Depending on the operating media used, your product must be equipped with the following safety devices:

Operating medium property	Splash guard	Drip tray	Earthing strap	Insulation	Warning sign
Highly explosive	X	X	X		
Flammable	X	X	X		
High pressure	X				
Temperature < 0°C				X	X
Temperature > 50°C				X	X
Corrosive, toxic, hazardous to the environment	X	X			

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

Additional protective measures

- Do not wear loose-fitting clothing, jewellery or long hair down.
- Immediately change clothing that has been soiled with highly flammable substances.
- Avoid contact with toxic liquids, 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 plate heat exchanger transfers heat from a heat-emitting medium to a heat-absorbing medium.

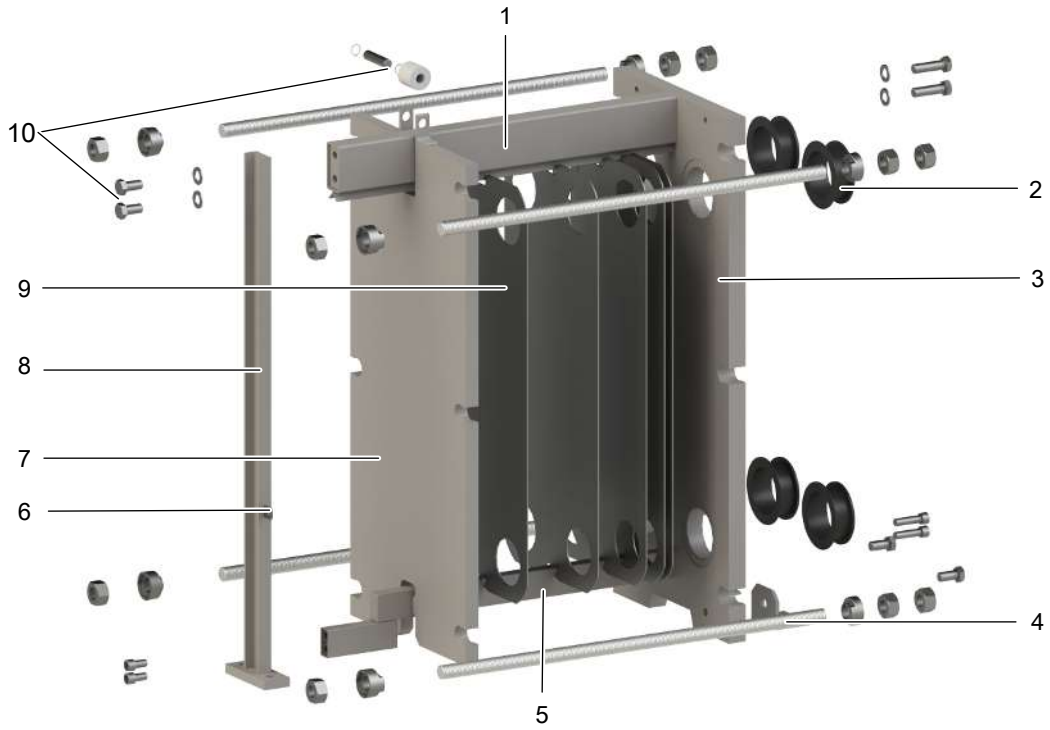
Design

The product consists of a pack of heat exchanger plates (HE plates) arranged close together. The plate pack is pressed together evenly between the fixed plate and the movable plate with clamping nuts and threaded bolts.

The HE plates are profiled and have outlet openings. Every second plate is rotated by 180°. There are flow gaps between the plates.

Flexible gaskets are snapped or glued into each plate to outwardly seal the medium in the flow gaps.

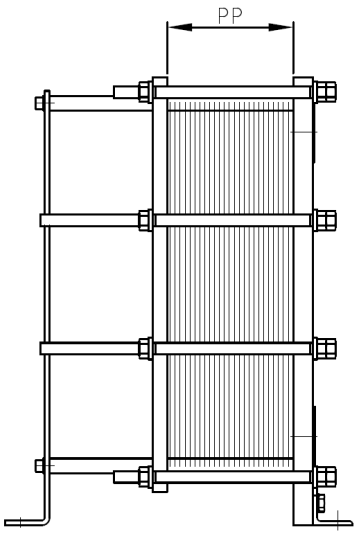
The product may have one or more earthing straps. The position and design of the earthing strap are order-specific; see the specification sheet for the design (▸Sec. 1.3 "Other applicable documents and further information").

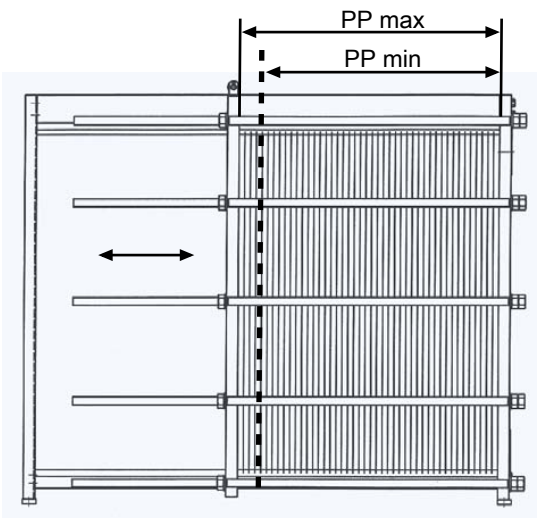


1	Carrier	2	Moulded rubber parts
3	Fixed plate	4	Threaded bolt
5	Lower plate guide	6	Earthing strap (optional)
7	Movable plate	8	Support
9	Heat exchanger plates	10	Mounting bolts

Clamping dimension

The clamping dimension ‘PP’ indicates how tightly or loosely the HE plates are clamped. The clamping dimension corresponds to the length of the plate pack.





Area of application

The heat generated by internal losses can be dissipated very effectively by liquid cooling. The following applications are possible:

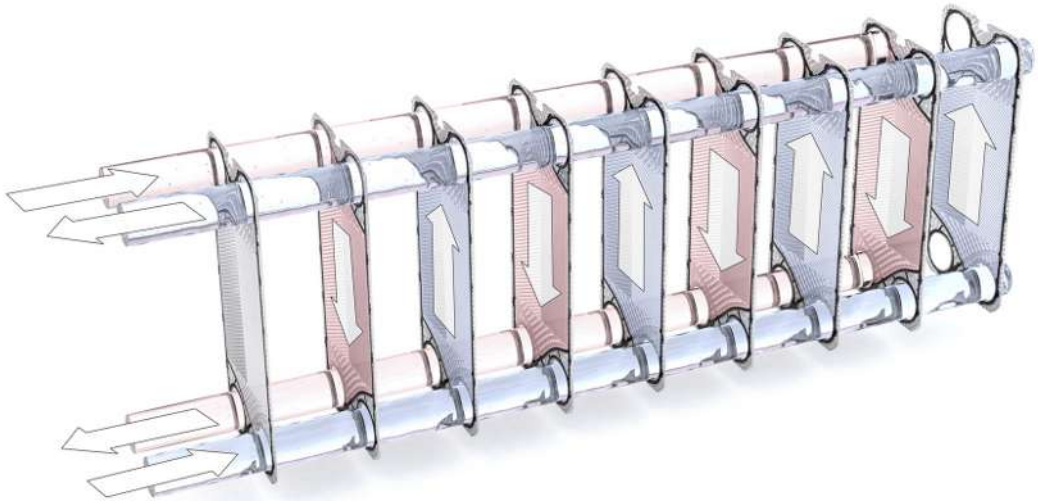
- Liquid-cooled drives: Motor spindles, torque motors, servo motors, linear motors
- Inverter cooling or other liquid-cooled electrical components
- Gearbox cooling and lubrication
- Bearing cooling
- Mould cooling
- Machine and system cooling in general
- Process cooling / heating
- Heat recovery in all industries / processes
- Heat transfer stations
- District heating / district cooling

3.2 Versions

3.2.1 Standard version

Single-use

All connections are on one side of the fixed plate.



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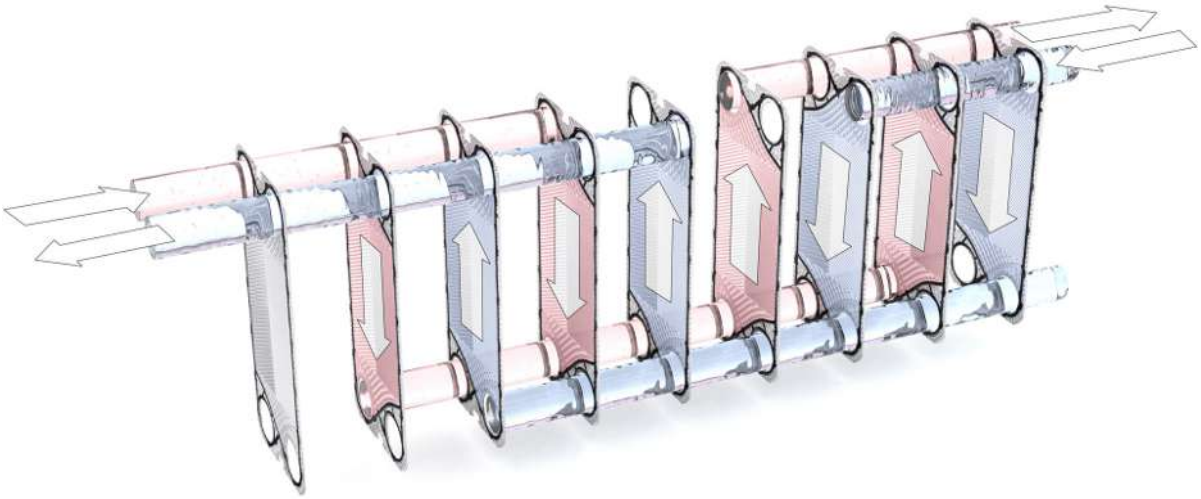
Reusable

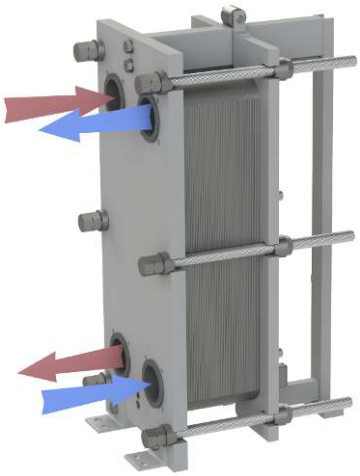
The connections are located on the fixed plate and the movable plate.



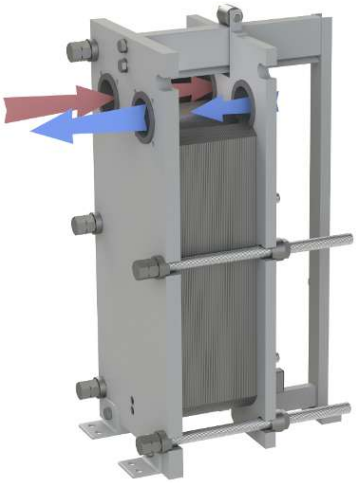
Terminal connections

The assignment of the connections is order-related. Specification: ▸Sec. 3.3 "Name plate".

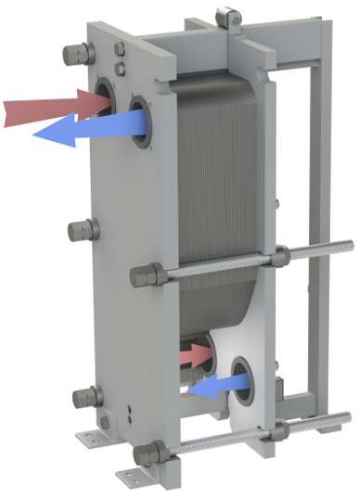
Single-use



Dual-use



Triple-use

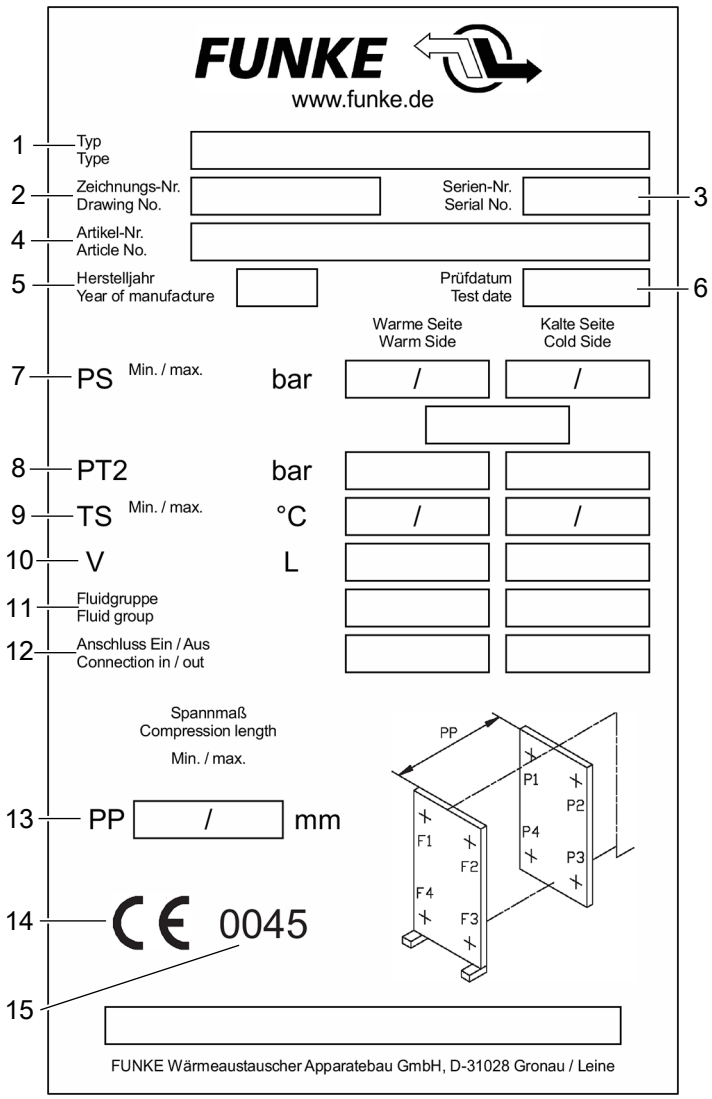


3.2.2 FPDW/BGDW safety version

In the safety version, a heat exchanger plate consists of two plates, one above the other, that are laser-welded together at the inner passages. There is a leakage gap between the plates. The medium can escape through the leakage gap if the plates are damaged due to plate breakage, for example.

3.3 Name plate

Type 1: Final inspection and proof test according to Manufacturing and Final Assessment Regulations PED, AD 2000



1	Type/series	2	Material number
3	Serial number	4	Part number
5	Year of manufacture	6	Test date
7	Operating pressure	8	Test pressure
9	Operating temperature	10	Volume
11	Fluid group (acc. to Pressure Equipment Directive 2014/68/EU)	12	Connection position
13	Clamping dimension	14	CE mark
15	ID number of “notified body” in acc. with Pressure Equipment Directive		

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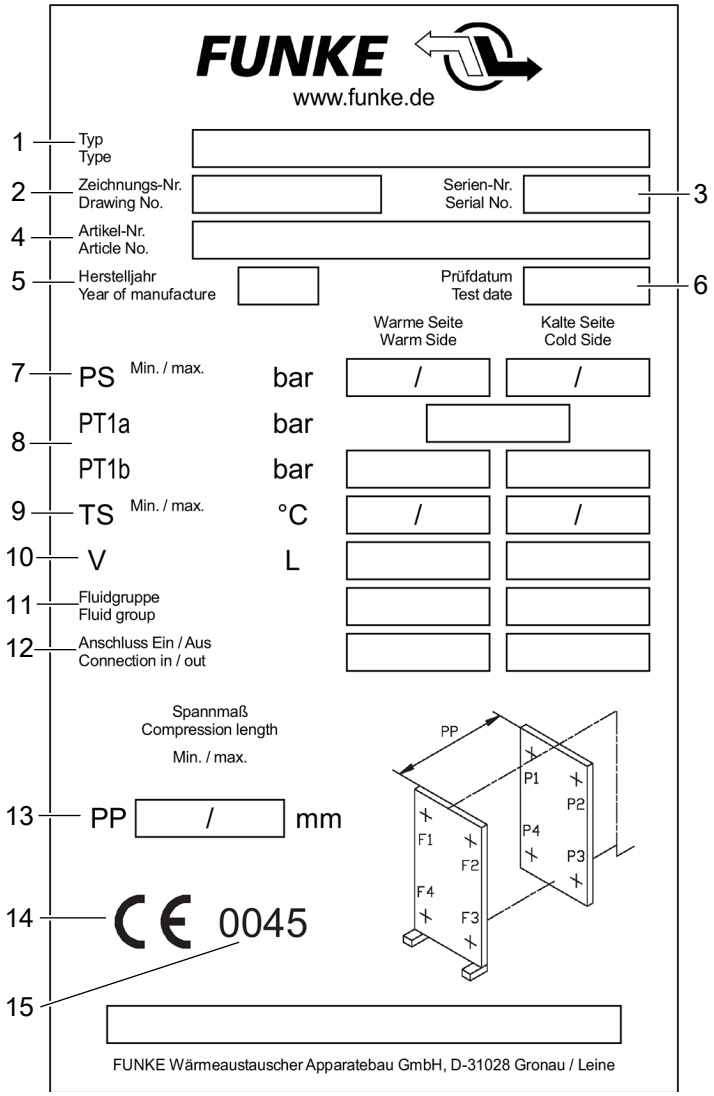
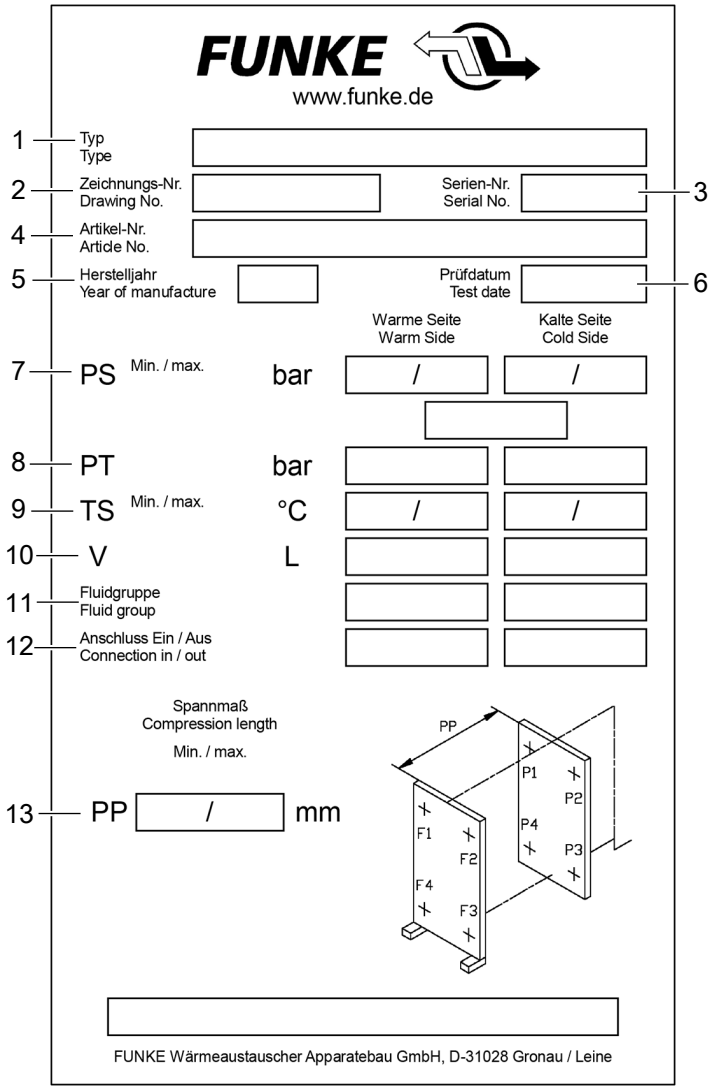
Type 2: Final inspection and proof test according to Manufacturing and Final Assessment Regulations PED, AD 2000; balanced



1	Type/series	2	Material number
3	Serial number	4	Part number
5	Year of manufacture	6	Test date
7	Operating pressure	8	Test pressure
9	Operating temperature	10	Volume
11	Fluid group (acc. to Pressure Equipment Directive 2014/68/EU)	12	Connection position
13	Clamping dimension	14	CE mark
15	ID number of “notified body” in acc. with Pressure Equipment Directive		

Type 3: Final inspection and proof test according to Manufacturing and Final Assessment Regulations PED, AD 2000; manufacturer standard



1	Type/series	2	Material number
3	Serial number	4	Part number
5	Year of manufacture	6	Test date
7	Operating pressure	8	Test pressure
9	Operating temperature	10	Volume
11	Fluid group (acc. to Pressure Equipment Directive 2014/68/EU)	12	Connection position
13	Clamping dimension		

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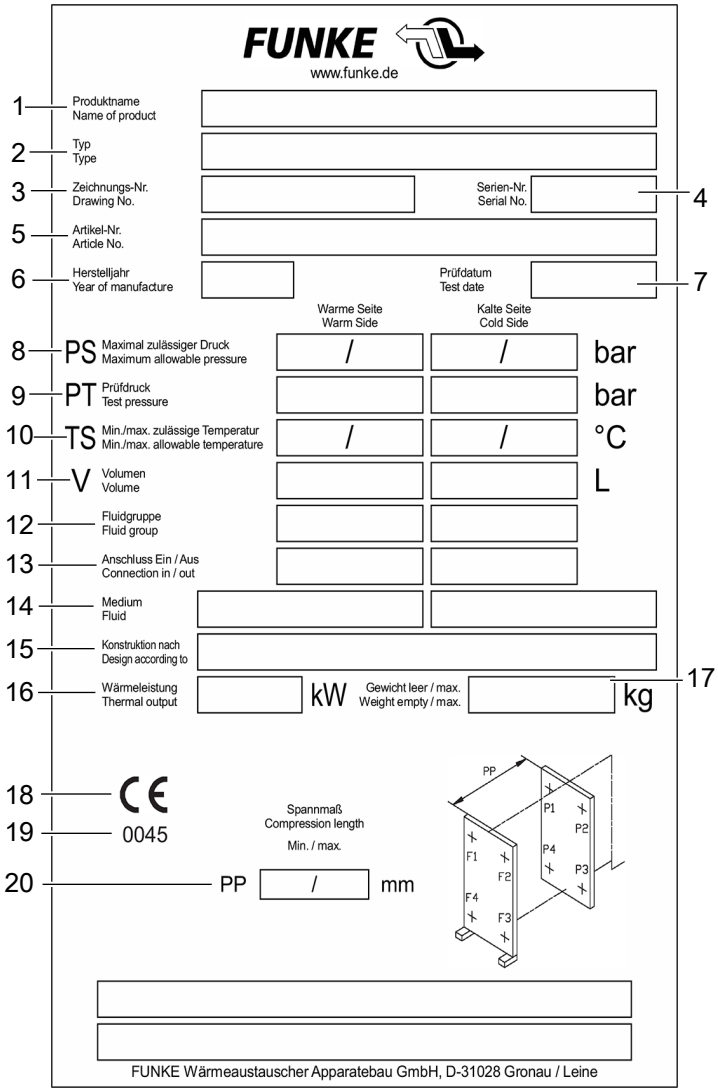
Type 4: Final inspection and proof test according to Manufacturing and Final Assessment Regulations PED, EN13445



1	Product name	2	Type/series
3	Part number	4	Serial number
5	Part number	6	Year of manufacture
7	Test date	8	Operating pressure
9	Test pressure	10	Operating temperature
11	Volume	12	Fluid group (acc. to Pressure Equipment Directive 2014/68/EU)
13	Connection position	14	Medium
15	Design according to	16	Heat output
17	Weight	18	CE mark
19	ID number of “notified body” in acc. with Pressure Equipment Directive	20	Clamping dimension

3.4 Scope of delivery

- Plate heat exchanger
- Declaration of conformity or manufacturer’s certificate
- Operating and maintenance instructions

4. Transport and storage

4.1 Storing the product

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The product is usually supplied for immediate installation. The transport packaging must be left on the product until installation.

No particular precautions need to be taken for storage up to one month.

Indoor storage

✓ The product is completely emptied, cleaned and dry.

1. Comply with the limit values (▸Sec. 12 "Technical data").
2. Do not operate ozone-emitting processes or machines in the vicinity of the product.
3. Do not store acids or alkalis in the vicinity of the product.
4. Store away from direct sunlight and intense heat.
5. Seal the connection openings appropriately (e.g. with metal covers).
6. Treat threaded bolts with rust inhibitor.

Outdoor storage

NOTICE

Sub-zero temperatures / frost

Product damage

Even a small amount of water in the plate heat exchanger can cause the HE plates to break in sub-zero temperatures.

▶ Drain the plate heat exchanger carefully (▸Sec. 8 "Shutdown").

1. Observe the specifications for indoor storage.
2. Store the product so that it is protected from the cold and the elements.
3. Check the following points every three months:

- Lubrication of the threaded bolts
- Connection cover
- Plate pack protection
- Sealing of the packaging

4.2 Unpacking the product

The product is function-tested at the factory prior to delivery. Check the product for any transport damage.

1. Inspect the product more closely if there is visible damage. Contact the manufacturer if anything is unclear.
2. Note the nature and extent of the damage on the shipping document.
3. Have the shipping document acknowledged by the supplier.
4. Check the scope of delivery to ensure that the product is complete (▸Sec. 3.4 "Scope of delivery").

Procedure

1. Remove the transport packaging.
2. Leave the transport caps on the pipe connections.
3. If the product is supplied filled with compressed air or inert gases: Reduce the overpressure at the corresponding drain valve before loosening the transport flanges.
4. Carefully remove the packs of desiccant in the distribution ducts without damaging them.
5. Dispose of the transport packaging in accordance with the applicable regulations.

4.3 Transporting the product

Safety notices

DANGER

Product toppling over and falling during transport

Life-threatening injury!

Requirements for safe transport:

▶ Transport and assemble the product exactly as described below.

NOTICE

Damage when using chains and steel ropes

The product may be damaged if the product comes into direct contact with chains and steel ropes.

▶ Use the crossbeam.

Delivery condition

Depending on the design, weight and size of the product, the product is delivered in either a horizontal or an upright position. The pipework connections are always sealed.

- Horizontal: The product is securely fastened for transport on pallets, with the fixed plate facing downwards.
- Upright: The product is secured on wooden planks or pallets.

Preparing for transport

The product may be filled with dried gas (e.g. nitrogen) with a maximum overpressure of 0.5 bar.

1. Reduce the overpressure at the drain valve before loosening the transport flanges.
2. DANGER **Product falling during transport**
   Check that all of the threaded bolt nuts are tight.
3. Make sure that all nuts on the tension bolts are tightened well.
4. Tighten the plate pack to the clamping dimension ‘PP max’ if the nuts have come loose during transport (see ▸Sec. 3.3 "Name plate").
5. If necessary, get in touch with the relevant FUNKE sales office.

4.3.1 Transporting a product delivered horizontally by forklift

1. Leave the transport straps unchanged.
2. Transport the product horizontally on the pallet to the assembly site by forklift.

4.3.2 Transporting a product delivered upright by crane

1. Cordon off the danger zone.
2. Prepare suitable lifting equipment.
3. Attach the lifting equipment to the product in accordance with the product design.
   Detailed instructions: ▸Sec. 4.3.3 "Positioning lifting equipment"
4. DANGER **Product falling during transport**
   Ensure that the lifting equipment is positioned correctly.
5. Transport the product to the assembly site suspended from a crane.
6. Do not stand under suspended loads.

EN

4.3.3 Positioning lifting equipment

Basic guidelines

- Fastening angle α: 5° – 30°
- Note the product's centre of gravity. Two individual round slings must be of different lengths so that the product can hang horizontally.
- Chains and steel ropes are only permitted if they do not come into direct contact with the product.
  NOTICE **Damage due to direct contact between the product and chains or steel ropes**
- **Do not** remove the product from the wooden planks.
  Leave the product bolted down to the wooden planks until it has been transported to its final installation location.

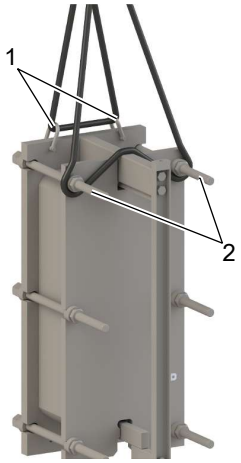
Options for attaching the lifting equipment

Depending on the product version, the following fastening options are permitted:

- Attaching to the carriers and shackles
- Attaching to the lifting lugs
- Attaching with round slings
- Attaching to the base plate and support
- Attaching to the sides with round slings

Attaching to the carriers and shackles

1. Attach the first round sling with shackles to the shackle holes in the fixed plate.
2. Place a second round sling on the movable plate, over the carrier and around the upper outer pairs of clamping nuts.

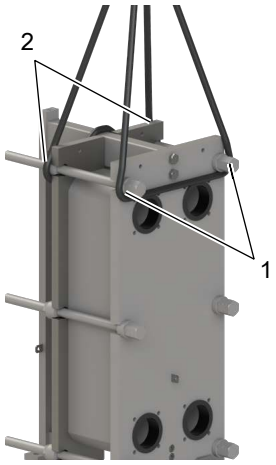


Attaching to the lifting lugs

▶ Attach round slings with or without shackles to the lifting lugs.

Attaching to round slings

1. Place the first round sling on the fixed plate around the upper outer pairs of clamping nuts. In case of clamping nuts with short protrusion: Place round slings around the fixed plate.
2. Place the second round sling on the movable plate, over the carrier and around the upper outer pairs of clamping nuts.

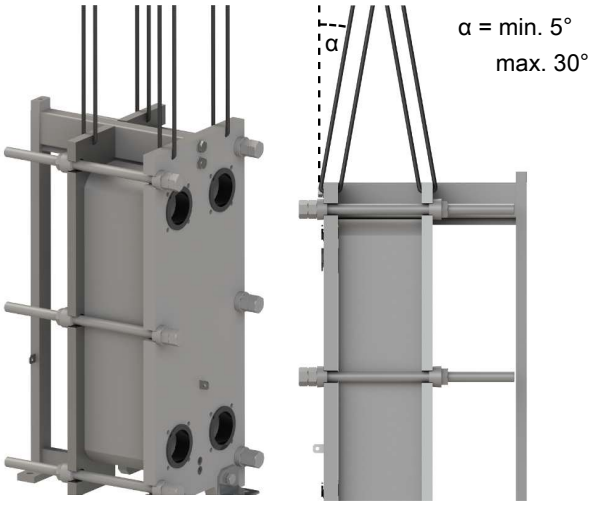


Attaching to the sides with round slings

▶ Place a sufficiently long round sling or two round slings measuring the same length on both sides of the product around the upper outer pairs of clamping nuts.

Attaching to the frame plates

1. Attach one round sling with shackles to each of the two shackle holes or to the attachment holes in the fixed plate and the movable plate.
2. DANGER **Product falling during transport**
   Ensure that the product is hanging almost horizontally.



5. Assembly

5.1 Basic guidelines

EN

Safety notices

DANGER

Product toppling over and falling during transport

Life-threatening injury!

Requirements for safe transport:

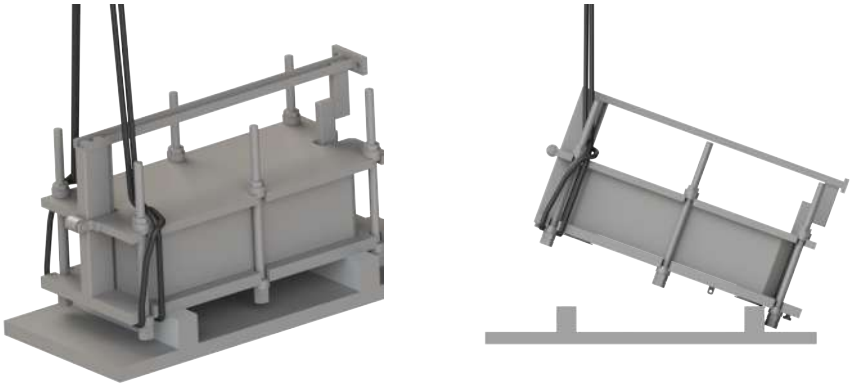
▶ Transport and assemble the product exactly as described below.

Environmental conditions

- Minimum distances from other objects: Product width × 1.5 or min. 0.6 m
- Assemble the product on a level, load-bearing surface.
- Observe the limit values (▸Sec. 12 "Technical data").
- Assemble the product such that it is protected from direct UV radiation.
- Do not operate the product in the vicinity of ozone-generating devices.
- Install gaskets such that they are protected from mechanical influences and aggressive substances.
- When used at > 70% humidity:
  - Assemble the product in a suitable enclosure.
  - Treat clamping screws with rust inhibitor.

5.2 Assembling a product delivered horizontal

Preparing for assembly



1. Cordon off the danger zone.
2. Remove all of the transport straps.
3. Place a round sling around the upper clamping nuts on the fixed plate from both sides.
4. Guide the round sling upwards so that it wraps around the upper clamping nuts on the movable plate.
5. Attach the lifting equipment to the crane.

Setting the product upright

1. DANGER **Product falling**
   Ensure that the lifting equipment is positioned correctly.
2. Slowly lift the product above the centre of gravity until the round slings are evenly tensioned.
3. DANGER **Product falling**
   Ensure that the round slings are always securely positioned around the upper clamping nuts.
4. Do not touch the lifting equipment when the product is lifted.
5. Slowly set the product upright.
6. Slowly lower the product onto the edge of the fixed plate or onto the product base.
7. Align the product.

Assembly

1. Anchor the product to the holes provided in the floor.
2. Remove the lifting equipment.

5.3 Assembling an upright product

1. Align the product.
2. Anchor the product to the holes provided in the floor.
3. Remove the lifting equipment.

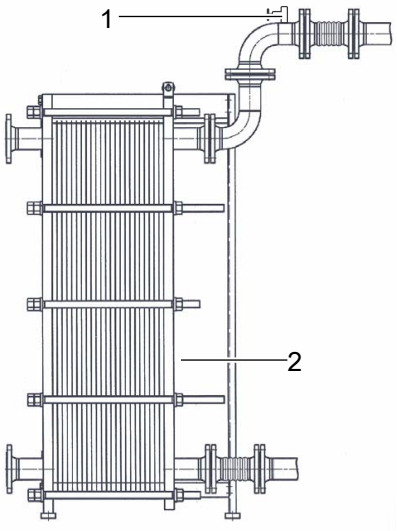
5.4 Connecting the product

NOTICE

Damage arising from excess forces, torques and vibrations

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

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



1	Vent valve	2	Opening space

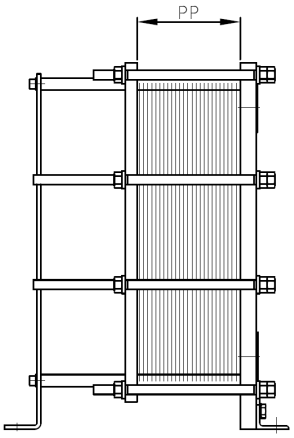
EN

Specifications

- The opening space must not be blocked by fixed pipework.

Fitting the pipework

1. Note the pin assignment (▸Sec. 1.3 "Other applicable documents and further information").
2. The pipe connections on the loose plate must be flexible so that the clamping dimension of the plate pack can be adjusted between PP max. and PP min. (see ▸Sec. 3.3 "Name plate").
   NOTICE **Damage due to incorrect clamping dimension**
3. Install vent valves at the highest points of the connections for both of the product's circuits.
4. Establish connections on the movable plate or on spacers parallel to the clamping bolts: Use expansion joints or flexible pipework.
5. Use suitable gaskets.
6. Equip the pipework for inlets and outlets with shut-off valves.



Fitting safety devices

1. Fit the prescribed safety devices (▸Sec. 2.5 "Safety devices").
2. CAUTION **Risk of injury due to sharp edges**
   Wear personal protective equipment.

5.5 Earthing the product (optional)

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

6. Startup

6.1 Safety notices

DANGER

Danger of death due to leakage of operating media

Operating media may escape if the product is damaged. Hazardous substances or fluids that are harmful to health leaking can cause life-threatening injury. Other operating media leaking can cause serious injury. Cold leaks can lead to injury at very low ambient temperatures.

- ▶ Observe the safety data sheets for operating materials.
- ▶ Wear personal protective equipment.
- ▶ Start up the product exactly as described below.

6.2 Preliminary check

1. Ensure that the plate pack is clamped correctly. See the clamping dimension ‘PP’ (▸Sec. 3.1 "Function and design"). The clamping dimension ‘PP max’ applies to new plate heat exchangers. Otherwise observe ▸Sec. 9.4.7 "Closing the product".
   NOTICE **Damage due to incorrect clamping dimension**
2. If necessary, get in touch with the relevant FUNKE sales office.
3. Ensure that all of the limit values are observed (▸Sec. 12 "Technical data").
4. Ensure that the product is assembled correctly and connected.
5. Ensure that the inlet valve between the product and the pump is closed.
6. Ensure that there are no residues from previous processes in the product when restarting.
7. DANGER **Danger to life due to leakage of operating media**
   Check leak tightness when putting back into operation (▸Sec. 9.2.1 "Tightness").
8. Ensure that pressure surges and cavitation impacts are avoided by means of appropriate process control.

6.3 Switching on the product

✓ The inlet valve between the product and the pump is closed.

1. Fully open the valve on the outlet nozzle.
2. Open the vent valve.
3. Start the pump.
4. DANGER **Risk of burns due to steam hammering**
   Start with the cold circuit first.
5. DANGER **Danger of death due to leakage of operating media**
   Slowly open the cold circuit’s inlet valve.
6. DANGER **Danger of death due to leakage of operating media**
   Slowly increase the operating temperature.
7. Allow the air to escape completely from the product.
8. Close the vent valve.
9. Repeat steps 1 to 6 for the second direction of flow.

7. Operation

7.1 Safety notices

EN

DANGER

Danger of death due to leakage of operating media

Operating media may escape if the product is damaged. Hazardous substances or fluids that are harmful to health leaking can cause life-threatening injury. Other operating media leaking can cause serious injury.

- ▶ Observe the safety data sheets for operating media.
- ▶ Comply with the limit values (▸Sec. 3.3 "Name plate").
- ▶ Avoid pressure surges and cavitation impacts by means of appropriate process control.
- ▶ Wear personal protective equipment.

NOTICE

Cold leakage due to operation at ambient temperatures that are too low

Gaskets may be damaged if the product is operated at an ambient or medium temperature that is too low. Damaged gaskets can lead to temporary cold leaks.

- ▶ Comply with the limit values (▸Sec. 12 "Technical data").
- ▶ Bring the operating medium and both of the product's circuits to operating temperature at low pressure.
- ▶ Slowly increase the operating temperature.

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 high chloride ion content in the media as this can cause corrosion (see ▸Sec. 12 "Technical data").

7.2 General specifications

Inspection during operation

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

- Open the valves slowly.
- Observe the max. pressure limits on the name plate.
- Observe the max. temperature limits on the name plate.
- Avoid flow velocities that are too low, as lower turbulence increases the tendency to fouling.
- Always operate the media with the maximum possible volume flow (according to the device specification).
- Regularly monitor and record pressure drops, temperatures, flow rates and load changes.
- Avoid sudden evaporation and condensation.
- Avoid pressure surges, liquid hammering and cavitation.
- Avoid ice formation by using suitable antifreeze agents at operating temperatures below 5°C and/or evaporation temperatures below 1°C.
- Media with antifreeze agents must also be indicated in the specification sheet, as the subsequent use of antifreeze agents leads to reduced performance of the plate heat exchanger (see ▸Sec. 2.1 "Intended use").

Restrictions for media

- The compatibility between the medium and the container or gasket material is the owner's responsibility (see ▸Sec. 2.2 "The owner's obligations").
- Only operate the product with media that it was designed for (see the specification sheet from the quotation stage)

▶ Observe the order-related specifications.

7.3 What to do in hazardous situations

If an immediate hazardous situation arises during normal operation due to an unforeseen increase in pressure, reaction sequence or a dangerous external influence, for example:

1. Take the necessary countermeasures immediately (▸Sec. 2.7 "Shutdown in an emergency").
2. Shut down the system immediately if necessary (▸Sec. 8 "Shutdown").

7.4 What to do in case of malfunctions

A malfunction exists if one of the following conditions is met:

- The permitted pressure is exceeded by more than 10%.
- The operating temperature significantly falls short of or exceeds the permitted operating temperature according to the name plate.

1. Carry out a special check in case of a malfunction.
2. If damage to the product is detected: Shut down the product immediately (▸Sec. 8 "Shutdown").

8. Shutdown

EN

DANGER

Danger of death due to leakage of operating media

Operating media may escape if the product is damaged. Hazardous substances or fluids that are harmful to health leaking can cause life-threatening injury. Other operating media leaking can cause serious injury. Cold leaks can lead to injury at very low ambient temperatures.

- ▶ Observe the safety data sheets for operating materials.
- ▶ Wear personal protective equipment.
- ▶ Shut down the product exactly as described below.

NOTICE

Damage due to corrosion

The HE plates may corrode if the operating medium remains in the product during standstill for a long period of time.

- ▶ Shut down the product exactly as described below.

Short-term shutdown

1. Ensure that flow media cannot escape during standstill.
2. Slowly close the inlet valve of the direction of flow with the higher pressure.
3. Slowly close the inlet valve of the other direction of flow.
4. Switch off the pumps.
5. Close the valves of the outlet pipework if necessary.
6. Put the product into temporary storage if necessary (▸Sec. 4.1 "Storing the product").

Long-term decommissioning

1. Ensure that flow media cannot escape during standstill.
2. Slowly close the inlet valve of the direction of flow with the higher pressure.
3. Slowly close the inlet valve of the other direction of flow.
4. Switch off the pumps.
5. Close the valves of the outlet pipework if necessary.
6. Aerate the product and empty the flow chambers completely.
7. Rinse the product and allow it to dry completely.
8. Seal the pipe connections with dummy plugs.
9. Declamp the plate pack: Add 10% to the last clamping dimension.
10. Store the product so that it is protected (▸Sec. 4.1 "Storing the product").

9. Maintenance and repair

9.1 Maintenance schedule

Daily

Task	Personnel	Description	Time required
Check for leaks	Specialists	Perform a visual inspection for leaks	Approx. 30 minutes
Check the operating data	Specialists	Document the output, pressure, flow volume and temperature of the cooling and operating medium	Approx. 30 minutes

Annually / as needed

Task	Conditions	Personnel	Description	Time required
Lubrication	Threaded bolt	Auxiliary personnel	▸Sec. 9.4.9.2 "Threaded bolt"	Approx. 30 minutes
	Bearing of the idler on the movable plate and spacers	Auxiliary personnel	▸Sec. 9.4.9.3 "Idler bearing on the movable plate"	Approx. 30 minutes
	Carrier profiles and top and bottom guide rails	Auxiliary personnel	▸Sec. 9.4.9.4 "Carrier profiles and guide rails"	Approx. 30 minutes
Cleaning	Frame	Auxiliary personnel	▸Sec. 9.4.9.1 "Frame plates"	Approx. 30 minutes
	Threaded bolt	Auxiliary personnel	▸Sec. 9.4.9.2 "Threaded bolt"	Approx. 30 minutes
	Idler bearing	Auxiliary personnel	▸Sec. 9.4.9.3 "Idler bearing on the movable plate"	Approx. 30 minutes
	Upper carrier	Auxiliary personnel	▸Sec. 9.4.9.4 "Carrier profiles and guide rails"	Approx. 30 minutes
Repaint the frame	Only where steel frames are coated with synthetic resin paint: In case of damage to the paintwork	Auxiliary personnel	▸Sec. 9.4.9.1 "Frame plates"	A few hours

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Task	Conditions	Personnel	Description	Time required
Reclamp the plates	If leaks occur	Specialists	▸Sec. 9.3 "Clamping and declamping the product"	A few hours
Replace the gaskets	■ If leaks occur and clamping would fall below the clamping dimension 'PP min' due to reclamping ■ If damage or wear has been detected on the gaskets	Specialists	▸Sec. 9.4.5 "Replacing gaskets"	A few hours to several days.
Clean the HE plates	As required	External specialist company	▸Sec. 9.4.3 "Cleaning the plates manually"	Several days

9.2 Inspection

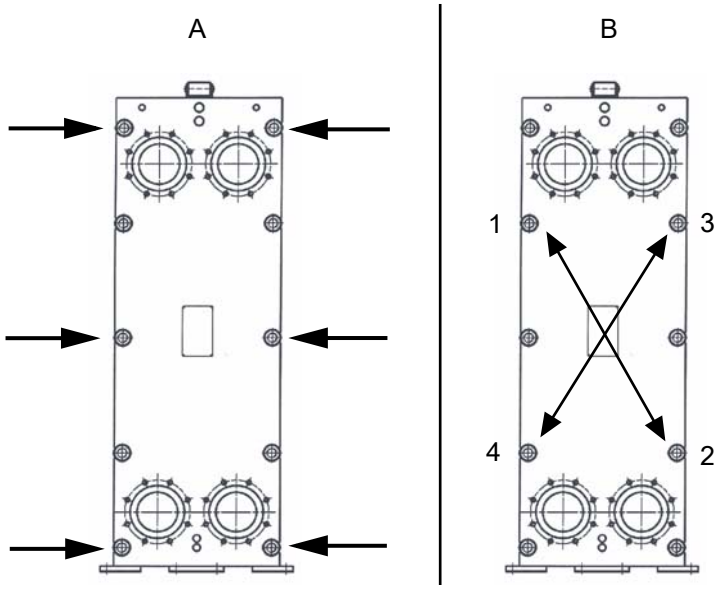
9.2.1 Tightness

▶ Check the product regularly for leaks.

9.2.2 Operating data

▶ Regularly record and analyse the operating data.

9.3 Clamping and declamping the product



Clamping the product

✓ The product is completely empty.

✓ The product is depressurised.

1. Tighten the nuts on threaded bolts 1 – 4 evenly and plane parallel. Alternately tighten the nuts of bolts 1 – 2 and 3 – 4 diagonally.
2. Comply with the limit values of the clamping dimension ‘PP’ (▸Sec. 3.3 "Name plate").
   NOTICE **Damage due to incorrect clamping dimension**
   - During clamping, the movable plate must not be inclined by more than 10 mm across the width (1 – 3 / 4 – 2) or by more than 20 mm across the diagonal (1 – 2 / 3 – 4). The difference between the individual nuts must not exceed 2 mm when the final clamping dimension ‘PP’ is reached.
3. Tighten the remaining threaded bolts.

Declamp the product

✓ The product is completely empty.

✓ The product is depressurised.

1. Loosen the nuts on threaded bolts 1 – 4 evenly and plane parallel. Alternately loosen the nuts of bolts 1 – 2 and 3 – 4 diagonally.
2. Comply with the limit values of the clamping dimension ‘PP’ (▸Sec. 3.3 "Name plate").
   NOTICE **Damage due to incorrect clamping dimension**
   - During clamping, the movable plate must not be inclined by more than 10 mm across the width (1 – 3 / 4 – 2) or by more than 20 mm across the diagonal (1 – 2 / 3 – 4). The difference between the individual nuts must not exceed 2 mm when the final clamping dimension ‘PP’ is reached.
3. Loosen the remaining threaded bolts.

EN

9.4 Corrective maintenance

Safety notices

DANGER

Danger of death due to leakage of operating media

Operating media may escape if the product is damaged. Hazardous substances or fluids that are harmful to health leaking can cause life-threatening injury. Other operating media leaking can cause serious injury. Cold leaks can lead to injury at very low ambient temperatures.

- ▶ Observe the safety data sheets for operating materials.
- ▶ Wear personal protective equipment.
- ▶ Start up the product exactly as described below.

WARNING

Risk of injury due to loose movable plate or loose HE plates

As soon as the movable plate or the HE plates are loosened, they can slip or topple out of the product and cause serious injury.

- ▶ Bring in a second person to secure all of the plates to stop them from slipping unexpectedly.
- ▶ Only remove plates one at a time.
- ▶ Never loosen the clamping screws on the fixed plate.
- ▶ Only carry out maintenance work on plates in a horizontal position.
- ▶ Wear personal protective equipment.

CAUTION

Risk of injury due to threaded bolts falling out of horizontal products

Threaded bolts can fall out and cause injury when opening horizontal products.

- ▶ Ensure that threaded bolts cannot fall out when opening the product.
- ▶ Wear personal protective equipment.

9.4.1 Opening the product

Prerequisites

Carry out all of the relevant troubleshooting steps before opening the product (▸Sec. 10 "Troubleshooting").

The product must be opened in the following cases:

- To remove the HE plates
- To replace gaskets
- In case of increased pressure loss
- In case of temperature fluctuations
- In case of leaks

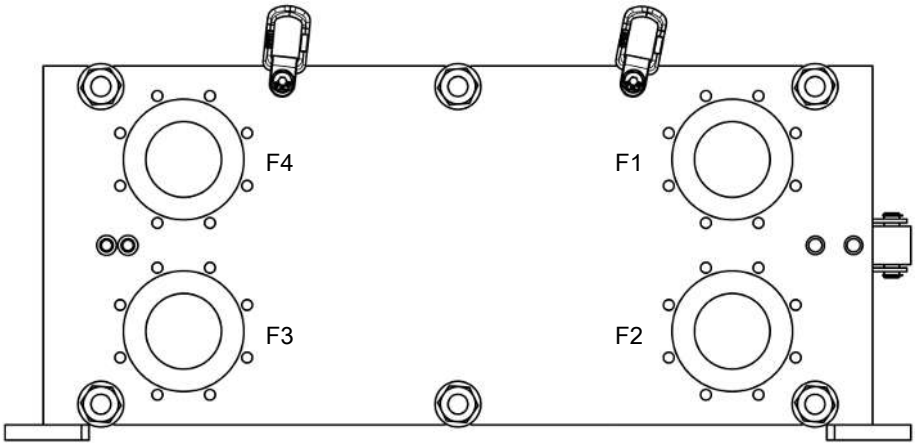
Preparation

1. Shut down the product (▸Sec. 8 "Shutdown").
2. DANGER **Danger of death in case of leakage of operating media**
   Slowly close the inlet valve of the side with the higher pressure.
3. Slowly close the inlet valve of the side with the lower pressure.
4. Switch off the pumps.
5. Release pressure from the product to the ambient pressure.
6. WARNING **Burns due to hot surfaces**
   Allow the product to cool down to ambient temperature.

7. Close the valves of the outlet pipework.
8. Aerate the product.
9. Empty the product. Safely collect the contents of the product.
   NOTICE Observe additional information for horizontal devices (see the section entitled ‘Emptying a horizontal product’ below).
10. In case of reusable product variants: Dismantle the supply lines on the movable plate and, if necessary, on the spacers.
11. Remove the insulation or splash guard, if present.
12. Clean and lubricate the threaded bolts (▸Sec. 9.4.9.2 "Threaded bolt").
13. Clean the outside of the idler, upper carrier and lower plate guide and plate pack. Lubricate the idler if necessary.
14. Note the current clamping dimension ‘PP’ (see the graphic under ▸Sec. 5.4 "Connecting the product").

Emptying a horizontal product

In case of horizontal devices, the media side on the top cannot be drained by means of the pipework.

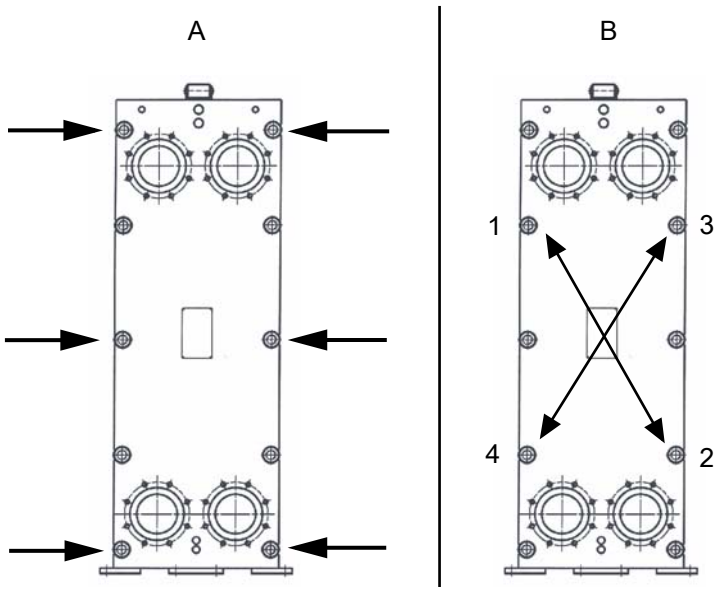


Drain valve	Sequence
Optional drain valve on F1 / F2 / F3 / F4	1. Open drain valve F2 / F3. 2. Carry out steps 5 and 6 below. 3. Open drain valve F1 / F4 4. Carry out steps 5 and 6 below. 5. Open the plate pack.
Optional drain valve on F2 / F3	1. Open drain valve F2 / F3. 2. Carry out steps 5 and 6 below. 3. Open the plate pack.
Not including the drain valve	1. Open the plate pack.

Tab. 2: Emptying sequence

1. Refer to the name plate to find out the product’s volume.
2. Determine the volume of the pipework.
3. Install a collection container that corresponds to the determined volume under the product.
4. Open the valve or plate pack very slowly according to the drainage sequence (▸Tab. 2, p. 37).
   ⇨ The first drops flow out.
5. Carefully open the valve further until the liquid emerges as a small gush.
6. Allow the liquid to drain slowly.

Procedure



1. Remove the threaded bolts marked in Fig. A in any order.
2. CAUTION **Risk of injury due to threaded bolts falling out**
   In case of horizontal products: Secure the threaded bolts against falling out.
3. WARNING **Risk of injury due to loose HE plates**
   Bring in a second person to secure the HE plates against toppling over or slipping.
4. Loosen the threaded bolts marked in Fig. B diagonally in alternating pairs: 1 – 2, 3 – 4.
   The incline of the movable plate must not exceed 10 mm across the width (1 – 3 / 4 – 2) and diagonal (1 – 2 / 3 – 4).
5. Ensure that all of the threaded bolts have been removed.
6. Slide the movable plate up to the support.
7. WARNING **Risk of injury due to loose movable plate**
   Secure the movable plate against slipping.
   ⇨ The product is open.

9.4.2 Removing and storing plates

⚠ WARNING

Risk of injury due to stacks of plates toppling over

Stacks of plates can topple over and cause injury.

▶ Observe the following storage specifications.

NOTICE

Damage to HE plates due to incorrect storage

Incorrect storage can cause damage to the HE plates and leaks.

▶ Observe the following storage specifications.

✓ The product is open.

1. Document the sequence and direction of the HE plates.
2. WARNING **Risk of injury due to loose HE plates**
   Bring in a second person to secure the HE plates against toppling over or slipping.
3. Swivel the individual HE plate in the direction of the movable plate from below.
   ⇨ The HE plate comes free from the lower guide rod.
4. Swivel the HE plate to the side.

5. Remove the HE plate.
6. Store the HE plates on a clean, level surface.
   NOTICE **Damage due to incorrect storage**
7. WARNING **Risk of injury due to stacks of plates toppling over**
   Store a maximum of 60 HE plates in one stack.

9.4.3 Cleaning the plates manually

NOTICE

Damage due to unsuitable cleaning tools

Damage and corrosion caused by hard cleaning tools, e.g. metal brushes. Damaged gaskets can cause leaks.

▶ Manually clean the product exactly as described below.

1. Open the product (▸Sec. 9.4.1 "Opening the product").
2. Do not use abrasive cleaning agents or abrasives.
3. Rinse the HE plates with a high-pressure cleaner.
4. Remove dirt with a soft brush.
5. Ensure that no particles get under the gaskets.
6. Use a high-pressure cleaner to remove highly adhesive deposits.
   - Maintain a sufficient distance between the high-pressure cleaner and the plate.
   - Do not point the high-pressure cleaner at the gaskets.

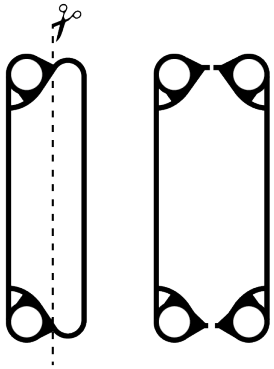
9.4.4 Dry cleaning plates

▶ Only have plates dry cleaned by a specialist company.

9.4.5 Replacing gaskets

Gaskets on the initial plate

The first HE plate after the fixed plate and/or after an intermediate frame must be fitted with a complete gasket. This initial gasket is made by cutting and putting together two standard gaskets.



1. WARNING **Risk of injury due to loose HE plates**
   Place the HE plate on the work surface.
2. Note the cut of the old gasket.
3. Remove the old gaskets.
4. Clean the gasket groove thoroughly.
   The gasket groove must be dry, clean and free of grease.
5. Cut two gaskets in half lengthwise.
6. Cut off all of the fastening nipples or straps.
7. Remove the spacer bars on one of the two sealing frames and the inner fastening nipples or straps on the eye gaskets.
8. Join both gaskets together to form an initial gasket.
9. Glue the initial gasket into the HE plate (▸Bottom, Section "Glued gaskets and initial gaskets").

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Gaskets with knobs

1. WARNING **Risk of injury due to loose HE plates**
   Place the HE plate on the work surface.
2. Remove the old gasket.
3. Clean the gasket groove thoroughly.
   The gasket groove must be free of grease, dry and clean.
4. Insert the new gasket into the gasket groove.
5. DANGER **Danger of death due to leakage of operating media**
   Ensure that only gaskets of the same type are used.
6. Snap the knobs of the new gasket into the corresponding recesses on the HE plate.
7. Ensure that the new gasket is correctly and firmly seated in the gasket groove.

Gaskets with clip-ons and knobs (clip+push gaskets)

Clip-on gaskets have sealing tongues in addition to knobs.

1. WARNING **Risk of injury due to loose HE plates**
   Place the HE plate on the work surface.
2. Remove the old gasket.
3. Clean the gasket groove thoroughly.
   The gasket groove must be dry, clean and free of grease.
4. Clean the gasket groove thoroughly.
   The gasket groove must be dry, clean and free of grease.
5. Insert the new gasket into the gasket groove.
6. DANGER **Danger of death due to leakage of operating media**
   Ensure that only gaskets of the same type are used.
7. Place the sealing tongues over the edge of the plate at the points provided.
8. Snap the knobs of the gasket into the corresponding recesses on the HE plate.
9. Ensure that the gasket is correctly and firmly seated in the gasket groove.

Glued gaskets and initial gaskets

Required tools:

- Hot air gun
- Short-cut brush
- Lint-free cloth
- Blunt wooden or plastic object
- Additional HE plate without a gasket
- Flat steel plate

Remove the old gaskets:

1. WARNING **Risk of injury due to loose HE plates**
   Place the HE plate on the work surface.
2. Heat the back of the gasket groove to approx. 150°C using hot air.
   NOTICE **Comply with the limit values! The plates must not overheat! No annealing colours may form!**
   ⇨ The adhesive becomes soft.
3. Pull the gasket out of the gasket groove.
4. Remove adhesive residues with a blunt wooden or plastic object.
   NOTICE **Do not scratch the surface of the plate**
5. Clean the gasket groove thoroughly.
   The gasket groove must be dry, clean and free of grease.

Glue in the new gaskets:

1. Prepare the adhesive according to the manufacturer's instructions.
2. Apply the adhesive into the gasket groove as an approx. 1 mm-thick strand.
3. Spread the strand of adhesive evenly in the groove using a short-cut brush.
4. Place the gasket in the groove and press it in by hand.

Putting plates into temporary storage:

1. Stack the ready-coated plates on a flat surface.
2. WARNING **Risk of injury due to stacks of plates toppling over**
   Observe the specifications for storage of HE plates.
3. Cover stacked plates with a gasket-less HE plate.
4. Weigh down the stack with a flat steel plate.
5. Allow the adhesive to harden. Observe the manufacturer's instructions.
6. Remove any excess adhesive that has been pressed out of the gasket groove with a blunt wooden or plastic object.

Plates with mixed gaskets

▶ Order mixed gaskets from FUNKE.

Fig. 1: Apply adhesive to the gasket groove

Fig. 2: Press in the gasket

9.4.6 Inserting plates

NOTICE

Leaks due to old HE plates or old gaskets

The product may leak if old HE plates or old gaskets are only partially replaced.

▶ Always replace all of the HE plates and gaskets.

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✓ Threaded bolts are greased.

1. Check all of the plates and gaskets for contamination.
   NOTICE **Damage caused by the smallest foreign bodies on the gaskets**
2. Ensure that the sealing rings and moulded rubber parts in the connections are clean.
3. Clean and lightly grease the upper guide rail.
4. Insert the start plate with the gasket facing the fixed plate.
5. Fit the remaining cleaned plates in exactly the same order that they were removed in.
   Carry out the steps from ▸Sec. 9.4.2 "Removing and storing plates" in reverse order.
6. Ensure that the plates are inserted correctly.
   The plates are inserted correctly if the plate pack has a continuous honeycomb pattern on the outside.
7. Close the product (▸Sec. 9.4.7 "Closing the product").

Fig. 3: Insert the HE plates; starting plate first

Fig. 4: Insert the plates

Fig. 5: Honeycomb pattern

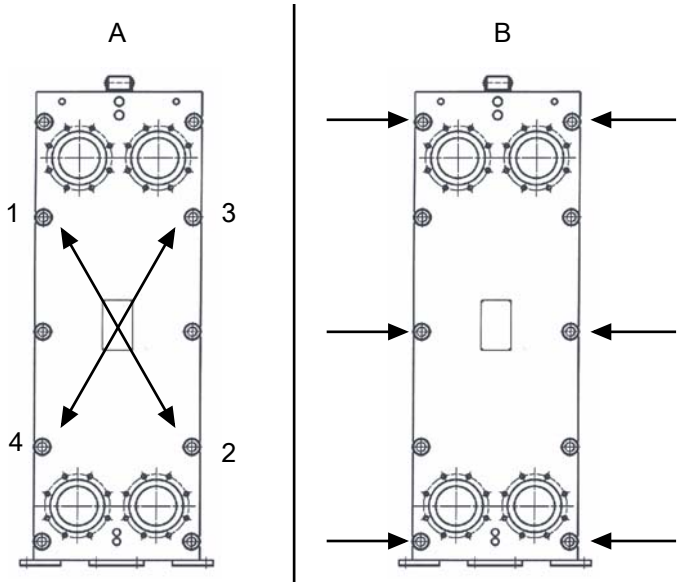
9.4.7 Closing the product

Specifications

- The incline of the movable plate must not exceed 10 mm across the width (1 – 3 / 4 – 2).
- The incline of the movable plate must not exceed 20 mm across the diagonal (1 – 2 / 3 – 4).
- The difference between the individual nuts must not exceed 2 mm at the final clamping dimension ‘PP’.
- Observe clamping dimensions according to Table 3 (▸Sec. 3.1 "Function and design", ▸Sec. 3.3 "Name plate").

Condition	Clamping dimension ‘PP’
All of the gaskets on the HE plates have been replaced	Clamping dimension ‘PP max’ according to the name plate on the product
HE plates were cleaned; gaskets were not replaced	Clamping dimension ‘PP’ before dismantling
When the number of HE plates is changed	Clamping dimension ‘PP max’ according to new documentation and new name plate on the product

Tab. 3: Clamping dimensions



Procedure

✓ Plates are inserted into the product in the correct order (▸Sec. 9.4.6 "Inserting plates").

1. Clean the lower plate guide.
2. Clean the surfaces between the clamping nuts and pressure discs or pressure pieces and lubricate if necessary.
3. Push the movable plate slowly and evenly against the plate pack.
4. Mount threaded bolts 1, 2, 3, 4 at the side or insert them axially.
   The lock nuts/knurled nuts on the side of the hard drive must fit tightly.
5. CAUTION **Risk of injury due to threaded bolts falling out**
   In case of horizontal products: Secure the threaded bolts against falling out.
6. Tighten the nuts on threaded bolts 1, 2, 3 and 4 evenly and plane parallel.
7. Alternately tighten the nuts of bolts 1 – 4 and 2 – 3 diagonally until the specified clamping dimension is reached.
8. Continuously check the clamping dimension ‘PP’.
9. Continuously check the incline of the movable plate.
10. Mount or push in the remaining threaded bolts, then tighten them.
11. Tighten the plate pack to the final clamping dimension ‘PP’.

    If the value exceeds or falls below ‘PP max’:
    - Check the correct number of plates according to the plate placement plan.
    - Check that the clamping nuts move freely.

9.4.8 Checking the product for leaks

General specifications

DANGER

Danger of death due to leakage of operating media

Operating media may escape if the product is damaged. Hazardous substances or fluids that are harmful to health leaking can cause life-threatening injury. Other operating media leaking can cause serious injury.

▶ Wear personal protective equipment.

▶ Carry out the leak test exactly as described below.

- If leaks occur: Carry out troubleshooting (▸Sec. 10 "Troubleshooting").

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Preliminary check

1. Ensure that the product is closed.
2. Ensure that the product is assembled correctly.
3. Ensure that there are no residues from previous processes in the product.
4. Ensure that the inlet valve between the pump and the product is closed.
5. Ensure that the product is earthed.

Procedure

Carry out the following steps one after the other – first for the hot circuit, and then for the cold circuit.

1. Connect the product to the pipework.
2. Fully open the valve on the outlet nozzle (if present).
3. Open the vent valve.
4. Start the pump.
5. Open the inlet valve slowly.
6. DANGER **Danger of death due to leakage of operating media**
   Avoid pressure surges and cavitation impacts.
   ⇨ The hot circuit is filled with operating medium. The cold circuit remains empty.
7. Vent the product completely.
8. Close the vent valves.
9. WARNING **Risk of injury due to leaks**
   Never carry out a leak test at test pressure; see the name plate.
10. Increase the pressure until the max. operating pressure is reached.
    Max. operating pressure: See name plate.
11. Monitor the max. operating pressure.
12. Maintain the pressure for min. 10 minutes, max. 30 minutes.
13. If the pressure drops slightly:
    - Vent the product again.
    - Increase the pressure back to the max. operating pressure.
      If the pressure continues to drop slightly, this is due to compression of the remaining gases / air in the plate pack. The product is leakproof.
14. Continue to monitor the pressure.
    ⇨ The leak test is passed if the following conditions are met:
    - The pressure remains constant for 30 minutes.
    - No medium escapes to the outside or from the connection on the other side.
15. Depressurise the product.
16. Close the inlet valve slowly.
17. Switch off the pump.
18. Close the valves of the outlet pipework.

9.4.9 Maintaining the frame

All of the moving parts must be clean so that the product can be opened smoothly (▸Sec. 9.1 "Maintenance schedule").

9.4.9.1 Frame plates

Steel

Steel frame plates are coated with cold-curing synthetic resin paint.

1. Clean the frame plates with a weak alkaline cleaning solution.
   Use a sponge, cloth or soft brush to apply the cleaning solution.
2. Touch up paint damage if necessary.

Made of or clad in stainless steel

1. Clean the frame plates with a sponge, cloth or soft brush and a weak alkaline cleaning solution.
2. Allow the frame plates to dry.
3. Rub the frame plates with acid-free grease.

9.4.9.2 Threaded bolt

1. Remove coarse dirt and corrosion with a brush.
2. Rub the threaded bolt with a grease that is suitable for the material.

9.4.9.3 Idler bearing on the movable plate

1. Remove coarse dirt with a soft brush.
2. Lubricate the bearings.

9.4.9.4 Carrier profiles and guide rails

✓ The product is open.

▶ Clean the carrier profiles with a soft brush.

10. Troubleshooting

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DANGER

Danger of death due to leakage of operating media

Operating media may escape if the product is damaged. Hazardous substances or fluids that are harmful to health leaking can cause life-threatening injury. Other operating media leaking can cause serious injury. Cold leaks can lead to injury at very low ambient temperatures.

- ▶ Observe the safety data sheets for operating materials.
- ▶ Wear personal protective equipment.
- ▶ Start up the product exactly as described below.

NOTICE

Damage due to incorrect repair work

Insufficient knowledge when working on the FUNKE plate heat exchanger can lead to consequential damage.

- ▶ Contact FUNKE before carrying out repair work on the plate heat exchanger.

Fault	Potential causes	Remedy
Leak in the leakage gap (for products with a safety design)	▪ Plate breakage	▶ Replace the double plate.
Leak between connection and frame plate	▪ Stresses / forces acting on the connection ▪ Defective sealing ring, moulded rubber part or flange screw connection ▪ Age-related or operational material fatigue	1. Check the flange connection. 2. If necessary, tighten loosened screws evenly. 3. Check the pipework system for stresses and forces acting on connections. 4. Loosen defective connections. 5. Check the gaskets; clean or replace them if necessary (▸Sec. 9.4.5 "Replacing gaskets").
Leakage between the plate pack and the fixed plate or movable plate	▪ Defective sealing rings or moulded rubber parts on the inside of the fixed or movable plate. ▪ Defective gasket or incorrect first plate position ▪ Age-related or operational material fatigue	1. Mark the leakage point. 2. Open the product (▸Sec. 9.4.1 "Opening the product"). 3. Check that the first plate gasket is properly positioned on the frame plate and correct it. Clean or replace the gasket if necessary. 4. Check moulded rubber parts or sealing rings on the fixed or movable plate for damage and replace if necessary.

Fault	Potential causes	Remedy
Leak between the HE plates to the outside	■ Permitted operating pressure or permitted temperature exceeded. ■ Movable plate is not clamped flat / parallel ■ The clamping dimension ‘PP’ is not correct. ■ Incorrectly seated or damaged gaskets ■ Age-related or operational material fatigue	1. Regulate operating pressure or temperature to permitted values. 2. Clamp the movable plate plane parallel. 3. Set the clamping dimension ‘PP’ correctly or reduce it gradually in the direction of ‘PP min’. Clamping dimension ‘PP’ between the individual clamping screws must not differ by more than 2 mm! 4. Open the product (▸Sec. 9.4.1 "Opening the product"). Check that the gaskets are seated correctly; clean the gaskets if necessary or replace damaged gaskets. 5. Close the product (▸Sec. 9.4.7 "Closing the product").

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Fault	Potential causes	Remedy
Internal leak / media mixing	■ Pitting corrosion or hairline cracks ■ Blocked external leak; opening of the plate gasket in the inlet area ■ Double defect on the double gasket in the inlet area of a plate (extremely rare)	1. Open the product (▸Sec. 9.4.1 "Opening the product"). 2. Empty a flow chamber. 3. Dismantle the connection pipework for the shut-down flow chamber. 4. Put the connected flow chamber under low pressure (▸Sec. 9.4.8 "Checking the product for leaks"). ⇨ The water enters the open flow chamber through the leak and flows out of the open pipe socket. 5. Use a spotlight or a powerful torch to determine which plate gap is affected. 6. Check the gasket and the entire surface of the affected plate, clean, replace the gasket or plate if necessary (▸Sec. 9.4.5 "Replacing gaskets"). 7. Close the product (▸Sec. 9.4.7 "Closing the product").
Sharp drop in device performance (sharp increase in pressure loss or drop in heat output).	■ Fault in the overall system (deviating media quality, changed inlet temperature, deviating volume flow). ■ Foreign bodies or heavy deposits in the connection lines.	1. Check for faults in the overall system. 2. Shut down and clean the product (▸Sec. 9.4.3 "Cleaning the plates manually").
Clamping dimension ‘PP min’ reached	■ Age-related or operational material fatigue; wear limit reached.	Completely reseal the product (▸Sec. 9.4.5 "Replacing gaskets"). Do not tighten the product below the clamping dimension ‘PP min’.

11. 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.

12. Technical data

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General information

	Specification
Clamping dimension ‘PP min’ – ‘PP max’	See the name plate on the product
Connection position	See the name plate on the product
Max. air 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. load change[1)]	Where ΔP = PS[2)]	1000
	Where ΔP = PS/10	Can be defined by the user

[1)] These limit values only apply to designs according to AD2000 S1, (1.4). Please note that other load changes may be permitted for deviating design codes (see the specification sheet). The PHE must be operated in such a way that no fatigue stress occurs.

[2)] PS = Max. operating pressure

Storage

	Specification
Ambient temperature	0 °C … 50 °C

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**

Water component	Unit	EN 1.4301 (AISI 304)	EN 1.4404 (AISI 316L)
pH value	(-)	6 – 10	6 – 10
Saturation index SI (delta pH value)	(-)	Not specified	Not specified
Oxygen	mg/l	Not specified	Not specified
Total hardness	°dH	6 – 15	6 – 15
Conductivity	µS/cm	Not specified	Not specified
Filterable substances	mg/l	< 30	< 30

Water component	Unit	EN 1.4301 (AISI 304)	EN 1.4404 (AISI 316L)
Chloride (CL)	mg/l	< 150 (≤ 25 °C) < 50 (≤ 60 °C) < 25 (≤ 80 °C) < 5 (≤ 90 °C) No chlorides permitted above 100 °C	< 450 (≤ 20 °C) < 300 (≤ 50 °C) < 100 (≤ 75 °C) < 10 (≤ 90 °C) No chlorides permitted above 100 °C
Free chlorine	mg/l	< 0.5	< 0.5
Hydrogen sulphide (H_2S)	mg/l	Not specified	Not specified
Ammonia (NH_3)	mg/l	Not specified	Not specified
Sulphate (SO_4^{2-})	mg/l	< 400	< 400
Hydrogen carbonate (HCO_3^-)	mg/l	Not specified	Not specified
Hydrogen carbonate / sulphate (HCO_3^- / SO_4^{2-})	mg/l	Not specified	Not specified
Sulphide (SO_3^{2-})	mg/l	< 7.0	< 7.0
Nitrate (NO_3)	mg/l	Not specified	Not specified
Nitrite	mg/l	Not specified	Not specified
Iron, dissolved	mg/l	Not specified	Not specified
Manganese (Mn)	mg/l	Not specified	Not specified
Free, aggressive carbonic acid	mg/l	Not specified	Not specified
Filterable substances	mg/l	< 30	< 30

Tab. 4: Water quality requirements for plate materials 1.4301 and 1.4404

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FUNKE Wärmeaustauscher Apparatebau GmbH
Zur Dessel 1
31028 Gronau (Leine)
Germany
Tel. +49 51 82 / 582-0
info@funke.de
www.FUNKE.de