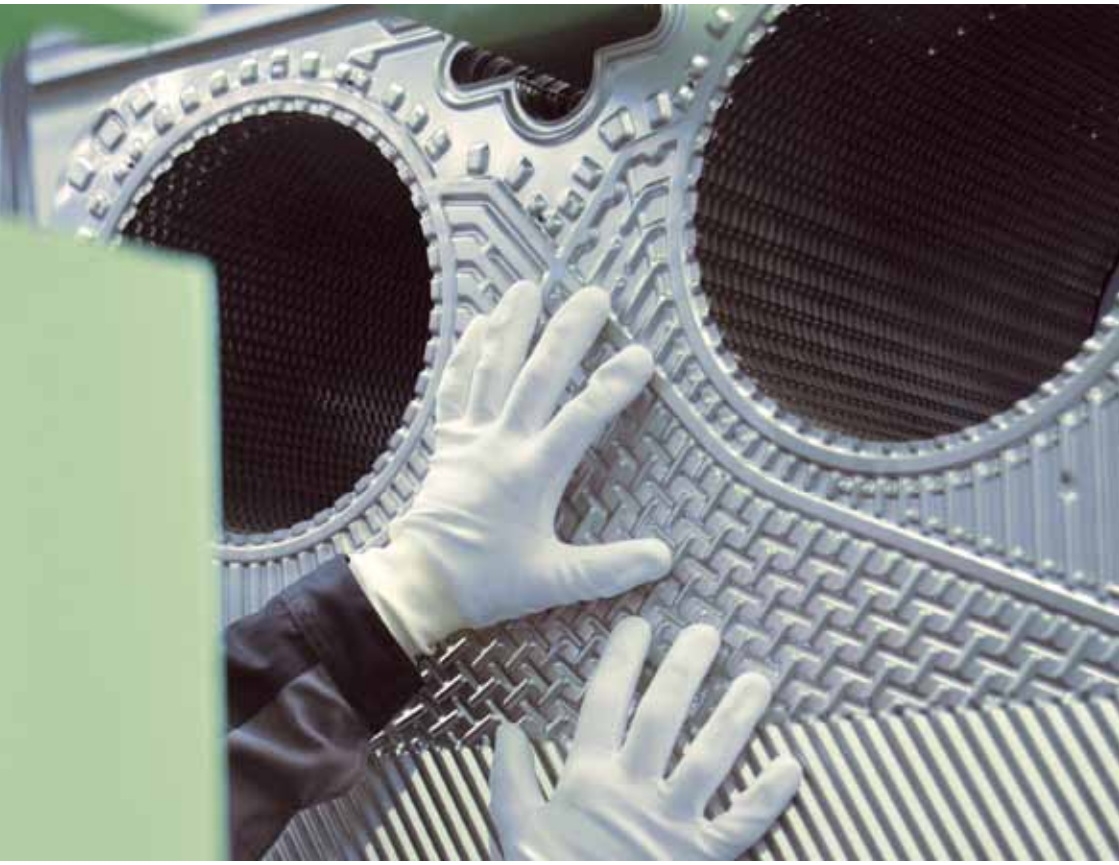


General Operation Manual
Gasketed Plate Heat Exchangers

engineering for a better world

GEA Heat Exchangers

Plate Heat Exchanger

General Operating Instructions

Version: 1.5, 2012-01-03

1 We enjoy working for you

Within the **GEA Heat Exchangers Segment** of the international **GEA Group**, **GEA PHE Systems** is responsible for plate heat exchanger technologies. Strong individual companies: GEA Ecoflex, GEA WTT, GEA PHE Systems Asia Pacific and GEA PHE Systems NA with production locations in Germany, USA and India manufacture gasketed, fully welded and brazed plate heat exchanges for worldwide distribution, covering almost all industrial applications. Our GEA EcoServe service organisation provides quick and competent maintenance and spare parts service throughout the world with customer service centers in many countries.

With GEA PHE Systems you put the technical edge of one of the leading manufacturers of plate heat exchangers (PHE) worldwide to good use

These operating instructions are your personal guide explaining design, function, installation, operation, maintenance, troubleshooting, transport and repairs to you in an easy-to-understand and clear manner. The present operating instructions in particular aim at avoiding possible hazards or damage right from the beginning. This is why all employees working with the PHE should have access to these operating instructions at any time.

If any questions remain unanswered, your GEA PHE Systems Sales Office or the Central Service Dept. will be glad to help you.

Additional technical information is available for specific applications.

Please take note of the rear cover of these operating instructions! You can find the address of your Sales Office there.

Responsible for content:
GEA Ecoflex GmbH
Karl-Schiller-Str. 1-3
D-31157 Sarstedt
Germany

Content

2 About these operating instructions

The present operating instructions contain important information required for safe and proper installation, transport, commissioning, operation, maintenance, dismounting and troubleshooting of your PHE.

➔ Read these operating instructions thoroughly and completely before working with the PHE.

➔ Keep these operating instructions so that they are accessible for all users at any time.

➔ If you pass the PHE on to third parties, please include these operating instructions and all other documents included in the scope of supply.

2.1 Scope of validity of these operating instructions

These operating instructions apply to all gasketed PHE manufactured and delivered by GEA PHE Systems. The designation of your PHE can be found on its rating plate - see chapter “5.2 Identification” (page 16).

Designations of gasketed PHE made by GEA PHE Systems

PHE type	Designation
Concitherm	CT 187 CT 193
Free-flow	FA 159 FA 161 FA 184 FA 192 N 40 NF 350
LWC – Laser-Welded Cassettes	LWC 100 T LWC 100 M LWC 100 X LWC 150 S LWC 150 L LWC 250 S LWC 250 L LWC 350 S LWC 350 M
NH	NH 250 S NH 250 M NH 250 L NH 350 S NH 350 M NH 350 L
NT	NT 50 T NT 50 M NT 50 X NT 100 T NT 100 M NT 100 X NT 150 S NT 150 L NT 250 S NT 250 M NT 250 L NT 350 S NT 350 M NT 350 L NT 500 T NT 500 M NT 500 X
NX	NX 100 X NX 150 X NX 250 L
Safetytherm	VT 10 VT 20 VT 40
VARITHERM	VT 04 VT 10 VT 20 VT 405 VT 40 VT 805 VT 80 VT 1306 VT 130 VT 180 VT 250 VT 2508

2.2 Representation of information

2.2.1 Warnings

In this document, warnings precede requests for action involving a hazard for persons or objects. These warnings are structured as follows:

⚠ SIGNAL WORD

Type of hazard

Consequences

➔ Protective measures

- **Warning symbol** – Points out to mortal danger or danger of injury.
- **Signal word** – Indicates the seriousness of the hazard (see table below).
- **Type of hazard** – Designates the type and source of the hazard.
- **Consequences** – Describes possible consequences when failing to observe the information.
- **Protective measures** – Indicates how the hazard can be avoided. You **must absolutely comply with** these protective measures!

Warning sign, signal word	Meaning acc. to ANSI Z535.6-2006
⚠ DANGER	Identifies a danger which will certainly result in death or serious bodily injury when failing to avoid the danger.
⚠ WARNING	Identifies a danger which can result in death or serious bodily injury when failing to avoid the danger.
⚠ CAUTION	Identifies a danger which can result in slight to medium bodily injury when failing to avoid the danger.
NOTICE	Identifies possible material damage. The PHE or the surroundings may suffer damage when failing to avoid this danger.

2.2.2 Symbols

Symbol	Meaning
	This symbol appears besides paragraphs that provide you with useful or important information for the correct handling of the PHE. This information helps you to avoid problems and makes handling the PHE easier.
➔	Identifies a request for action within a warning. Act accordingly in order to avoid a danger.
➔	Identifies a request for a specific action/step. When such requests follow one another, you do not have to follow a specific order for these actions.
1. **2.**	Identifies a specified order of steps to be taken. Carry out these steps exactly in the order as specified.
✔	Identifies the result of a series of steps taken. This information describes the new condition of the PHE after you have carried out all steps correctly.
➥	Identifies a supplementary information with a direct relation to the previous request for action.
■	Identifies a list.

2.2.3 Abbreviations

Abbreviation	Meaning
PHE	Plate Heat Exchanger
HE plate	Heat exchanger plate

2.2.4 Drawings and figures

The drawings used in these operating instructions are exemplary. Many details are shown in a simplified manner. The actual conditions of an individually manufactured PHE cannot be reflected here. You find binding views and dimensions of the PHE delivered to you in the technical documentation supplied.

3 Important safety information

The PHE has been manufactured in accordance with the state of the art and the recognized safety rules. The PHE can still be the origin of hazards to persons and material assets if you

- fail to observe this chapter,
- fail to observe the warnings in these operating instructions,
- fail to use the PHE in accordance with the intended use.

➔ For this reason, please read this chapter attentively. It contains important information and obligations. It concerns your health and the troublefree operation of the PHE.

3.1 Hazards on the PHE

- The PHE is heavy. Should it tip over or fall down during transport, persons may be killed or seriously injured.
  Transport the PHE to its intended position with the transport packaging if possible. Use sufficiently dimensioned lifting equipment exclusively for handling the PHE at the place of installation. Never stand under suspended loads and keep other persons away.
- Upright PHEs have a high center of gravity and may tip over.
  Put up a PHE delivered in a horizontal position only directly before it is installed. Secure the upright PHE against tipping over by bolting it to the ground. If possible, remove the lifting devices used only after the PHE has been fastened to the ground.
- The use of dangerous flow media (explosive, flammable, caustic, toxic) involves danger of chemical burns, fire burns or intoxication.
  Wear suitable protective clothing when working on the PHE. Ensure that the PHE is depressurized and empty prior to opening.
- When opening the PHE, sharp-edged HE plates may fall out.
  Keep HE plates from falling out by having them secured by another person.

- The flow media may be colder than 0 °C and hotter than +50 °C. This is why PHEs involve the danger of frostbites and burns.
  Protect persons by a protection against accidental contact and install warning signs relating to frostbites and burns.
- A cutting hazard exists on burrs, threads and the HE plates.
  Wear protective equipment at all times when working on the PHE.

3.2 Intended use

The PHE is a component intended for permanent installation in a plant or a machine. It serves for heat transmission from a heat-emitting flow medium to a heat-absorbing flow medium.
We recommend that you put the PHE into operation only after checking if the plant or machine into which the PHE has been integrated meets the applicable national regulations, safety rules and standards.

The PHE is a technical equipment and not intended for private use. It is basically designed for mostly stationary use.

The PHE was designed and built specifically for the operating conditions you have specified. The operating conditions are documented in the technical documentation:

- min./max. allowed pressure
- min./max. allowed temperature
- flow rates
- type and composition of the flow media
- additional loads if allowed

➔ Deviating from these allowed operating conditions will void the warranty and the operating permit. The same applies to unauthorized essential modifications on the PHE.

➔ Please contact your GEA PHE Systems Sales Office for checking such requirements and the modifications which may become necessary.

The intended use also includes:

- observing the present operating instructions and the technical documentation included in the delivery..
- that the plate heat exchanger is in technically flawless condition, i.e. it shows no apparent defects, e.g. loose or missing tensioning bolts, leaks due to defective HE plates and/or frame gaskets.
- compliance with the national and international laws, decrees, regulations, guidelines and other rules in force at the place of installation, e.g. occupational safety and accident prevention regulations, even if those are not mentioned in these operating instructions.

3.3 Personnel qualification

Persons entrusted with setting-up, transportation, installation, commissioning, operation, dismounting or maintenance of the PHE must have the following knowledge:

- Basic mechanical knowledge,
- knowledge of the plant and/or machine into which the PHE is integrated,
- knowledge of the associated technical terms.

To ensure operational safety, such activities may be carried out only by a suitable specialist or by a trained person supervised by a specialist.

A specialist is a person who, in view of his technical training, the knowledge and experience gathered and his knowledge of the relevant regulations, can

- assess the work entrusted to him,
- identify possible hazards and
- take suitable safety precautions.

A specialist must comply with the relevant technical rules, e.g. the accident prevention regulations.

3.4 Obligations of operating company

The operating company is responsible for the safe operation of the PHE.

Ensuring safe operation

As the operating company you must ensure that:

- the PHE is operated only according to the intended use (see chapter 3.2)
- there will be no wear of certain PHE components due to unfavourable ambient conditions.

Unfavourable ambient conditions

Component	Unfavourable ambient conditions
Gasket materials	– Aggressive gases and/or aggressive aerosols in the surrounding air – Effects of UV radiation (e.g. sunlight) – Extreme ambient temperatures
Metal components	– Aggressive gases and/or aggressive aerosols in the surrounding air – Humidity

- all maintenance operations/inspections are carried out at regular intervals. The time intervals have to be fixed as a function of area of use, the flow media, the risk potentials and the regulations applicable for operation.
- that the personnel regularly inspects the PHE for leaks. These must be repaired without delay if required.

Training of personnel

As the operating company, you must regularly train your personnel in these subject-matters:

- Observing and use of the operating instructions and of legal provisions,
- use of the plate heat exchanger in line with the intended use,
- observing the operating instructions in force at the operating company,
- behaviour in an emergency.

3.5 Personnel protective equipment

To protect yourself against injuries, you have to:

- wear solid gloves, protective clothing and safe shoes as well as a hard hat and eye or face protection if required while working on the PHE (especially when using explosive, flammable, caustic or toxic flow media).

3.6 Additional protective equipment

When using hazardous flow media

When using explosive, flammable, caustic or toxic flow media, you have to fit additional protective equipment in order to protect persons against injuries.

- Fit a tray with a sufficient volume beneath the PHE for collecting its entire content. This tray must be made of a material resisting the flow media permanently.
- Fit a splash guard in order to avoid persons and objects being sprayed with flow media in case of a leaky HE plate pack.
- Provide earthing when handling explosive and flammable media.

When using cold flow media

When the temperature of a flow medium is below 0 °C, you must fit the following safety equipment:

- an insulation in order to prevent freezing up of the PHE,
- a protection against accidental contact in order to avoid frostbites of persons,
- warning signs indicating the low temperatures to persons.

When using hot flow media

When the temperature of a flow medium is above +50 °C, you must fit the following safety equipment:

- a protection against accidental contact in order to avoid burns of persons,
- warning signs indicating the high temperatures to persons.

3.7 Warranty

The warranty applies to the delivered PHE version exclusively and will cease to be valid if the PHE if incorrectly installed or not used in line with its intended use.

4 Description of function

Serially arranged profiled HE plates with flow openings form a pack of flow gaps inside the PHE. The flow media flow through every other flow gap involved in heat exchange in different directions.

Single-pass or multi-pass PHE

Single-pass PHEs are normally used. In a single-pass PHE, all incoming and outgoing pipes are connected to the fixed plate, i.e. on the same side.

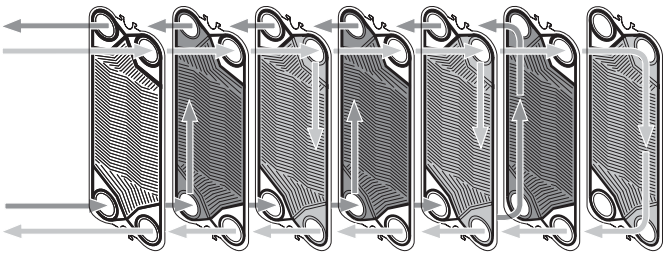


Fig. 4 a – Path of flow media in a single-pass PHE

Small temperature differences between the flow media may call for multi-pass PHE. In this case, the connecting piping is on the fixed and on the loose plate, i.e. on both sides.

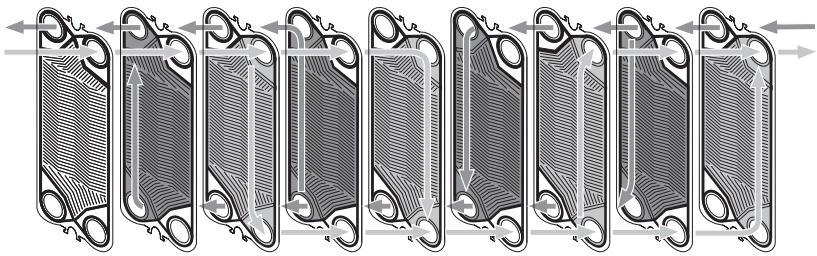


Fig. 4 b – Path of flow media in a multi-pass PHE

5 Overview and description

5.1 Basic structure

The basic structure of a PHE is shown below. The specific design depends on the application.

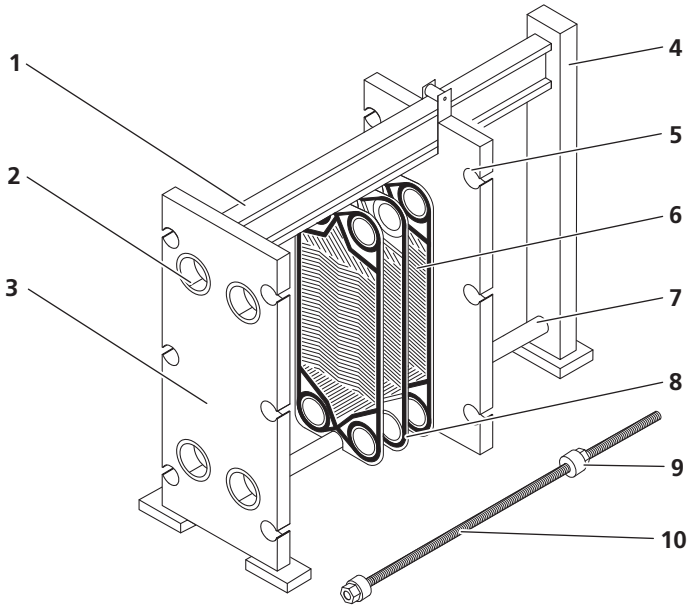


Fig. 5.1 a – Components of a gasketed PHE

No.	Component	No.	Component
1	Top beam	6	HE plates
2	Piping connections	7	Bottom guide beam
3	Fixed plate	8	HE plate gasket
4	Column	9	Hexagon nut on tensioning bolt
5	Loose plate	10	Tensioning bolt

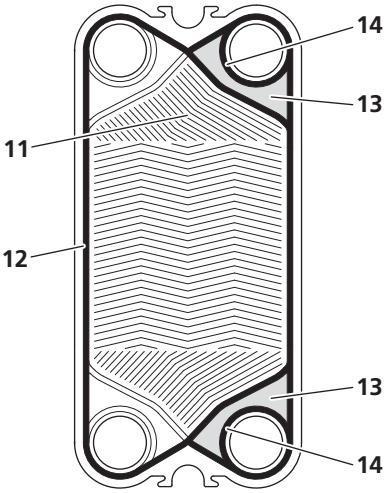


Fig. 5.1 b – Constituents of a HE plate

The HE plate pack consists of individual embossed HE plates with the associated HE plate gaskets.

The HE plate gaskets seal the flow media towards one another and the environment. For further details see chapter “9.2 Leaks” (page 71).

The number and the arrangement of HE plates depends on the requirements specified in the order.

Nr.	Component	Nr.	Component
11	Embossed HE plate profile	**13**	Leakage spaces
12	HE plate gasket	**14**	Round gasket sections

5.2 Identification

Every PHE manufactured by GEA PHE Systems has a rating plate. This plate is fitted on the outside of the PHE fixed plate.
It usually provides information about:

- PHE type
- Serial no.
- Permitted pressure levels
- Permitted temperatures
- Test pressures
- Capacities
- Dry equipment weight
- Year of construction
- Tensioning dimensions a max. and a min.
- Manufacturer

The rating plate also provides additional project-related information.

Execution of rating plates

Example of a rating plate in accordance with ASME and the European Pressure Vessel Directive 97/23/EC:

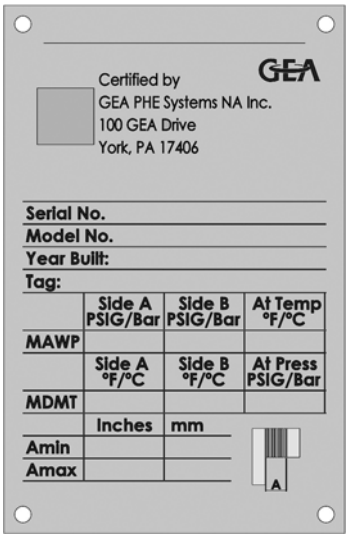


Fig. 5.2 a – Example of a PHE rating plate in the scope of validity of **ASME**

Fig. 5.2 b – Example of a rating plate for PHE subject to **CE** marking regulations

Enclosed documentation

Each PHE is delivered with a dimension sheet and/or an assembly drawing and a circuit diagram.

The **dimension sheet** and/or the assembly drawing include, among others, the outer dimensions as well as type, size and position of the piping connections.

The **circuit diagram** shows the specific arrangement of the HE plates, their type, the material used as well as the material thickness and indicates the gasket material and the part nos.

5.3 Frames

PHE made by GEA PHE Systems are available in various application-specific frame versions. The basic versions are the C and B designs, with the B design being used above all for longer plate packs. Variants of these designs are marked by further abbreviations.

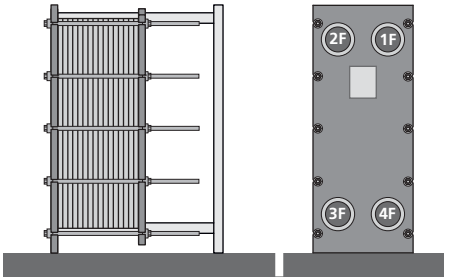


Fig. 5.3 a – C frame with column

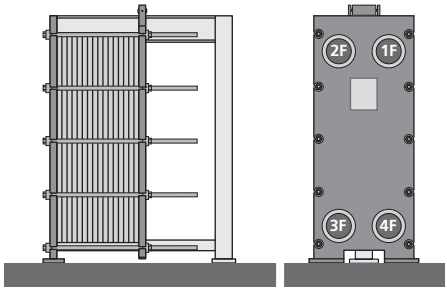


Fig. 5.3 b – PHE with a B frame

Particular execution details

Special stainless steel versions are employed in foodstuff and pharmaceutical applications and may include intermediate plates for separating the individual sections.

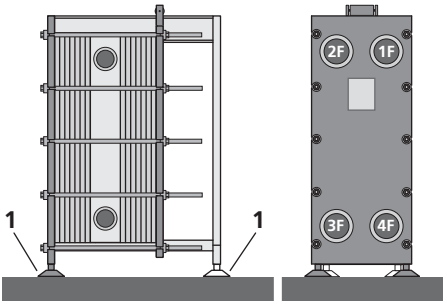


Fig. 5.3 c – Version with bases

Some frames are equipped with height-adjustable bases [**1**].

5.3.1 Fitting the piping

The piping may be connected to the fixed plate, the loose plate and the intermediate plate. Please take the position and type of connections from your dimension sheet, circuit diagram or the assembly drawing.

The piping connections on the fixed plate and on the loose plate are consistently numbered according to the following pattern:

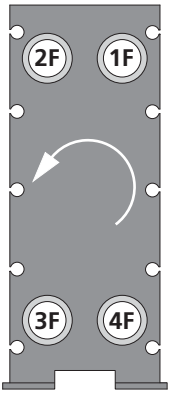


Fig. 5.3.1 a – Fixed plate connections 1F–4F

Fixed plate

When viewing the fixed plate from the outside, the numbering of connections 1F–4F is continuous and anti-clockwise.

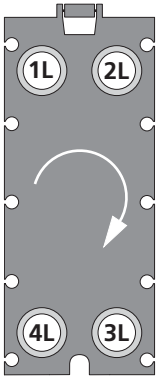
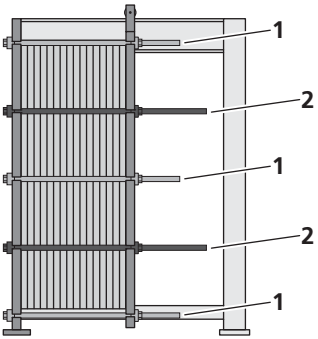


Fig. 5.3.1 b – Loose plate connections 1L–4L

Loose plate

When viewing the loose plate from the outside, the numbering of connections 1L-4L is continuous and clockwise.

5.3.2 Tensioning bolts and pre-tensioning bolts



All PHE frames include at least four tensioning bolts [**1**]. On PHE with more than four tensioning bolts per side, two tensioning bolts per side are usually longer than the others. These are referred to as pre-tensioning bolts [**2**] and serve for pre-tensioning the HE plate pack. See also chapter “8.9.4 Tensioning and testing the HE plate pack” (page 68).

Fig. 5.3.2 – Longer pre-tensioning bolts (from five pairs of tensioning bolts)

5.3.3 Fitting the HE plates in the frame

Depending on the PHE frame type, the HE plates are fitted in the frame in different ways.

C frames

In C frames, the HE plates **stand** on the lower round carrier bar [**2**]. The **upper** round bar [**1**] ensures guiding. See chapter “8.4 Opening the PHE” (page 53).

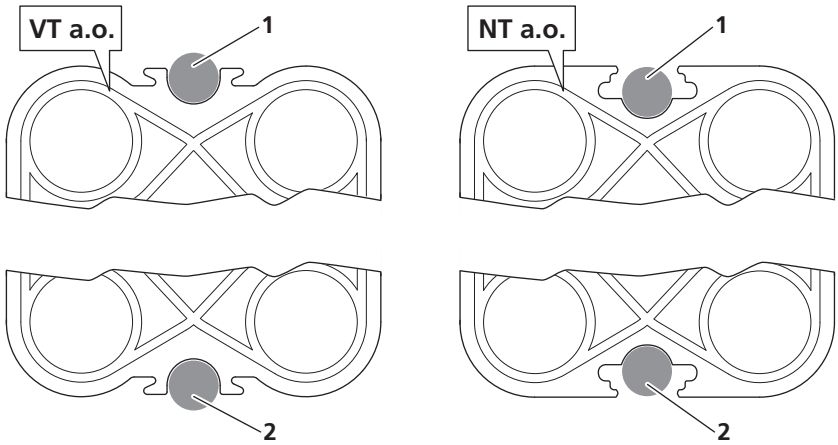
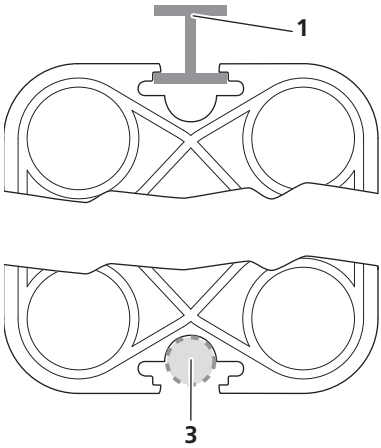


Fig. 5.3.3 a – HE plate for C-frames of VT and NT series

B frames

The HE plates **are suspended** directly from the top beam [**1**] or from a special suspension rail [**2**] fitted below the top beam in B frames. The **bottom** connecting bar [**3**] ensures guiding.

Variant 1

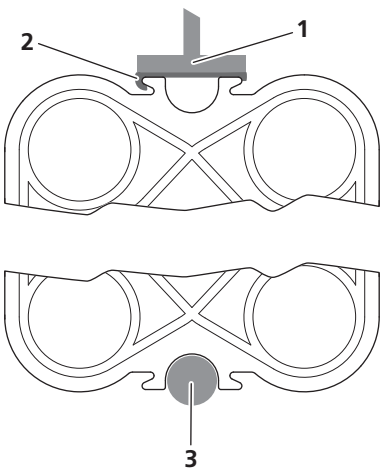


Top beam [**1**] without any additional suspension rail

This variant applies to all PHE not mentioned under variants 2 and 3.

Fig. 5.3.3 b – Variant 1: Top beam (1) without any additional suspension rail

Variant 2



Top beam [**1**] with special suspension rail [**2**]

This variant applies to VT 20, 40, 405, 80 and 805 PHEs and to FA 161 and FA 184 PHEs.

Fig. 5.3.3 c – Variant 2: Top beam (1) with special suspension rail (2)

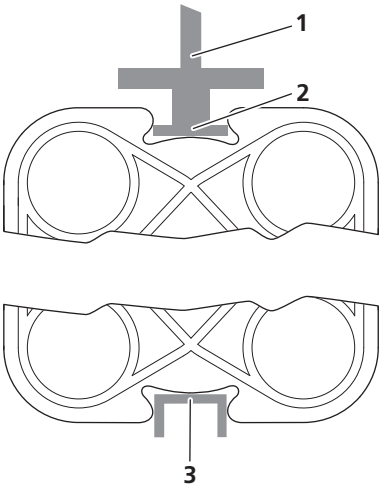
Variant 3		Top beam[**1**] with special suspension rail [**2**] without any additional guide rail This variant applies to NT 500, VT 130, 1306, 1309, 250 and 2508 PHEs and to FA 192 and CT 193 PHEs.

Fig. 5.3.3 d – Variant 3: Top beam (1) with suspension (2)

5.4 HE plates

The HE plate material is selected to meet the customer's requirements (e.g. pressure, temperature, media, operating mode).

Material abrasion on HE plates
In some special applications, HE plate material abrasion caused by the media used is a typical process.
Material abrasion may result in functional failure of the HE plates and in mixing of the flow media.

5.5 HE plate and frame gaskets

The **HE plate gasket** material is selected to meet the customer's requirements (e.g. pressure, temperature, media, operating mode).

HE plate gaskets made of elastomers are available in various materials and designs (e.g. HE plate gaskets for two openings). The HE plate gasket material is clearly marked by a color marking.

Most HE plate gaskets are fixed without glue, using a mechanical joint on the HE plate. As an alternative, the HE plate gaskets can also be glued.

The type of gasket used between the HE plate pack and the frame components depends on the frame type. Two types of **frame gaskets** can be distinguished:

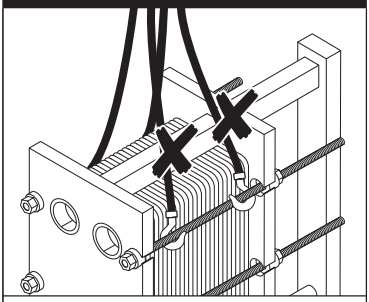
- Gasket rings positioned in a groove.
- Rubber mouldings covering the entire connection opening and providing a sealing effect – towards the HE plate pack and the connected piping flange – on both sides.

Material changes of gaskets

HE plate and frame gaskets may lose their initial properties due to external environmental influences and the flow media used. This may cause leaks and damage.

6 Setting up and connecting PHEs

DANGER

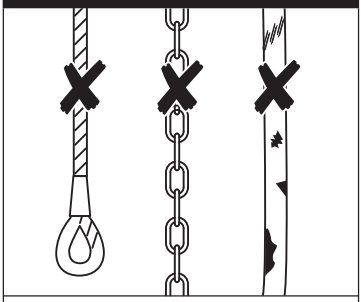


Danger to life if the load slips!

Always transport the PHE horizontally.

Never transport the PHE using the tensioning bolts.

DANGER

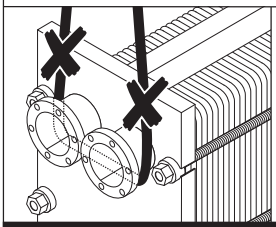


Danger to life if incorrect slinging equipment is used!

Never use steel hawsers or chains when setting up the PHE.

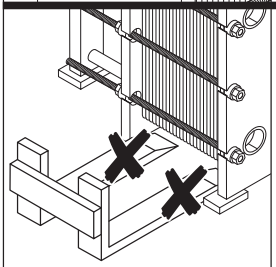
Use only undamaged round slings.

CAUTION



Damage to connection nozzles!

Never attach slinging equipment to the connection nozzles.



Damage to the heat exchanger plates!

Never transport the PHE using a lift-truck.

Always transport the PHE suspended.

6.1 Inspecting the PHE upon delivery

If you notice damage to an item at delivery in spite of careful packaging, please be sure to note the extent and type of the damage in the transport documents and have a receipt for this signed by the deliverer.

Transport variants

The completely assembled PHE is packed either horizontally or vertically, depending on the execution. The piping connections are plugged.

- PHE delivered **in a horizontal position** are fastened on pallets with the fixed plate facing down to enable safe transportation.
- PHE delivered **in an upright position** are frequently fixed on wooden boards or pallets.

Specific transportation features

- The height-adjustable bases of the BC frame are substituted by transport bases. The bases are enclosed with the PHE.
- The PHE may be filled with dried gas at an excess pressure of 1 bar max. **CAUTION!** Before removing the transport flanges, relieve the excess pressure on the associated bleed valve.

➔ Check if all nuts of tensioning bolts are firmly tightened. Should the nuts have come loose during transportation, tension the HE plate pack to the tensioning dimension a max. (see rating plate). If required, contact your GEA PHE Systems Sales Office.

6.2 Transporting the PHE to its place of installation

WARNING

Mortal danger due to high weight of PHE

The use of unsuitable or unsafe means of transport may cause very serious accidents.

➔ If possible, put up a PHE delivered in horizontal position only at its place of installation - See chapter “6.3 Putting up a horizontal PHE at the place of installation” (page 26).

Transporting a PHE delivered in horizontal position

➔ Leave the transport straps unchanged. Transport the PHE laying horizontally on the pallet to its place of installation with a fork lift truck.

➥ Put up the PHE only there as described in chapter “6.3 Putting up a horizontal PHE at the place of installation” (page 26).

Transporting a PHE delivered in upright position

A PHE delivered in upright position must be suspended during transport to its final position.

6.3 Putting up a horizontal PHE at the place of installation

WARNING

Danger of injury when putting up the horizontal PHE

Fitting of round slings, lifting and tipping of the PHE involves danger of serious injuries.

➔ Fasten the lifting equipment so that it will not come loose from the PHE.

➔ Do not tilt the PHE jerkily.

➔ Wear sturdy gloves, safety shoes and a safety helmet.

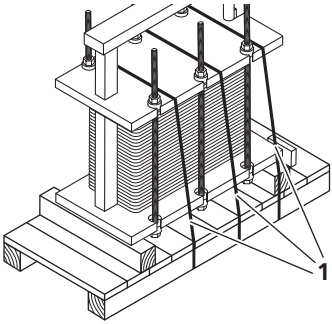


Fig. 6.3 a – Removing all transport straps

1. Remove all transport straps [**1**] from the PHE and the pallet.

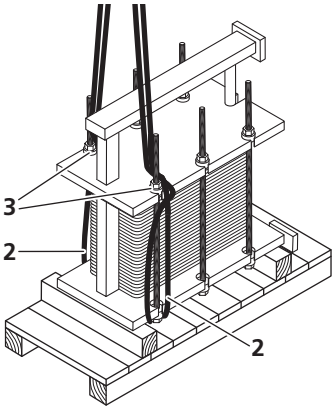


Fig. 6.3 b – Fitting round slings

2. Put a round sling [**2**] around the upper tensioning nuts [**3**] of the fixed plate on both sides.

➥ Guide the round sling upwards so that it goes around the top tensioning bolts on the loose plate on both sides and suspend the sling in a crane hook.

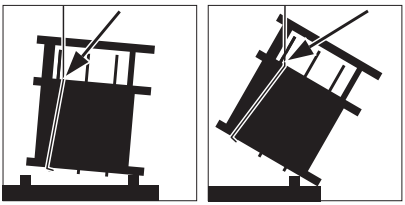


Fig. 6.3 c – Lifting the PHE slowly beyond the point of gravity

3. Slowly lift the PHE from the pallet beyond its point of gravity. Ensure that the round sling always fits safely around the top tensioning bolts.

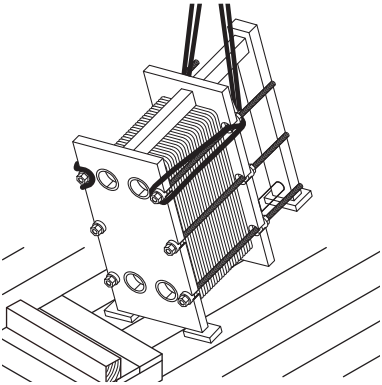


Fig. 6.3 d – Lowering the PHE slowly

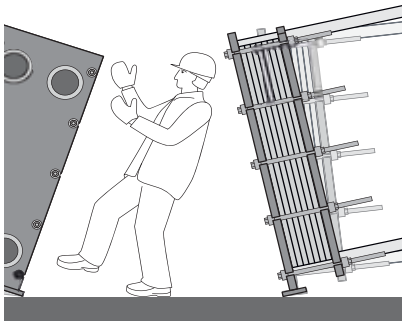
4. Slowly lower the PHE down to the edge of the fixed plate or on the PHE bases. Align the PHE and move it to its final position at the place of installation.

DANGER

Mortal danger by PHE falling over

Some PHE types may fall over very easily due to their high centre of gravity.

➔ After putting up the PHE, bolt the PHE down at the place of installation or anchor the PHE at a temporary location before removing the lifting equipment.



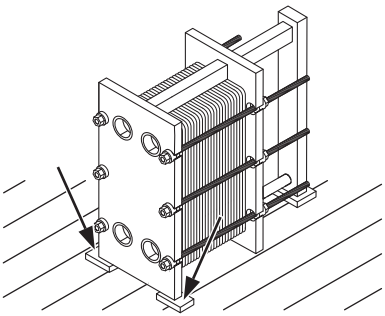


Fig. 6.3 e – Anchoring a PHE on the floor

5. After putting up the PHE, bolt the PHE down at the place of installation or anchor the PHE at a temporary location before removing the lifting equipment.
6. Remove the round slings and other aids only after that.

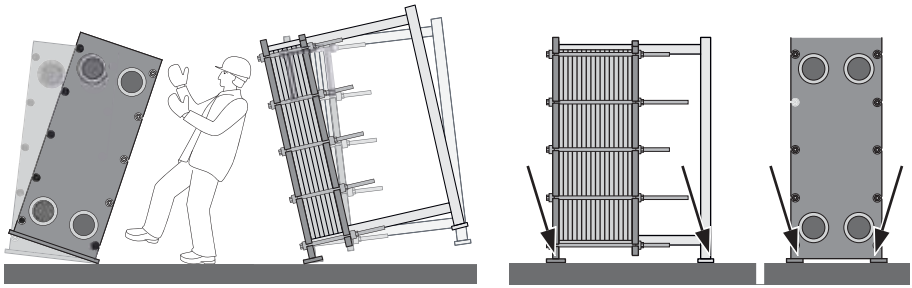
✔ The PHE is now put up.

6.4 Relocating an upright PHE

DANGER

Mortal danger by PHE falling over

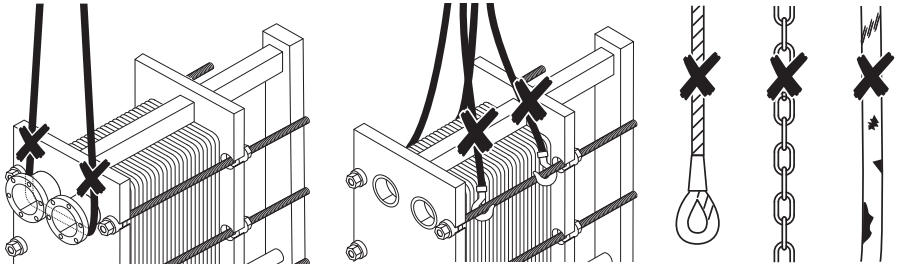
Some PHE types may fall over very easily due to their high centre of gravity.



- ➔ Leave the PHE bolted down to wooden boards until it has been transported to its final place of installation.
- ➔ Loosen the PHE from the wooden boards only after it is held by lifting equipment.
- ➔ Ensure that the floor of the installation site is sufficiently large, level and able to support the load.
- ➔ Bolt the PHE down at the place of installation as planned.

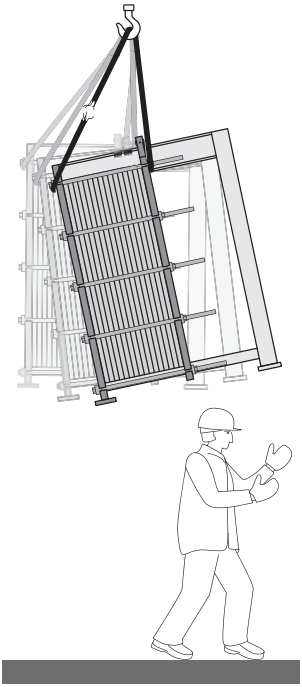
Mortal danger by PHE falling down

The PHE may fall down if you fix lifting equipment incorrectly or use improperly dimensioned lifting equipment.



- ➔ Always fix the lifting equipment as described in the following chapters.
- ➔ **Never** fix the lifting equipment at the PHE tensioning bolts.

- ➔ **Never** fix the lifting equipment at the piping connections.
- ➔ Use undamaged and sufficiently long round slings exclusively as lifting equipment on tensioning nuts.
- ➔ **Never** use chains or steel ropes as lifting equipment with shackles when the lifting equipment touches the PHE directly.
- ➔ Before transporting the PHE, ensure that the lifting equipment can carry the weight of the PHE reliably.



Mortal danger by PHE falling down

Persons can be killed by the high weight of a PHE falling down.

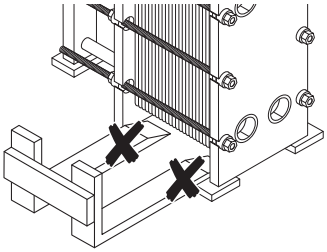
- ➔ **Never** stand underneath suspended loads.
- ➔ Keep persons that are not involved out of the hazard area.
- ➔ Do not grab the lifting equipment after the PHE has been lifted.

The suspended PHE may be easily set swinging. Round slings may slip off of the tensioning nuts.

- ➔ When selecting the round slings, bear in mind that the point of gravity of the PHE is not in the center, but closer to the fixed plate
- ➔ Lift a PHE carefully in order to avoid lateral swinging movements.

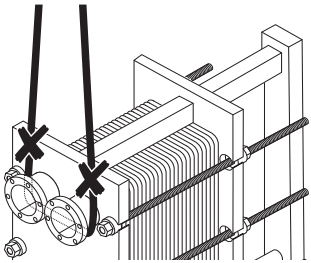
NOTICE

Damage of PHE due to incorrect lifting



The HE plates will be damaged if you apply a fork lift truck directly at the bottom of the HE plate pack.

➔ **Never** lift the PHE at the bottom of the HE plate pack.



If you fix lifting equipment at the piping connections, these may be bent, may break off or tear off.

➔ **Never** fix the lifting equipment at the piping connections.

➔ Always fix the lifting equipment as described in chapters 6.4.1 to 6.4.5.

6.4.1 Slinging the PHE at a beam and at shackles

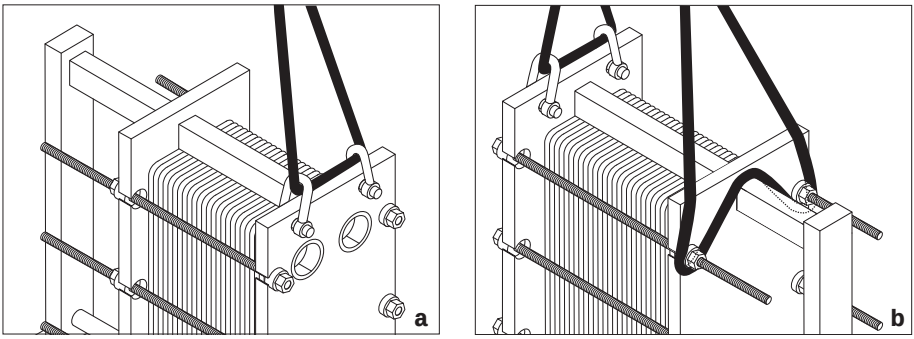


Fig. 6.4.1 a – Fastening the first shorter round sling

Fig. 6.4.1 b – Fastening the second longer round sling

Applying the slings

1. Fasten a round sling to shackles fitted in both shackle bores in the fixed plate [**a**].
2. Place another round sling over the top beam and around the top outside pairs of tensioning nuts [**b**] at the loose plate.

Selecting the right round slings
When using two round slings, two different lengths are needed!

Lifting

3. Slowly lift the PHE until the round slings are evenly tensioned and the PHE is almost horizontal.

Lowering

4. Slowly lower the PHE down above the prepared place of installation and avoid jerky floor contact.

6.4.2 Slinging the PHE at bolt-on lifting plates

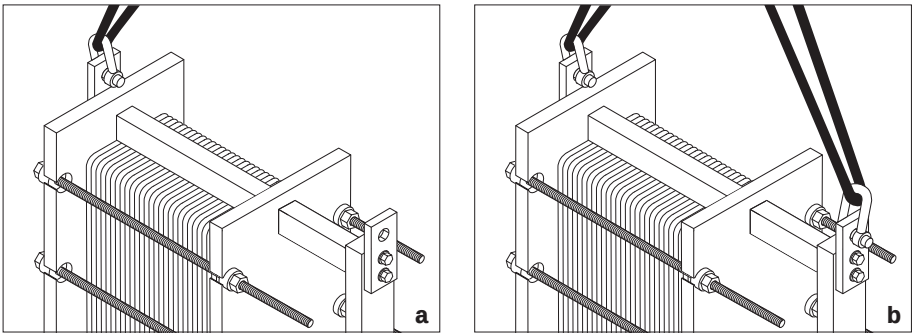


Fig. 6.4.2 a – Fastening the first shorter round sling

Fig. 6.4.2 b – Fastening the second longer round sling

Applying the slings

1. Fix a round sling to a shackle fitted in the hole in the plate bolted to the fixed plate [**a**]. (chains and steel ropes are permitted only if they do not directly touch the PHE. Otherwise the PHE may be damaged.)
2. Fix another round sling to a shackle fitted in the hole in the plate bolted to the column [**b**].

Selecting the right round slings
When using two round slings, two different lengths are needed!

Lifting

3. Slowly lift the PHE until the round slings are evenly tensioned and the PHE is almost horizontal.

Lowering

4. Slowly lower the PHE down above the prepared place of installation and avoid jerky floor contact.

6.4.3 Slinging the PHE at weld-on lifting lugs

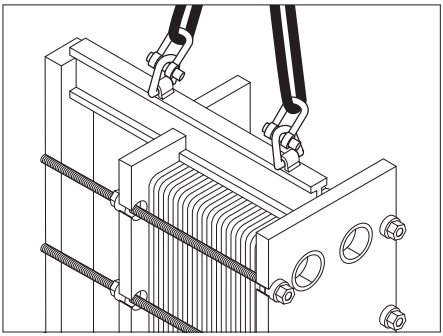


Fig. 6.4.3 – Fastening round slings to shackles fitted in lifting lugs

Applying the slings

1. Fasten one round sling to shackles fitted to one lifting lug each. (chains and steel ropes are permitted only if they do not directly touch the PHE. Otherwise the PHE may be damaged.)

Lifting

2. Slowly lift the PHE until the round slings are evenly tensioned and the PHE is almost horizontal.

Lowering

3. Slowly lower the PHE down above the prepared place of installation and avoid jerky floor contact.

6.4.4 Slinging the PHE at the front with round slings

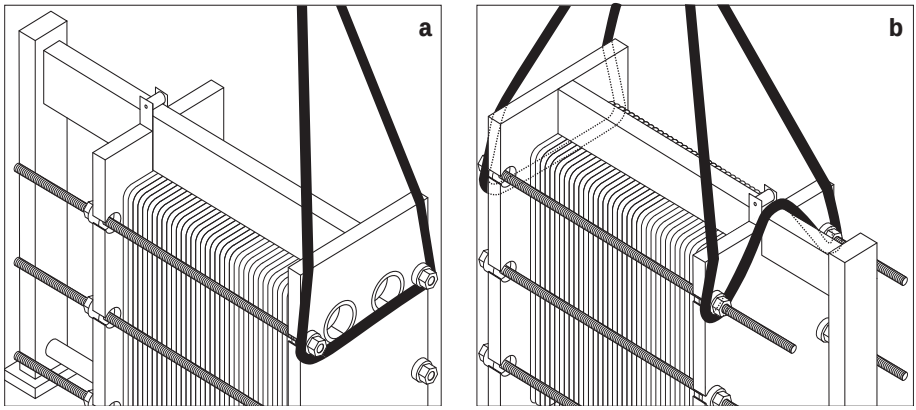


Fig. 6.4.4 a – Fastening the round sling to the fixed plate

Fig. 6.4.4 b – Fastening the round sling to the loose plate over the top beam

Applying the slings

1. Apply the round sling around the upper outside pairs of tensioning nuts [**a**] at the fixed plate - with tensioning nuts projecting only a little, the round sling must be applied completely around the fixed plate.
2. Place another round sling around the top outside pairs of tensioning nuts [**b**] at the loose plate.

Selecting the right round slings
When using two round slings, two different lengths are needed!

Lifting

3. Slowly lift the PHE until the round slings are evenly tensioned and the PHE is almost horizontal.

Lowering

4. Slowly lower the PHE down above the prepared place of installation and avoid jerky floor contact.

6.4.5 Slinging the PHE at the side with round slings

➔ Choose this type of transportation if the fastening methods described in the previous chapters are not provided or impossible.

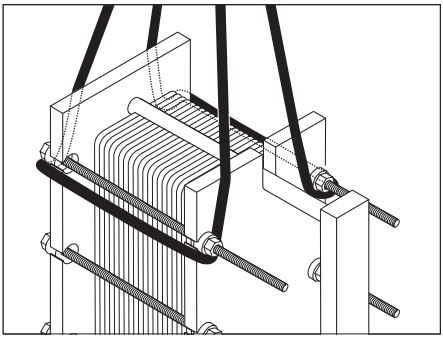


Fig. 6.4.5 – Applying round slings laterally around the top outside pairs of tensioning nuts

Applying the slings

1. Apply a sufficiently long round sling or two equally long round slings around the top outside pairs of tensioning nuts on both sides of the PHE.

Lifting

2. Slowly lift the PHE until the round slings are evenly tensioned and the PHE is almost horizontal.

Lowering

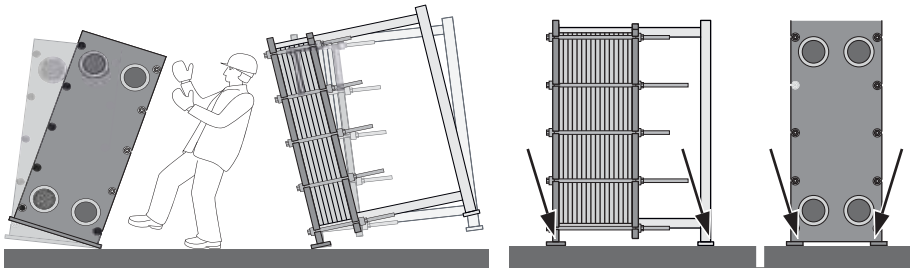
3. Slowly lower the PHE down above the prepared place of installation and avoid jerky floor contact.

6.5 Setting up and connecting PHEs

DANGER

Mortal danger by PHE falling over

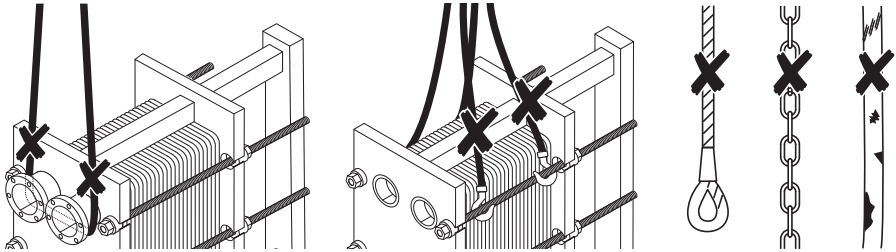
Some PHE types may fall over easily due to their high centre of gravity.



- ➔ Leave the PHE bolted down to wooden boards until it has been transported to its final place of installation.
- ➔ Loosen the PHE from the wooden boards only after it is held by lifting equipment.
- ➔ Ensure that the floor of the installation site is sufficiently large, level and able to support the load.
- ➔ Bolt the PHE down at the place of installation as planned.

Mortal danger by PHE falling down

The PHE may fall down if you fix lifting equipment incorrectly or use improperly dimensioned lifting equipment.



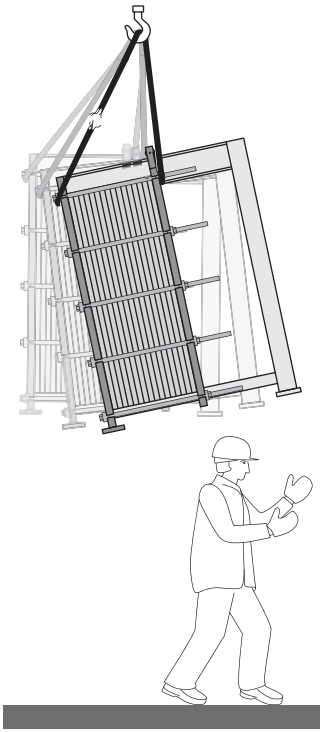
- ➔ Always fix the lifting equipment as described in the following chapters.
- ➔ **Never** fix the lifting equipment at the PHE tensioning bolts.
- ➔ **Never** fix the lifting equipment at the piping connections.

- ➔ Use undamaged and sufficiently long round slings exclusively as lifting equipment on tensioning nuts.
- ➔ **Never** use chains or steel ropes as lifting equipment with shackles when the lifting equipment touches the PHE directly.
- ➔ Before transporting the PHE, ensure that the lifting equipment can carry the weight of the PHE reliably.

Mortal danger by PHE falling down

Persons can be killed by the high weight of a PHE falling down.

- ➔ **Never** stand underneath suspended loads.
- ➔ Keep persons that are not involved out of the hazard area.
- ➔ Do not grab the lifting equipment after the PHE has been lifted.



The suspended PHE may be easily set swinging. Round slings may slip off of the tensioning nuts.

- ➔ When selecting the round slings, bear in mind that the point of gravity of the PHE is not in the center, but closer to the fixed plate.
- ➔ Lift a PHE carefully in order to avoid lateral swinging movements.

WARNING

Danger of injury due to hazardous flow media

If you wish to use hazardous flow media (e.g. explosible, flammable, caustic, toxic, under high pressure, very hot or very cold) when operating the PHE, ensure that the safety accessories below are provided and/or fitted:

Required safety accessories	Property of flow media		
	Highly explosive	Flammable	Under high pressure
Collecting tray	x	x	
Splash guard	x	x	x
Earthing tab	x	x	
Insulation			
Warning sign			

Required safety accessories	Property of flow media		
	Very cold	Very hot	Caustic, toxic, hazardous to the environment
Collecting tray			x
Splash guard			x
Earthing tab			
Insulation	x	x	
Warning sign	x[1]	x[2]	

[1] Surface temperature below 0° C

[2] Surface temperature above + 50° C

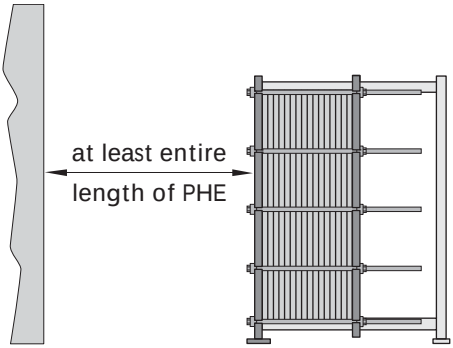
WARNING

Damage to PHE due to freezing of flow media

➔ Ensure that the temperature will not drop below the freezing temperature of the flow media used in all setting-up and operating conditions.

As a function of the future operating conditions and of the permanent place of use, the PHE may have to be retrofitted.

6.5.1 Space requirement at the place of installation



Ensure sufficient free space around the PHE. This makes access to the PHE and maintenance work easier. The specified reference values for the free space required are guideline values and are recommended by GEA PHE Systems.
They enable sufficient access to the PHE.

Fig. 6.5.1 a – Only for C frames: Recommended spacing from fixed plate

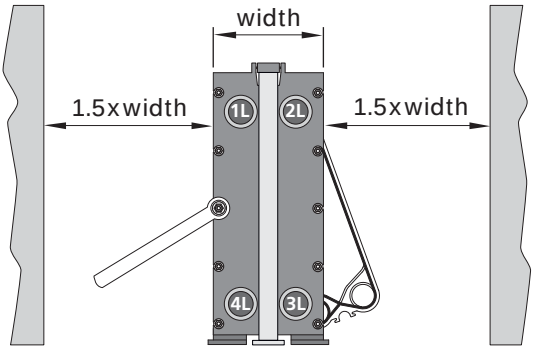


Fig. 6.5.1 b – Recommended lateral spacing from HE plate pack

6.5.2 Removing and disposing of transport packaging

➔ Remove the transport packaging as far as provided.

➔ Leave the transport covers on the piping connections unless you install the piping straightaway.

➔ PHE may be filled with dry compressed air or inert gases at an excess pressure of 1 bar max. in order to avoid ingress of moisture.

NOTICE

Reducing the excess pressure

If the PHE was delivered with a compressed-air or inert gas filling, the excess pressure must be reduced before you can loosen the flanges.

➔ Before loosening the flanges, reduce the excess pressure on the associated valve.

➔ In case of PHEs with a seaworthy packaging, remove the desiccant packs provided in the manifold channels without damaging them.

➔ Dispose of the transport packaging according to the regulations applicable to you.

6.5.3 Installation of piping

⚠ WARNING

Hazard due to deactivated safety equipment

When deactivating safety equipment for installation, maintenance or commissioning work, you have to ensure that this produces no hazard to persons and material assets.

➔ Observe the instruction manual of the plant or machine in question where the PHE is integrated.

NOTICE

Damage to piping connections and to PHE due to excessive forces and torques

When excessive forces and torques are transmitted on the PHE connections through the piping, the piping connections and/or the PHE may be damaged.

➔ You can take the forces and torques permitted for your PHE from the technical documentation.

➔ Ensure that the forces and torques transmitted from the piping to the PHE connections are not too high.

Flexible piping connections

Realise the piping connections at the loose plate and on intermediate plates flexibly so that the tensioning dimension of the HE plate pack can be adjusted between a max. and a min.

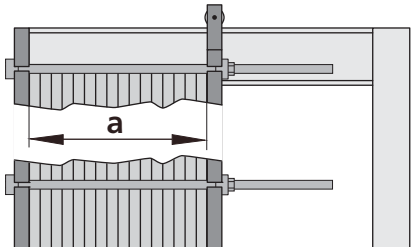
7 Commissioning, decommissioning, operation

WARNING

Danger of injury due to hazardous flow media

If you use hazardous flow media (e.g. explosible, flammable, caustic, toxic, under high pressure, very hot or very cold) and the PHE becomes leaky, persons can be sprayed with flow medium and become injured.

➔ Tension the HE plate pack of the PHE to the fixed values of tensioning dimension a min. ≤ a ≤ a max. See chapters “10 Technical terms” (page 73), “5.2 Identification” (page 16) and “8.9 Installing the HE plates and closing the PHE” (page 64).

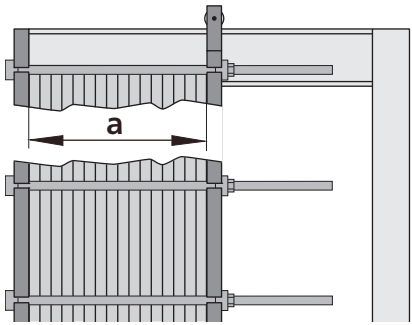


➔ If you use hazardous flow media, ensure that an anti-splash guard is provided. This splash guard may only be removed after the PHE has adapted to its ambient pressure and temperature.

NOTICE

Damage to HE plates by excessive tightening

When the HE plate pack is tensioned to less than tensioning dimension a min., the HE plates are damaged. The PHE may become leaky and flow media can escape.



- ➔ **Never** tension to less than tensioning dimension a min.
- ➔ Ensure that the tensioning dimension a of the HE plate pack is always within the permitted value range a min. ≤ a ≤ a max. (see explanation of rating plate, starting on page 16).

Environmental damage due to leaks

- ➔ When using environmentally hazardous media, ensure that these can be reliably collected in case of a PHE leak (e.g. collecting trays and suction equipment) and cannot pollute the environment

Damage to PHE by sudden pressure rise (liquid hammer) or sudden pressure drop (cavitation hammer)

When the flow velocity of a flow medium changes, a liquid hammer or a cavitation hammer may occur. This can damage the PHE and flow media can escape.

- ➔ Always open or close the valves of the piping connected to the PHE slowly.
- ➔ Avoid sudden condensation of gases by suitable process control.

Damage to PHE due to freezing of flow media

- ➔ Ensure that the temperature will not drop below the freezing temperature of the flow media used in all setting-up and operating conditions.

Leaks when putting multi-stage PHE into and out of operation

When putting multi-stage PHEs into and out of operation and failing to pressurize or relieve all sections evenly, the tensioning dimension may be exceeded in individual sections. This may produce leaks.

- ➔ Ensure that when putting multi-stage PHEs into and out of operation, all sections must be pressurized or relieved evenly.

7.1 Commissioning

Initial commissioning of the PHE is to follow the conditions below:

➔ Before starting PHE commissioning, ensure
- that all required components of the PHE have been completely installed,
- that all piping connections are firmly connected with the PHE,
- that the tensioning dimension a of the HE plate pack is always within the permitted value range $a_{min.} \leq a \leq a_{max.}$ (see explanation of rating plate, starting on page 16),
- that no residues from previous processes (e.g. cleaning media) are present inside the PHE when putting the unit back into operation.

➔ Ensure that operating conditions are so
- that liquid hammers and cavitation hammers are avoided,
- that the PHE is not operated with unpermitted flow media, pressure or temperature levels.

➔ When integrating the PHE into your plant, ensure that the PHE is vented.

Commissioning at very low ambient temperatures

If you wish to commission or re-commission the PHE at very low ambient temperatures, GEA PHE Systems recommends to heat up the PHE slowly to the operating temperature, using the flow media.

➔ Bring the PHE to the operating temperatures of the two circuits by means of the flow media at low pressure.

➥ In this process, cold leaks may occur briefly due to the low elasticity of the gaskets. These will disappear as soon as the operating temperature has been reached.

Commissioning of multi-stage PHE

Ensure that when commissioning multi-stage PHE, all sections must be pressurized or relieved evenly.

Removing faults during commissioning

If faults appear during PHE commissioning, please refer to chapter “9 Troubleshooting” (page 70).

7.2 Operation

CAUTION

Danger of injury due to failure of HE plate gaskets

Operation at unpermitted pressure and temperature levels and with unpermitted media may cause direct functional failure of the HE plate gaskets. Hazardous media may escape at high pressure and possibly high or low temperatures and cause personal injury.

➔ Always respect the permitted values specified on the rating plate.

NOTICE

Material damage due to unpermitted operating conditions

When operating the PHE under conditions for which it is not designed, damage may result.

➔ Carry out visual inspections of the PHE at regular intervals during operation. If the PHE is leaky, service or repair it.

➔ Ensure that the PHE is not operated with unpermitted flow media, pressure or temperature levels. The permitted minimum and maximum values are specified on the rating plate, see „Identification“ (Seite 16).

➔ Avoid liquid hammers and cavitation hammers.

Removing faults during operation

If faults appear during PHE operation, please refer to chapter “9 Troubleshooting” (page 70).

7.3 Decommissioning

NOTICE

Damage due to hazardous flow media

If you use hazardous or environmentally incompatible flow media and these leak during standstill, damage may result.

➔ Ensure that no flow media can escape during the standstill phase.

Damage of PHE due to freezing

Freezing of flow media may cause damage when de-commissioning the unit.

➔ Ensure that the flow media remaining inside the unit cannot freeze, e.g. by draining or heating.

7.3.1 Short-term decommissioning

➔ Ensure that no flow media can escape during the standstill phase.

7.3.2 Long-term decommissioning

NOTICE

Corrosion of HE plates

Flow media remaining inside the PHE during extended standstill periods may cause corrosion of the HE plates.

➔ Drain the flow media completely.

➔ Flush the PHE and the HE plates and let the PHE dry well.

➔ Plug the piping connections to be used with blind plugs in order to avoid ingress of moisture or dirt into the PHE during standstill.

➔ Take care of protected storage until the unit is put back into operation.

7.4 Disposal

Upon request, GEA PHE Systems will take care of disposing of your PHE. The PHE will be dismounted, transported away and disposed of properly by our employees against payment of the expenses incurred.

Disposal of parts polluted by contaminants

If PHEs or parts thereof are contaminated, GEA PHE Systems cannot take care of the disposal. In this case, disposal of the PHE is the responsibility of the operating company.

8 Maintenance

➔ Prepare a time schedule for regular maintenance work in order to enable reliable unit operation.

Prior to PHE maintenance
Prior to PHE maintenance, we recommend that you contact your GEA PHE Systems Sales Office (see rear cover).

Process-related deposits on the HE plates

- affect heat transfer between the flow media,
- increase the pressure loss,
- can cause or accelerate corrosion on the HE plates.

The application in question will dictate

- the necessity,
- the type and
- the frequency of PHE cleaning.

Hard dirt such as deposits on the surface of HE plates which cannot be removed by a CIP process (see page 49) can be successfully treated by manual cleaning and/or open chemical baths.

WARNING

Danger of injury when carrying out work during operation

When working on the PHE during operation, you may be injured and the PHE may be damaged.

➔ Always put the PHE out of operation prior to maintenance work, see chapter “7.3 Decommissioning” (page 46).

8.1 Frame maintenance

Carry out simple maintenance work yourself at regular intervals:

➔ Clean the outside of the PHE frame, especially the beams, rails and bars.

➔ Grease the guide rails of B frames (see page 67).

➔ Rework paint damage on the PHE frame.

Frame maintenance
Detailed information about frame maintenance is available from your GEA PHE Systems Sales Office (see rear cover).

8.2 Cleaning HE plates while PHE is closed

Prior to cleaning the HE plates
Prior to cleaning of HE plates while the PHE is closed, we recommend that you contact your GEA PHE Systems Sales Office (see rear cover).

8.2.1 CIP cleaning

In the CIP cleaning process (“Cleaning in place”), a cleaning medium flows through the PHE instead of the flow media. The deposits are removed by the dissolving power of the cleaning medium and by the mechanical effect of the turbulent flow.

WARNING

Danger of injury due to aggressive cleaning media

The use of aggressive cleaning media involves a poisoning hazard and danger of chemical and possibly thermal burns.

Ensure the following:

➔ that you have been instructed in the handling before starting CIP cleaning and have a safe command of all work steps.

➔ that you always wear suitable protective clothing while working with aggressive cleaning fluids.

➔ that the cleaning medium you use is completely removed from the PHE after the cleaning process is complete.

NOTICE

Material damage due to exceeding permitted values

The rating plate of your PHE specifies the permitted values, e.g. for pressure and temperature. When these values are exceeded during PHE cleaning, the PHE may be damaged.

➔ Ensure that all permitted values specified on the rating plate are respected in the cleaning process as well.

Damaged HE plates and HE plate gaskets due to aggressive cleaning media

Chemical cleaning processes may attack the HE plate and gasket material and cause leaks.

➔ Always use cleaning media that do not attack the HE plate and gasket material.

➔ Choose a suitable temperature and do not let the cleaning media take effect for an unnecessarily long time.

➔ Always comply with the safety regulations and follow the recommendations of the cleaning media producers.

Environmental damage due to aggressive cleaning media

When aggressive cleaning media are discharged into the environment, environmental damage may result.

➔ Collect the cleaning agent you have used completely so that it cannot be discharged into the environment.

➔ Have the cleaning agent you have used disposed of in an environmentally compatible way.

8.2.2 Reverse flushing cleaning method

Cleaning by reverse flushing is a possible alternative to CIP cleaning. Reverse flushing is employed when the flow media contain coarse dirt particles plugging the manifold channels. The dirt particles are removed from the PHE by briefly reversing the flow direction.

8.3 Preparatory measures for opening the PHE

WARNING

Danger of injury

Maintenance work on the PHE involves danger of injury.
For this reason, always observe the following rules:

- ➔ Wear suitable protective equipment at all times.
- ➔ Hazardous flow media (caustic, toxic, flammable, explosive etc.) present a severe danger of injury for the operator and bystanders. Ensure that the regulations for flow media are followed during all work.
- ➔ When opening a pressurized and/or filled PHE, the flow media may escape in an uncontrolled way. This is a danger of injury for the operators and bystanders. Ensure that the PHE is at the ambient pressure level.
- ➔ When using hot or very cold flow media there is a danger of burns or, respectively, frostbites. Before starting maintenance work, always ensure that the PHE has reached ambient temperature.
- ➔ Drain the PHE, ensuring that the media contained inside are reliably collected.

Frame types C or B

Before starting work, establish which frame type (C or B) has been delivered with the PHE, using the enclosed documentation.
Follow the work steps in chapters 8.4 to 8.5 and 8.9 for the relevant frame type C or B.

1. Stop operation of the PHE.
2. Slowly close the valves of the incoming and outgoing lines and relieve the PHE pressure until ambient pressure is reached.
3. Wait for the PHE to reach the ambient temperature level.
4. Drain the PHE, ensuring that the content of the PHE is collected.
5. Remove any provided insulation and/or splash guards.

6. The tensioning bolt nuts on the loose plate must be accessible.
If required, remove all piping connected to the loose plate.
The loose plate must be freely movable towards the column.

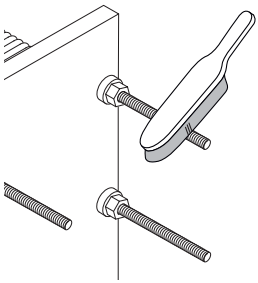


Fig. 8.3 a – Cleaning the threads

7. Clean the tensioning bolt threads.

➥ This removes dirt and avoids jamming-up of the nuts.

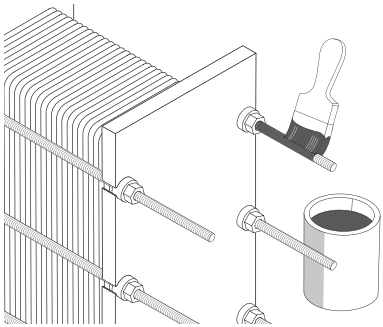


Fig. 8.3 b – Greasing the tensioning bolt nuts

8. Apply a little grease to the visible threads of the tensioning bolts.

➥ This makes slackening off the tensioning bolt nuts easier later.

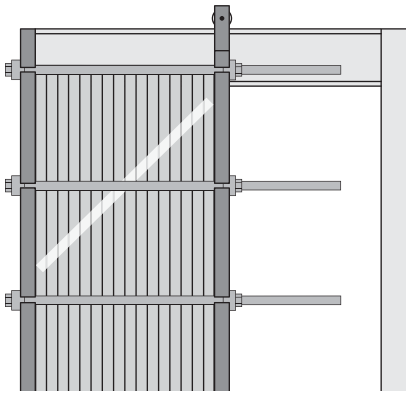
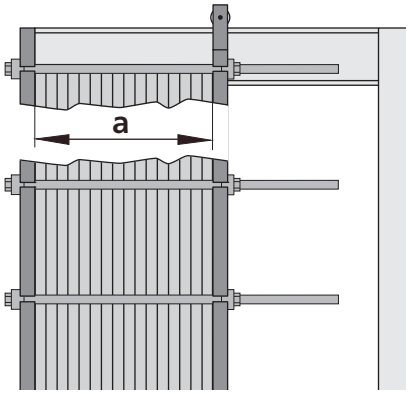


Fig. 8.3 c – Lateral marking of HE plate pack by a strip of paint

9. Mark the HE plate pack with a diagonal strip of paint on the side in order to know the correct order of HE plates when reinstalling.



10. Be sure to write down the current tensioning dimension “a” of the HE plate pack.

Fig. 8.3 d – Measuring the tensioning dimension between fixed and loose plate

8.4 Opening the PHE

WARNING

Danger of injury from movable loose plate

There is a high bruising hazard when relocating/moving the loose plate.

➔ Secure the loose plate against unexpected movements (e.g. on board of ships).

CAUTION

Danger of injury on sharp edges, threads and burrs

Both the HE plates and threads or burrs on the PHE may have sharp edges that may cause cuts.

➔ Wear protective gloves when working on the PHE and/or with the HE plates.

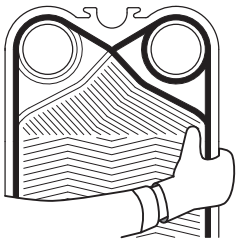
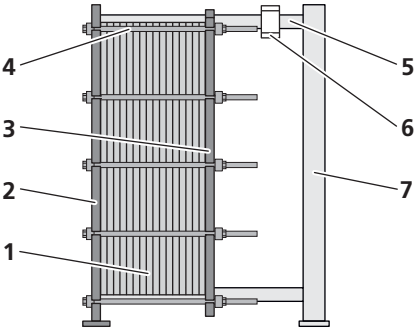


Figure reference for chapters 8.4 through 8.9

The PHE components are referred to as follows in the chapters below:



1 = HE plate(s)
2 = Fixed plate
3 = Loose plate
4 = Tensioning bolts
5 = Top beam
6 = Safety stop
7 = Column

Fig. 8.4 – C frame with safety stop

8.4.1 Opening a PHE with C frame

➔ **WARNING!** Prior to opening, the preparatory measures described in chapter 8.3 must be carried out.

The drawings below show a CL frame (with column).
The handling of CS frames (without column) is identical.

Most C frames have a safety stop at the end of the top beam. This safety stop limits the travel of the loose plate.

➔ **WARNING!** Always carry out the maintenance work described below with at least two persons.

Position of safety stop

The position of the safety stop [5] depends on the size and the number of HE plates. If you have any questions, please contact your GEA PHE Systems Sales Office (see rear cover).

➔ When opening C frames without a safety stop, proceed in a similar way as described for C frames with a safety stop.

WARNING

As soon as the tensioning bolts have been slackened off, there is danger of HE plates coming loose from their guiding, falling out laterally and causing serious injury.

➔ Absolutely comply with the procedure described below.

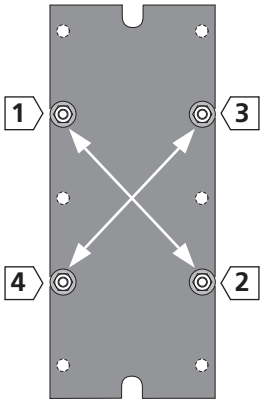


Fig. 8.4.1 a – Slackening off tensioning bolts (diagram)

1. Remove all tensioning bolts except for the four tensioning bolts shown.
2. Slacken off the nuts of the four remaining tensioning bolts at the loose plate.

➥ Proceed evenly in small steps alternatingly (1–2–3–4) and diagonally (1–2 and 3–4) in order to avoid overloading specific tensioning bolts and the loose plate.

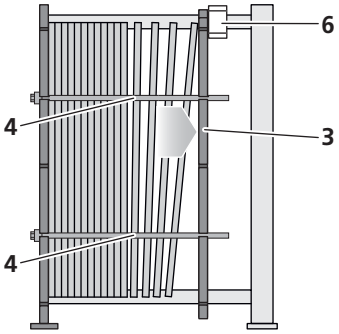
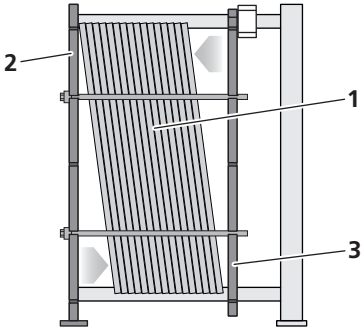


Fig. 8.4.1 b – Pushing the loose plate next to the safety stop

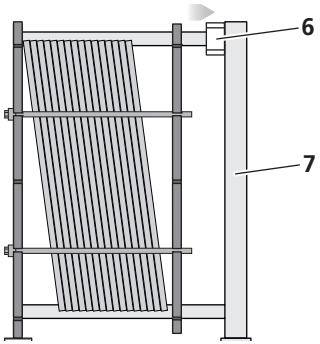
3. Remove the nuts of the remaining tensioning bolts [**4**] on the loose plate side [**3**].
   WARNING! There is a bruising hazard when relocating/moving the loose plate. Push the loose plate [**3**] up to next to the safety stop[**6**].



4. Now push the HE plates[**1**] towards the loose plate on the bottom beam [**2**] and towards the fixed plate [**3**] at the top beam.

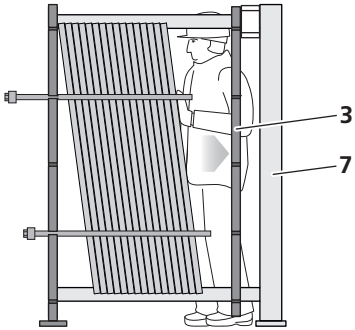
➥ Now the HE plates must be **safely** held by the fixed plate.

Fig. 8.4.1 c – Setting HE plates at an angle and letting them rest against the fixed plate top



5. Mark the position of the safety stop [**6**]. Now slide the safety stop [**6**] up to column [**7**].

Fig. 8.4.1 d – Pushing the loose plate next to the safety stop



6. Push the loose plate [**3**] up to next to the column [**7**].

➥ In this process, the **second person** safeguards the HE plate pack against slipping.

✔ The PHE is open.

➥ To continue, see “8.5.1 Removing HE plates from a C frame” (page 59).

Fig. 8.4.1 e – Pushing the loose plate next to the safety stop

8.4.2 Opening a PHE with a B frame

➔ **WARNING!** Prior to opening, the preparatory measures described in chapter 8.3 must be carried out.

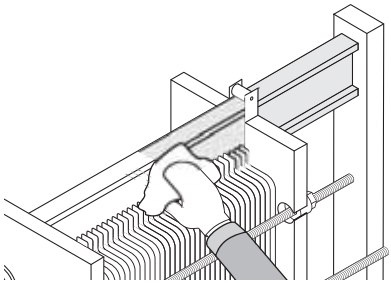


Fig. 8.4.2 a – Cleaning the top beam

1. Clean the visible areas of the top beam.

➥ This improves the movability of the HE plates.

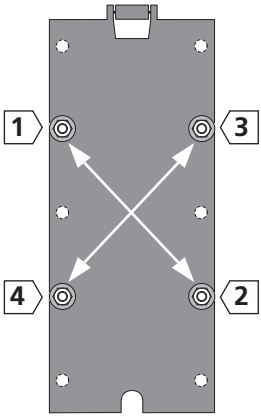


Fig. 8.4.2 b – Slackening off tensioning bolts (diagram)

2. If short tensioning bolts are provided, first slacken off the nuts of these tensioning bolts.
3. Slacken off the nuts of the long tensioning bolts (pre-tensioning bolts).

➥ Proceed evenly in small steps alternatingly (1-2-3-4) and diagonally (1-2 and 3-4) in order to avoid overloading specific tensioning bolts and the loose plate getting wedged.

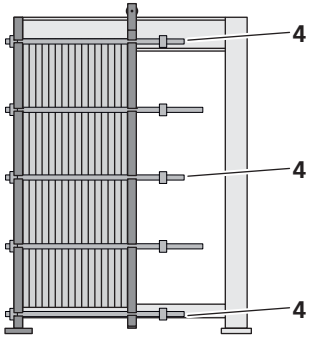
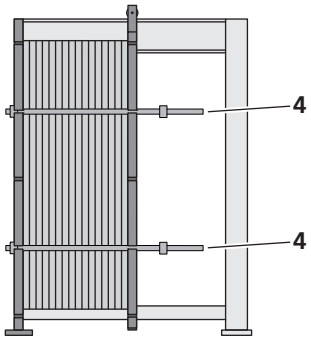


Fig. 8.4.2 c – Removing the short tensioning bolts

4. Remove the short tensioning bolts [**4**].



5. Remove the remaining long tensioning bolts [**4**] (pre-tensioning bolts).

Fig. 8.4.2 d – Removing the long tensioning bolts (pre-tensioning bolts)

8.5 Removing the HE plates from the PHE

WARNING

Danger of falling over when stacking HE plates

When stacking removed HE plates too high, these stacks may fall over. This may injure you and other persons and damage HE plates.

➔ Never stack HE plates any higher than:
- 60 HE plates for Varitherm/NT
- 30 cassettes for LWC
- 30 HE plates for Freistrom / Concitherm / Safetytherm

NOTICE

Damage of HE plates by improper storage

When the HE plates including the associated HE plate gaskets are not properly handled and stored, damage may result that causes PHE leaks.

➔ Ensure that HE plates are not damaged by transport and storage. Observe the max. stacking height (page 60) and the instructions within the defined work steps.

Documenting the order of HE plates
Document the order of HE plates upon removal, using the circuit diagram included in the technical documentation.

HE plates sticking to one another
If necessary, loosen sticking HE plates from one another without damaging the HE plate gaskets in this process.

8.5.1 Removing HE plates from a C frame

1. Observe chapter “5.3.3 Fitting the HE plates in the frame” (page 20). This chapter describes how the HE plates are held in the frame.

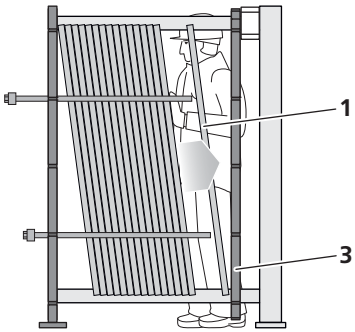


Fig. 8.5.1 a – Removing HE plates one by one

2. **CAUTION!** Have the HE plates secured against unwanted movements by **another person**.
   Remove the HE plates one by one.
   ➥ Push one HE plate [**1**] at a time towards the loose plate [**3**].
   ➥ Tilt this HE plate and remove it laterally from the guide.

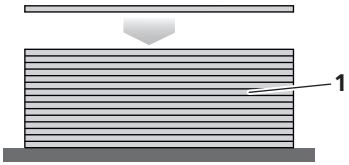


Fig. 8.5.1 b – Stacking HE plates horizontally

3. **WARNING!** Do not exceed the permitted stacking height (page 58). Stack the HE plates [**1**] on a clean and level surface.

8.5.2 Removing HE plates from a B frame

Observe chapter “5.3.3 Fitting the HE plates in the frame” (page 20). This chapter describes how the HE plates are held in the frame.

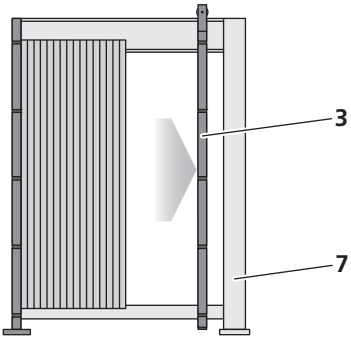


Fig. 8.5.2 a – Pushing the loose plate next to the column

1. The HE plates must not fall out. If required, have the open HE plate pack secured by a **second person**. Push the loose plate [**3**] up to next to the column [**7**].

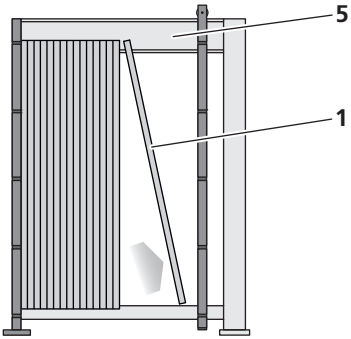


Fig. 8.5.2 b – Removing HE plates one by one

2. For removing, swing out one HE plate [**1**] at a time laterally and remove them one by one from the top beam guide rail [**5**].

➥ Some Varitherm top beams allow swinging out to **one side** only. See Figure 5.3.3 (page 21).

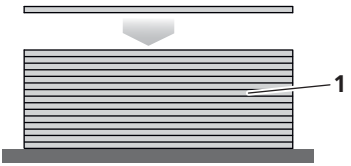


Fig. 8.5.2 c – Stacking HE plates horizontally

3. **WARNING!** Do not exceed the permitted stacking height (page 58). Stack the HE plates [**1**] on a clean and level surface.

8.6 Cleaning HE plates while PHE is open

Prior to cleaning the HE plates
Prior to cleaning of HE plates while the PHE is open, we recommend that you contact your GEA PHE Systems Sales Office (see rear cover).

8.6.1 Manual cleaning of HE plates

WARNING

Danger of injury due to aggressive cleaning media

The use of aggressive cleaning media involves a poisoning hazard and danger of chemical and possibly thermal burns.

Ensure the following:

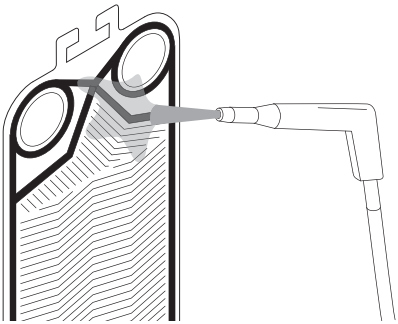
- ➔ that you have been instructed in the handling of the aggressive cleaning media prior to the cleaning process and have a safe command of all work steps.
- ➔ that you always wear suitable protective clothing while working with aggressive cleaning fluids.
- ➔ that the cleaning medium you use is completely removed from the HE plates after the cleaning process is complete.

NOTICE

Damage by cleaning tools

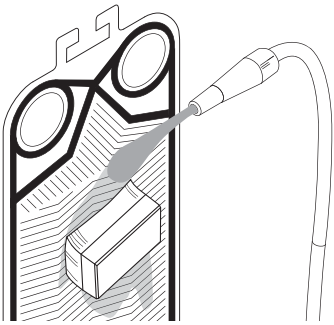
Hard cleaning tools (e.g. brushes with metal bristles) can damage the metal surface of the HE plates and cause corrosion. Damaged HE plate gaskets may cause leaks.

- ➔ Never use hard cleaning tools.
- ➔ Always proceed carefully when cleaning in order to avoid damage to HE plates and plate gaskets. Ensure that no particles will end up beneath the HE plate gaskets as this may cause leaks.



1. When removing coarse dirt, use a high-pressure cleaner nozzle for loosening the particles before starting the actual cleaning process.
   CAUTION! The high-pressure cleaning jet may accidentally remove the HE plate gaskets.

Fig. 8.6.1 a – Cleaning away dirt from the HE plate with a high-pressure jet cleaner



2. Now clean each HE plate on both sides with running, **warm** water and a **soft** brush.

Fig. 8.6.1 b – Cleaning of a HE plate with a soft brush under running water

8.6.2 Chemical cleaning of HE plates

NOTICE

Damaged HE plate gaskets due to aggressive cleaning agents

Chemical cleaning processes may attack the HE plate gasket material and cause leaks.

- ➔ Always use cleaning agents that do not attack the HE plate gasket material.
- ➔ Choose a suitable temperature and do not let the cleaning agents take effect for an unnecessarily long time.
- ➔ Always comply with the safety regulations and follow the recommendations of the cleaning agent producers.

NOTICE

Corrosion due to chloride-containing cleaning agents

Chlorides in the cleaning agent used reduce the corrosion resistance of nickel-chromium and nickel-chromium-molybdenum steel grades (including Hastelloy, Incoloy and Inconel).

➔ Dilute the cleaning liquid only with chloride-free or low-chloride water of low hardness.

➔ Select the cleaning agent as a function of the dirt to be removed and of the resistance of HE plates and gasket materials..

1. Clean the HE plates according to the working instructions by the cleaning agent producer.
2. Always flush the cleaned HE plates with a sufficient amount of clean water prior to reinstalling them.
3. Check both sides of the HE plate if any dirt has remained on the plate.
4. Remove particles on and beneath the HE plate gaskets, e.g. using a soft brush.

8.7 Replacing HE plate gaskets

You can take the type of fastening of HE plate gaskets from the technical documentation of the plate heat exchanger. The HE plate gaskets may be glued or fixed without glue.

We recommend that you replace all HE plate gaskets at the same time. Always use original GEA PHE Systems HE plate gaskets exclusively.

Contacting the GEA PHE Systems Sales Office

Contact your GEA PHE Systems Sales Office for replacing the HE plate gaskets of your PHE. The contact addresses can be found on the rear cover.

8.8 Replacing the frame gaskets

The type of gasket used between the HE plate pack and the frame components depends on the frame type.

Contacting the Sales Office
Contact your GEA PHE Systems Sales Office for replacing the frame gaskets of your PHE. The contact addresses can be found on the rear cover.

8.9 Installing the HE plates and closing the PHE

➔ Observe the work steps detailed in chapter “3.1 Hazards on the PHE” (page 9), before installing the HE plates and closing the PHE.

8.9.1 Preparatory measures for installing the HE plates

NOTICE

Leaky PHE due to old HE plate or frame gaskets

If you reuse used HE plate gaskets and frame gaskets or replace only part of them, the PHE may leak.

➔ Perform a visual inspection to see if replacement is needed.

➔ Replace used HE plate gaskets and used frame gaskets (sealing rings or rubber mouldings) always for the entire PHE at the same time.

Leaky PHE due to damaged HE plate and frame gaskets

HE plate gaskets and frame gaskets (sealing rings or rubber mouldings) are easily damaged.

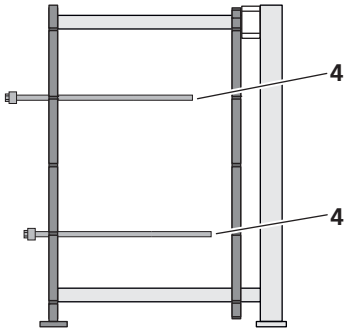
➔ Handle HE plate and frame gaskets with care.

➔ Carry out the four steps below for **all PHE**:

1. Ensure that the HE plate gaskets and the HE plates are free of foreign objects and dirt. Clean them if required.
2. Check if the HE plate gaskets properly fit in the grooves of the HE plates.
3. Clean the sealing faces of the frame gaskets.
4. Clean the threads of the tensioning bolts and the tensioning nuts and apply a little grease.

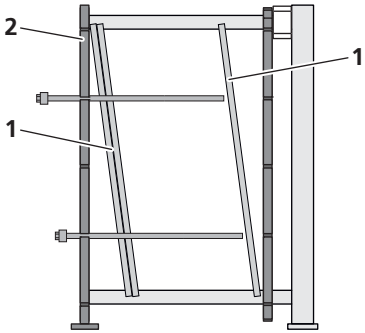
8.9.2 Installing HE plates in PHE with a C frame

➔ First carry out the work steps described in chapter "8.9.1 Preparatory measures for installing the HE plates" (page 64).



1. Before installing the HE plates, insert two tensioning bolts [**4**] on both sides as a safeguard.
   Install the HE plates in the PHE frame in the correct order.

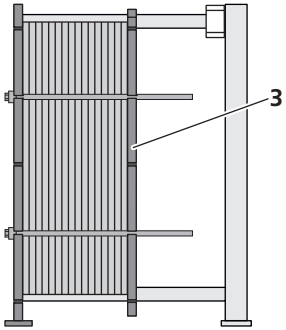
Fig. 8.9.2 a – Leaving tensioning bolts in the PHE as a safeguard



2. Always install the HE plates [**1**] so that they are slightly tilted and rest firmly against the fixed plate [**2**] at the top.

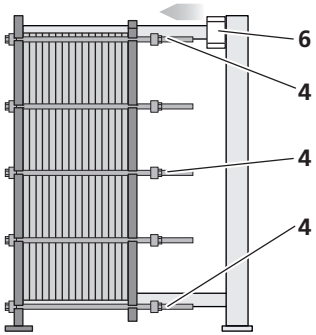
➥ Have the HE plate pack secured by **another person**.

Fig. 8.9.2 b – Resting HE plates against the fixed plate top after installation



3. Push the loose plate [**3**] next to the HE plate pack.

Fig. 8.9.2 c – Pushing the loose plate next to the HE plate pack and inserting the tensioning bolts



4. Insert the remaining tensioning bolts [**4**].
5. Fix the safety stop[**6**] at the position marked before the PHE was opened

➥ Do **not yet** tighten the HE plate pack.

➥ Continue with chapter “8.9.4 Tensioning and testing the HE plate pack” (page 68).

Fig. 8.9.2 d – Pushing the loose plate next to the HE plate pack and inserting the tensioning bolts

8.9.3 Installing HE plates in PHE with a B frame

➔ First carry out the work steps described in chapter “8.9.1 Preparatory measures for installing the HE plates” (page 64).

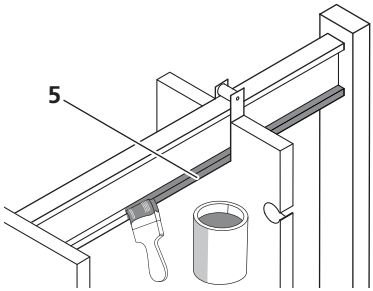


Fig. 8.9.3 a – Applying grease along the beam

1. Clean the HE plate suspension beam [**5**] and apply a little grease.

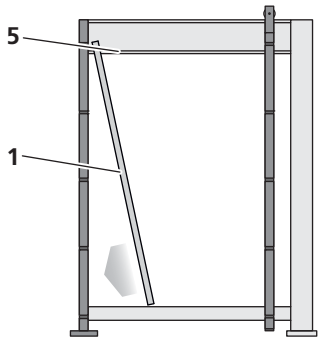


Fig. 8.9.3 b – Installing the HE plate into the frame

2. Install the HE plates [**1**] in the PHE frame in the correct order.

➥ Swing one HE plate at a time laterally into the HE plate suspension of beam [**5**]. Push the HE plates towards the fixed plate one by one.

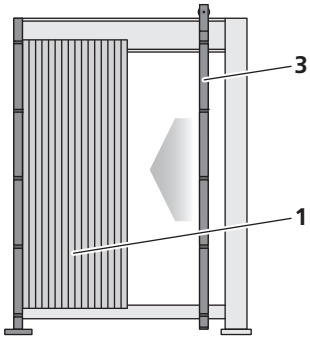


Fig. 8.9.3 c – Pushing the loose plate next to the complete HE plate pack

3. Push loose plate [**3**] next to the HE plate pack [**1**] and insert all tensioning bolts.

➥ Do **not yet** tighten the HE plate pack.

➥ Continue in the next chapter 8.9.4.

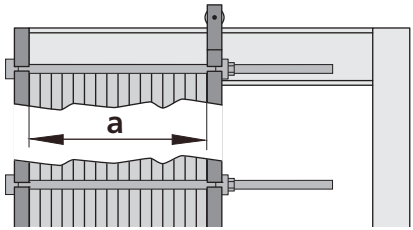
8.9.4 Tensioning and testing the HE plate pack

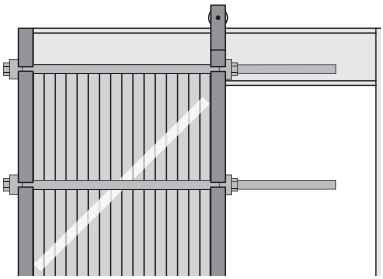
NOTICE

Damage to HE plates by excessive tightening

When tensioning the HE plate pack beyond the value permitted by tensioning dimension a min., the HE plates will be damaged and the PHE may leak.

➔ Tension the HE plate pack of the PHE within the fixed values a min. < a < a max.

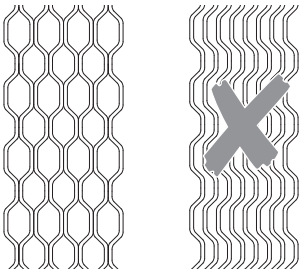




1. Check if the HE plates have been properly installed.

➥ To do this, use the diagonal strip of paint you have applied before opening the PHE.

Fig. 8.9.4 a – Diagonal strip of paint as an aid for checking the order



2. Check if all HE plates have been correctly installed (no reverted installation).

➥ When all HE plates are properly installed, the HE plate pack usually shows a continuous honeycomb pattern (left).

Fig. 8.9.4 b – Lateral honeycomb pattern of correctly installed HE plates

3. Determine the necessary tensioning dimension a.

➥ The necessary tensioning dimension a is:

- in case of complete replacement of HE plate gaskets: the a max. specified on the rating plate a max.
- if the plates were merely cleaned and no HE plate gaskets were replaced: the tensioning dimension a taken down before opening the PHE.
- in case the number of HE plates has changed: the new tensioning dimension a max. which can be taken from the enclosed circuit diagram and the new rating plate.

4. Tighten the tensioning bolts to the necessary tensioning dimension a in small steps alternatingly (see 8.4.1 and 8.4.2) and diagonally.

5. Carry out a leakage test prior to putting the unit into operation again. Here the test pressure must be equal to the max. permitted pressure specified on the rating plate and must be applied to the PHE on all sides at the same time.

✔ Now the HE plate pack is tensioned again and tight.

➔ Refer to chapter „Troubleshooting“ (Seite 70) when leaks occur.

9 Troubleshooting

Prior to removing faults

You should contact your GEA PHE Systems Sales Office (see rear cover) before removing faults in order to avoid improper work on the PHE and its consequences.

9.1 Output deficit

Fault	Reason	Remedy
Reduced heat transfer	Deposits on the HE plates	Clean HE plates - see chapters 8.6 (page 61) and 8.2 (page 49)
	Change of operating mode, flow media etc. as compared with the design case	Have PHE design with new operating data checked by GEA PHE Systems
Excessive pressure loss	Plugging of manifold flow gaps obstructs flow	Clean HE plates - see chapters 8.6 (page 61) and 8.2 (page 49)
	Incorrect installation of HE plates obstructs flow	Check installation order by means of circuit diagram
	Change of operating mode, flow media etc. as compared with the design case	Have PHE design with new operating data checked by GEA PHE Systems

9.2 Leaks

Fault	Reason	Remedy
Leaks between the HE plates - flow media escape from the HE plate pack	Incorrect tensioning dimension of PHE	Check correct tensioning dimension according to rating plate data
	Excessive operating pressure	Check operating pressure according to rating plate data
	Excessive / insufficient operating temperatures	Check operating temperatures according to rating plate data
	HE plate gaskets are not properly seated	Open the PHE and correct the seat of HE plate gaskets
	HE plate gaskets are soiled	Open the PHE and clean the HE plate gaskets
	HE plate gaskets either defective or hardened	Open the PHE and replace the HE plate gaskets
Leaks between HE plates and frames, reinforcement plates and intermediate plates	Incorrectly seated HE plate and frame gaskets	Open the PHE and correct seat of plate and frame gaskets
	HE plate and frame gaskets are soiled	Open the PHE and clean the HE plate and frame gaskets
	HE plate and frame gaskets are defective	Open the PHE and replace the HE plate and frame gaskets

Fault	Reason	Remedy
Leaks between frame connection and pipework	Excessive load of frame connection from pipework	Reduce connecting loads to permitted values
	Gasket improperly seated	Slacken off frame connection and correct gasket seat
	Dirty gasket	Slacken off frame connection and clean the gasket
	Defective gasket	Slacken off frame connection and replace the gasket
	Flange connection is not sufficiently tightened	Check gasket and retighten connection evenly if required
Damaged HE plates	Excessive tightening of HE plate pack (tensioning dimension below a min.)	Replace defective HE plates
	Corrosion of HE plate material	Check design of PHE regarding flow media, contact GEA PHE Systems
Damaged HE plates at the beginning or at the end of the PHE	Incorrect earthing when welding on special connections to open frame connecting pipes	Replace defective HE plates

10 Technical terms

Term	Meaning
B frame	A particularly sturdy frame version permitting a high number of HE plates.
Bottom guide beam	Component serving for bottom guiding of HE plates and of the loose plate. Particularity: In C frames, the HE plates stand on and are supported by this beam.
C frame	A compact PHE frame design. In a C frame, the possible number of HE plates is lower than in a corresponding B frame.
CIP process (Cleaning In Place)	A cleaning process in which the flow channels of the unopened PHE are flushed with specific cleaning media.
Column	A fixed frame component to which the top beam and the bottom beam are attached.
Connection (pipe connection)	Piping connections provided on the fixed plate and possibly on the loose plate. Depending on the application, the piping connections may be executed in different ways (industrial version, rubber moulding, metal lining, flange nozzle etc.).
EcoLoc	A glueless fastening system for HE plate gaskets.
Fixed plate	The basic component of a frame. The fixed plate is a non-movable frame plate. Normally, the pipes are connected to this component.
Flow media	The term for the media involved in the heat transfer in the PHE.
Frame gaskets	Provide sealing of frame plates in the pipework connecting area. Versions as gasket ring (sealing on one side) or rubber moulding (sealing on both sides).
Frame plates	The fixed and loose plate of a PHE frame.

Term	Meaning
Gasket groove	Continuous recess stamped into the HE plate in which the HE plate gaskets are installed. When installing HE plate gaskets by gluing, the glue is applied here.
Gasket ring	Provides single-sided sealing of frame plates in the pipework connecting area. Gasket rings are located in a gasket groove.
HE plate gaskets	An elementary component for sealing the flow gap between the HE plates towards the environment and the leakage space. There are HE plate gaskets for glued and for glueless fastening (LocIn, EcoLoc) to the HE plates.
HE plate pack	The collective term for all of the HE plates located between the frame plates, including the HE plate gaskets.
HE plates	An elementary component that keeps the flow media separated from each other and transfers the heat.
Header channel	The flow channel of the outgoing medium formed by all passage openings of the HE plates.
Insulation	An insulating layer provided around the HE plate pack. GEA PHE Systems recommends an insulation at high and low operating temperatures.
Intermediate plate	A component inside the HE plate pack. The intermediate plate has lateral piping connections for multi-stage PHE designs.
Leakage space	Area around the gasket eyes (see page 22).
LocIn	A glueless fastening system for some types of HE plates.
Loose plate	A movable frame plate suspended at the frame top beam. This frame plate serves for tensioning the HE plate pack. The loose plate may have piping connections.
Manifold channels	The flow channel of the incoming medium formed by all passage openings of the HE plates.

Term	Meaning
Metal lining	Lining of the frame plates in the area of piping connections. The material used (stainless steel grades, titanium, etc.) depends on the application.
Multi-pass PHE	A special PHE design with internal deflections of the flow media. The design of multi-pass PHE always results in piping connections on the loose plate.
Multi-stage PHE	A special PHE version with more than 2 flow media (use of intermediate plates). This version combines more complex heat transfer tasks in one single PHE (heating and cooling, e.g. in food applications).
PHE	Short form of the term “Plate Heat Exchanger”.
Rating plate	A plate fitted on the fixed plate and indicating the basic technical data of the PHE.
Reinforcement plate	A component inside the HE plate pack. The reinforcement plate has no piping connections and is used for special multi-pass PHE designs.
Reverse flushing	A cleaning process in which the flow direction is reversed at regular intervals. This flushes dirt out of the PHE.
Rubber moulding	A positive lining (elastomer) of the frame plates in the piping connecting area. It serves for sealing towards both the HE plate pack and the connected piping.
Single corner (single pipe corner)	Component of the intermediate plate in the HE plate pack. This intermediate plate is used for realizing multi-stage PHE variants. The single corners are used for connecting additional pipes/media (especially for food applications).
Single-pass PHE	The standard version of a PHE with two flow media. The connections are usually located on the fixed plate.
Splash guard	An protective guard provided around the HE plate pack. GEA PHE Systems recommends fitting a splash guard when using hazardous media as a general rule. The splash guard can be included in the order.
Suspension (of loose plate)	The suspension of the loose plate on the top beam (normally using a moving roller). This suspension enables relocating the loose plate on the top beam.

Term	Meaning
Tensioner	Consists of tensioning bolt, tensioning nut and thrust washers/washers. The HE plate pack is tensioned between the frame plates by means of several tensioners.
Tensioning dimension a a max. / a min.	Dimension relating to the unpressurized (!) PHE. The HE plate pack between the frame plates must be tensioned to this dimension. The HE plate pack may be damaged if the actual tensioning dimension is below the specified a min. value. The tensioning dimension must be measured at the tensioning bolts.
Top beam	The component located at the top between the fixed plate and the column and on which the HE plates and the loose plate are suspended. Particularity: In C frames the top beam has a guiding function of the HE plates.

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GEA Heat Exchangers

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