GEABloc® Plate heat exchanger



General Operating Instructions

Process Equipment Division

GEA Ecoflex

GEABloc®
Plate heat exchanger

General Operating Instructions

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1 Preface

Within the **GEA Process Equipment Division** of the international **GEA Group**, **GEA PHE Systems** is responsible for plate heat exchanger technologies. Strong individual companies: GEA Ecoflex, GEA ViEX, GEA WTT, GEA Ecobraze and GEA PHE Systems NA with production locations in Germany, Sweden, USA, Canada and India manufacture gasketed, fully welded and brazed plate heat exchangers for worldwide distribution for use in almost all industrial applications. GEA EcoServe – the GEA PHE Systems service organisation - operates customer service centres in many countries to provide a rapid and competent maintenance and spare parts service, all around the world.

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

We would like to make the handling of the GEABloc plate heat exchanger as safe and simple as possible. For this reason, these comprehensive operating instructions serve as your personal adviser who explains everything understandably and clearly: structure, function, installation, operation, maintenance, troubleshooting, transport and repair.

We especially devote ourselves to the subject of safety, so that all possible dangers or damage can be avoided from the start. For that reason alone, all employees who deal with the plate heat exchanger should be able to refer to these important operating instructions at all times.

In the concise table of contents you will quickly find what you are looking for. If not, look in the index with page references. In the same way all technical terms are informatively explained. After all, no questions should remain open, and in the case they do, your GEA PHE Systems agent or the central service department is glad to assist you further.

Additional operating instructions for special applications supplement these general operating instructions.

With this in mind, we wish you a trouble-free operation with GEA PHE Systems plate heat exchangers.

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2 Safety at the plate heat exchanger

2.1 General safety

This chapter advises you on general precautions for the proper handling of the plate heat exchanger and on the dangers the user may encounter.

If the plate heat exchanger is employed improperly or not according to the intended purpose, or if the safety notes are not observed, dangers to persons and property can arise.

NOTE

Please read this chapter attentively. It contains important information and obligations. It concerns your health and the trouble-free operation of the plate heat exchanger.

WARNING

The operating company is responsible for the safe operation of the plate heat exchanger.

The following points must be observed:

- ➔ Always adhere to the general, national, and operational safety regulations, e.g. wear protective glasses, close-fitting protective clothing, and safety shoes.
- ➔ Always adhere to the safety instructions in the individual chapters of these operating instructions.
- ➔ The plate heat exchanger may be operated only in perfect condition. Each modification of the plate heat exchanger must immediately be reported to the nearest person responsible who is available.
- ➔ Before starting work on the plate heat exchanger, operators must familiarise themselves with the possible hazards.
- ➔ Ensure that all parts of the plate heat exchanger are in perfect condition and function correctly every time before operating the unit.

2.2 Incorrect operating conditions

Operation of the GEABloc plate heat exchanger is not permitted if:

- substantial faults or damage have occurred,
- maintenance is not performed on a regular basis,
- the permissible operating conditions (including internal pressure, temperature, media, external loads) are exceeded.

NOTE

GEA PHE Systems accepts no liability for damage caused by incorrect operating conditions.

2.3 Permitted operators

For operation of the GEABloc plate heat exchanger, everyone has to

- be appropriately trained for the task to be performed,
- be familiar with the work safety and accident prevention regulations,
- be instructed in the handling of the plate heat exchanger and
- have read and understood these operating instructions.

Persons who are responsible for set-up, assembly, start-up, maintenance or disassembly of the plate heat exchanger must have the knowledge required.

2.4 Residual hazards

Residual hazards can never be completely excluded. You can only avoid these hazards by appropriate behaviour.



DANGER

Danger of injury!

- ➔ **Outside of the plate heat exchanger:**
  The burr, threads or similar present a risk of injury. Always wear suitable protective gloves when handling the outside of the plate heat exchanger.
- ➔ **The plate heat exchanger may tip over:**
  All plate heat exchangers that are standing upright and not fixed present the risk of tipping over. Always secure the upright plate heat exchanger against tipping over by preferably fixing it securely to the ground.
- ➔ **Opening the plate heat exchanger:**
  Before opening the plate heat exchanger, ensure that it is unpressurised and empty and that the unit is at room temperature.
- ➔ **Transporting the plate heat exchanger:**
  Before transporting the plate heat exchanger, always ensure that the hoisting gear is of sufficient dimensions and securely fixed. Never step underneath suspended loads.
- ➔ **Hazardous flow media:**
  Hazardous flow media present hazards of chemical burns, burning or poisoning. Always wear suitable protective clothing when working on a plate heat exchanger with hazardous flow media.
- ➔ **Operation at low or high temperatures:**
  Hazard of frostbites or burns when the surface temperature of the PHE is below –5°C or above 50°C.You must insulate the plate heat exchanger in order to protect persons against frostbites and burns. Attach suitable and well-visible warning signs on the insulation or on the protective device.

3 Operating instructions

3.1 About these operating instructions

These operating instructions are the manufacturer's instructions for operators of GEABloc heat exchangers and for all persons who are responsible for the set-up, operation, maintenance and repair of the GEABloc plate heat exchangers.

These operating instructions are generally valid for all welded GEABloc plate heat exchangers manufactured and delivered by GEA PHE Systems.

3.1.1 User notes

Drawings and figures

The drawings used in these operating instructions are exemplary. For reasons of clarity, some drawings have been greatly simplified. The actual details depend on the individually delivered plate heat exchanger. You find diagrams and dimensions of the delivered plate heat exchanger in the technical documentation supplied.

Operator of the plate heat exchanger

The operator of the plate heat exchanger is the person who is in charge of operating the unit by order of the operating company.

Technician setting up the plate heat exchanger

These operating instructions contain no details about special tools that are needed for setting up and operating the plate heat exchanger.

3.1.2 Safety notes in the text

These operating instructions use the following symbols for drawing your attention to hazards involved when handling the plate heat exchanger or for providing you with information about handling the plate heat exchanger:



CAUTION

This symbol points to a potentially hazardous situation which may cause medium or light injuries or material damage unless it is avoided.

The following text explains the type of hazard and its effects and provides instructions for averting the hazard.

➔ Failure to adhere to the instructions can have health effects or cause substantial damage to the plate heat exchanger.



WARNING

This symbol points to a possible hazard which may cause serious injuries or even kill you unless the hazard is avoided.

The following text explains the type of hazard and its effects and provides instructions for averting the hazard.

➔ Failure to adhere to the instructions can have health effects including death.



DANGER

This symbol points to an imminent large-scale hazard which will certainly cause serious injuries or even kill you unless this hazard is avoided.

The following text explains the type of hazard and its effects and provides instructions for averting the hazard.

➔ Failure to adhere to the instructions can have health effects including death.

NOTE

This symbol appears above paragraphs that provide you with useful or important notes for the correct handling of the plate heat exchanger. This information helps you to avoid problems and makes it easier to handle the plate heat exchanger.

4 Operating company's obligations

WARNING

Danger of injury!

In the case of hazardous media (acids or similar media), high pressure levels and high/low temperatures in the plate heat exchanger, there is a danger of injury during maintenance or in case of leaks.

➔ In this case you must be sure to provide a splash protector.

➔ This splash protector may only be removed after the plate heat exchanger pressure and temperature has been relieved/lowered to room levels, or has been emptied.

As the operating company of the GEABloc plate heat exchanger you must ensure that each operator who is responsible for setting up, operation, maintenance or repair of the plate heat exchanger has read and understood, from beginning to end, the parts of the operating instructions important for the job.

The GEABloc plate heat exchanger is built according to state-of-the-art technology and is reliable in service. Nevertheless the plate heat exchanger may present hazards or may be damaged if you do not observe the following instructions:

- These operating instructions must always be accessible to the operators entrusted to work on the plate heat exchanger.
- Only operators who are instructed in handling the plate heat exchanger and the basic work safety and accident prevention regulations may work on the plate heat exchanger. For safety reasons other persons are not allowed near the plate heat exchanger.

- You must check the safety-conscious work of the operators at regular intervals.
- As the operating company you must ensure that:
  - the plate heat exchanger remains in functional order.
  - no premature wear of specific parts of the plate heat exchanger can result from unfavourable ambient conditions.

Unfavourable ambient conditions, for instance for sealing materials, include:

Gasket material:	– Aggressive gases and/or aggressive aerosols in the surrounding air – Effects of UV radiation (e.g. sunlight) – Extreme ambient temperatures
Metallic components:	– Aggressive gases and/or aggressive aerosols in the surrounding air – Humidity

  - all maintenance operations/inspections are carried out at regular intervals.
  - no changes or modifications are carried out on the plate heat exchanger unless approved by the manufacturer of the plate heat exchanger. A modification can lead to the expiry of the operating permit.
  - all laws and regulations - even if they are not explicitly mentioned here - applicable to the GEABloc plate heat exchanger as well as the applicable accident prevention regulations are observed.

5 Operational limits

CAUTION

Danger from exceeding the operational limits

The design pressure and temperature are specified on the nameplate of every unit.

➔ These values must never be exceeded.

Limit pressure and temperature values

Never operate the GEABloc plate heat exchanger at elevated pressure and/or temperature levels exceeding those specified on the nameplate (see 7.3 “Identification” page 18).

Flow velocity

The minimum flow velocity is 10% of the gap velocity specified in the data sheet.

When feeding steam, superheated water or thermal oil into the primary circuit of the plate heat exchanger, the flow velocity in the secondary circuit must be at least 20%. Interrupting the flow in the secondary circuit may result in transient condensation shocks in the plate heat exchanger and in condensation in the piping. Repeated transient condensation shocks may cause damage to the heat exchanger and its environment.

CAUTION

Hazard from operating the plate heat exchanger under vacuum or when empty.

Unless specifically designed for such conditions, plate heat exchangers do not work under vacuum or when empty.

➔ If necessary, a vacuum breaker should be installed.

➔ Check also if your GEABloc plate heat exchanger is suitable for full vacuum operation.

6 Intended use

This GEABloc plate heat exchanger is designed especially to suit the operating conditions such as pressure, temperature and flow rates as well as the type and composition of the flow media specified by you.

If the fixed operating conditions must be modified, this must be agreed with GEA PHE Systems. Operation under modified operating conditions requires the previous inspection, approval and possibly modification of the GEABloc PHE documentation by the manufacturer.

The intended use includes:

- Adhering to the national and international laws, decrees, regulations, directives and other rules in force on the installation site.
- Following all safety instructions provided in these operating instructions.
- Adhering to regular inspection and maintenance work.

NOTE

GEA PHE Systems accepts no liability for damage caused by deviating from the intended use of the GEABloc plate heat exchanger.

7 Overview and description

7.1 Application

By default, the GEABloc plate heat exchanger for liquid/liquid applications is installed vertically. To suit special applications, e.g. as an evaporator or as a condenser, this heat exchanger can also be installed horizontally. However, this requires a suitable previous unit design. The modification of the installation from vertical into horizontal by the customer is not possible.

7.2 Basic structure

Welded plate heat exchangers of the GEABloc series offer a large heat transfer surface, but still are very compact. These units are dimensioned according to their application.

The basic structure of a plate heat exchanger is shown below. The specific design depends on the application.

GEABloc plate heat exchangers are made of welded heat transfer plates. This plate pack is installed between four columns, four side panels and the top and bottom thrust plates, using bolts. This creates a compact plate heat exchanger with two circuits. Every circuit can be fitted with welded or removable baffle plates.

Connection with the piping is through the four solid side panels made of carbon steel and fitted with pipe nozzles. Depending on your order, the side panel coverings and the heat exchanger plates can be made from the same material. The heat exchanger plates, the baffle plates and the side panel coverings can be made from stainless steel, titanium or similar materials.

The individual plates are welded with one another on the two longitudinal sides and at the corners. This creates two pressure-resistant chambers separated from one another inside the unit. Figure 7.1 shows the design of the GEABloc as an exploded view.

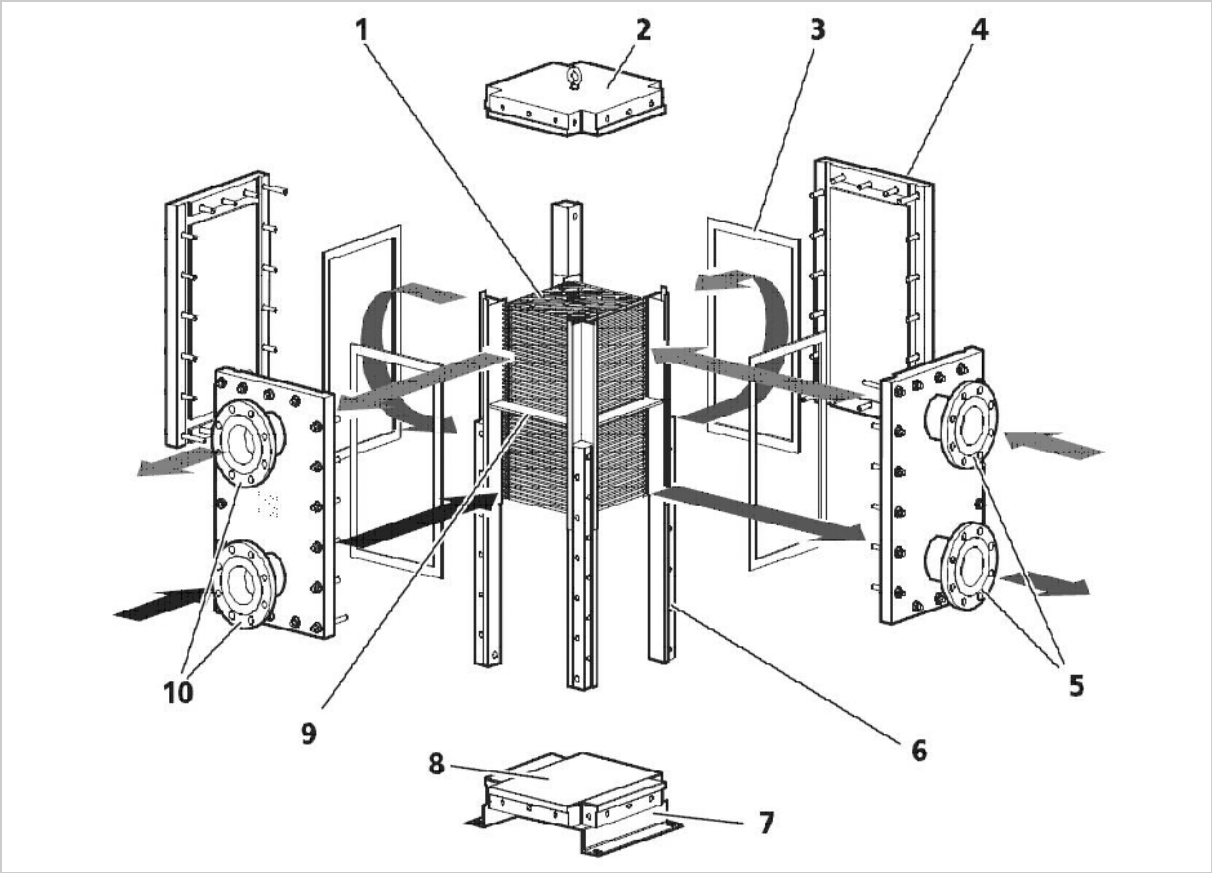


Figure 7.1 – Exploded view of GEABloc

	Designation		
1	Plate pack	**6**	Column
2	Top thrust plate	**7**	Foot
3	Side panel gasket	**8**	Bottom thrust plate
4	Side panel	**9**	Baffle plate
5	Primary circuit connection	**10**	Secondary circuit connection

7.3 Identification

Every GEABloc plate heat exchanger manufactured by GEA PHE Systems has a rating plate. This plate provides information, among others, about:

- Plate heat exchanger type
- Serial no.
- Permitted pressure levels [bar g]
- Permitted temperature levels [° C]
- Testing pressure levels [bar g]
- Capacity [l]
- Dry equipment weight
- Year of construction
- Additional information [project-specific]

Example of arating plate in accordance with the European Pressure Vessel Directive 97/23/EC:

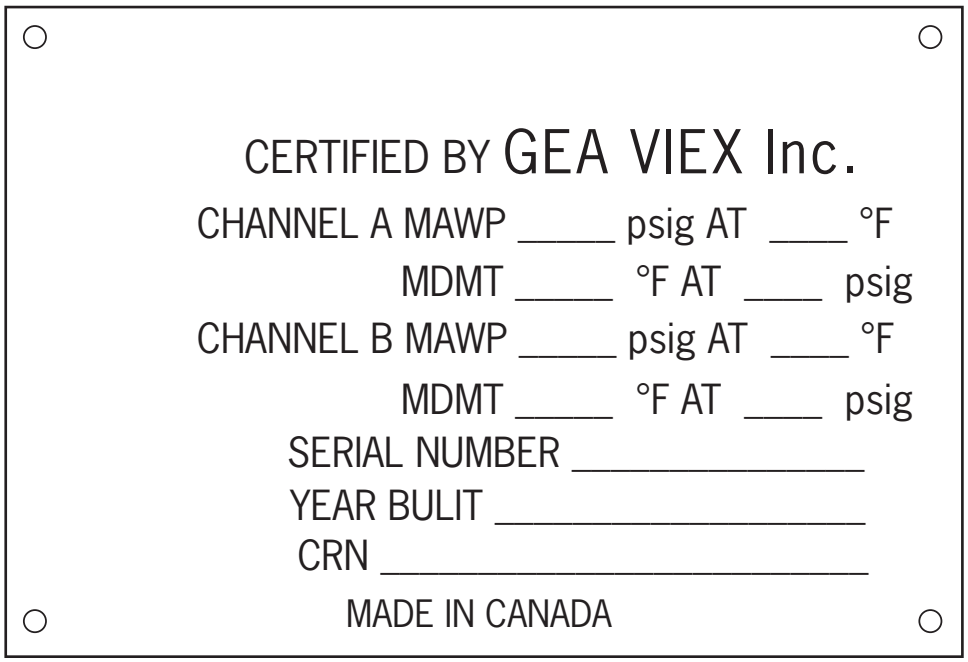
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Name Plate
Leistungsschild für Wärmetauscher
Plaque d'identification de l'Èchangeur de chaleur

Plate Heat Exchanger Type Wärmetauscher Echangeur de chaleur			
Serial no. Fabrik-Nr. No de fabr.			
min./max. allowable pressure min./max. zul. Druck (PS) P min/max de service	bar	1 /	2 /
min./max. allowable temp. min./max. zul. Temp. (TS) T min/max de service	°C	/	/
Test pressure Prüfdruck (PT) Pression d'Épreuve	bar		
Volume Volumen (V) Contenu	L		
Net weight Leergewicht Poids ‡ vide	kg	Fluid group Fluid Gruppe Groupe de fluide	
Year of constr. Herstellungsjahr AnnÈe de fabr.		Index-no. Kenn-Nr. Ident-no.	CE
"a" max	mm		
"a" min	mm		

9.562-404

Example of a rating plate in accordance withASME:



Every GEABloc plate heat exchanger comes with a dimension sheet.

The dimension sheet includes, among others, the external dimensions as well as type, size and position of the piping connections.

7.4 Heat exchanger plates

Two different plate patterns are available:
A corrugated pattern with a 45° angle and a so-called “double dimple” pattern. This pattern consists of dimples embossed in the plate material both upwards and downwards.

The corrugated pattern produces high heat transfer coefficients at higher pressure drop values and therefore enables higher performance efficiency.

As compared with the corrugated pattern, the “double dimple” pattern has lower pressure drop values and therefore offers less favourable heat transfer properties. However, its special geometry makes it much more easy to clean, which is why this pattern is particularly suited for applications with a high fouling risk.

NOTE

The heat exchanger plate material is selected to meet the customer's requirements (e.g. pressure, temperature, media, operating mode). In some special applications, heat exchanger plate material abrasion caused by the media used is a typical process. This may result in functional failure of the heat exchanger plates and in mixing of the media.

7.5 GasketsGaskets

WARNING

Personal injury and damage to property!

The use of unpermitted pressure and temperature levels as well as media may cause direct functional failure of the gaskets and produce a severe hazard to persons and the environment.

➔ For this reason, never exceed the permitted values.

CAUTION

Leak!

The gaskets are wear parts and sensitive to chemical, thermal and mechanical damage. The selection of the gasket material and its properties follow customer requirements (pressure, temperature, media).

➔ Unit use that is not in line with the intended use may reduce the unit's service life.

In general, there are three types of gaskets:

PTFE gaskets

These gaskets are available as PTFE strips with an adhesive tape on the rear. (see also 10.2.1 "Gasket installation")

Graphite or similar gaskets

The large graphite gaskets can be supplied in 4 or more parts. These gaskets are typically reinforced with stainless steel plates embedded between two graphite layers.

Asbestos-free hard gaskets

These include Klingersil 4430, 4400, 4401, Durabla Green, Red, Blue and others.

8 Installation

8.1 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. Please take a photograph of the damage and report it to us immediately. We need to receive your notification of claim within the legally stipulated period of time, together with the original freight receipt and the signed reservation.

8.2 Transport

DANGER

Danger to life! Damage to the plate heat exchanger!

Before transporting the plate heat exchanger, always ensure that:

- ➔ the hoisting gear is of sufficient dimensions,
- ➔ the hoisting gear cannot come loose or slide off,
- ➔ a sufficient safety distance is respected by the operating personnel,
- ➔ the floor at the installation site is sufficiently large, level and able to support the load.

CAUTION

Damage to the plate heat exchanger!

The connecting nozzles can bend, start cracking partially or break off completely.

- ➔ Attach the hoisting gear (slings) only as described below.
- ➔ When attaching the hoisting gear (slings), make sure that they are firmly seated.

8.2.1 Vertical GEABloc units

➔ For lifting the plate heat exchanger, attach two slings at the rings and/or eyelets at the top of the PHE (Figure 8.1).

DANGER

➔ Never use the pipe nozzles for transporting the unit.

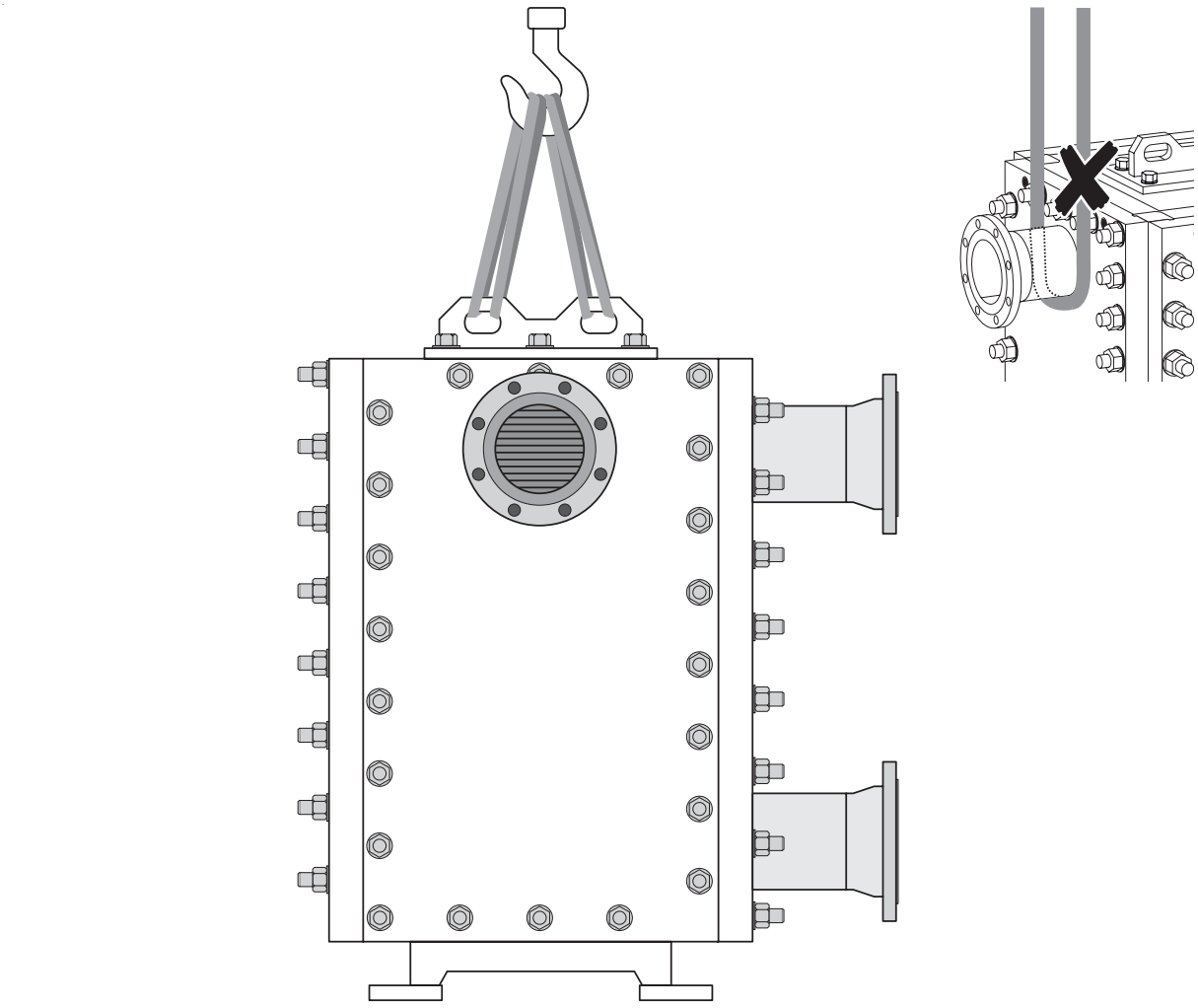


Figure 8.1 – Transporting with round slings

8.2.2 Horizontal GEABloc units

BT20 - BT30 - BT40 - BT50 - BT75

➔ For lifting the plate heat exchanger, attach two slings at the eyelets and use a cross beam as shown in figure 8.2

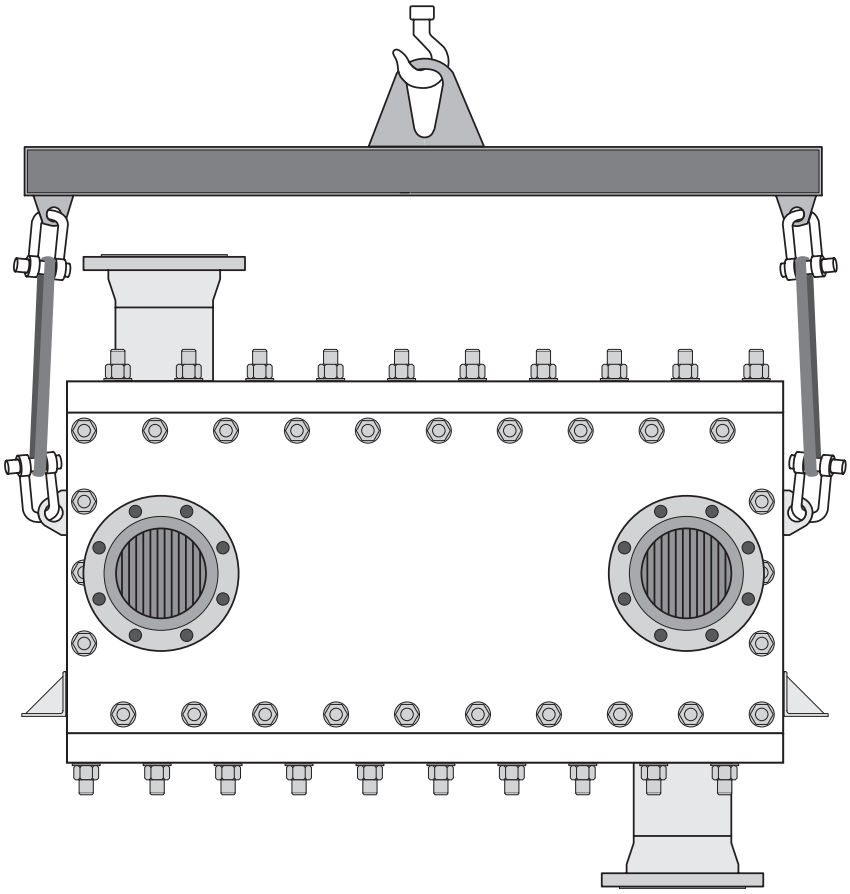


Figure 8.2 – Transporting with a cross beam

8.3 Installation

WARNING

Danger to life! Tipping over of PHE even from the effect of a small force

There is always danger of tipping over when installing the plate heat exchanger. All plate heat exchangers that are standing upright and not anchored present the risk of tipping over.

➔ Plate heat exchangers standing upright must immediately be fixed to the ground before removing the hoisting gear.

We recommend leaving a free space of 60 cm (24") around the GEABloc plate heat exchanger for maintenance and inspection work in order to make removal of the side panels easier.

A free space of 100 cm (40") must remain above the plate heat exchanger to enable the use of a suitable hoisting gear if required (see figure 8.3).

8.4 Connections / piping

Piping

Connecting the plate heat exchangers does not require any particular safety precautions. However, if the connecting lines include long, straight sections, the appropriate pipe bends and expansion joints must absolutely be fitted and the piping supports must be positioned at a distance of 200 cm (72") max. from the plate heat exchanger (see figure 8.3 and section 8.5 “Allowed loads on the pipe nozzles” page 28).

Shut-off valves

The shut-off valves of the plate heat exchanger must be positioned so that the side panels can be removed without having to dismount the valves.

The function of the valves must always be ensured. We recommend using shut-off valves or butterfly valves.

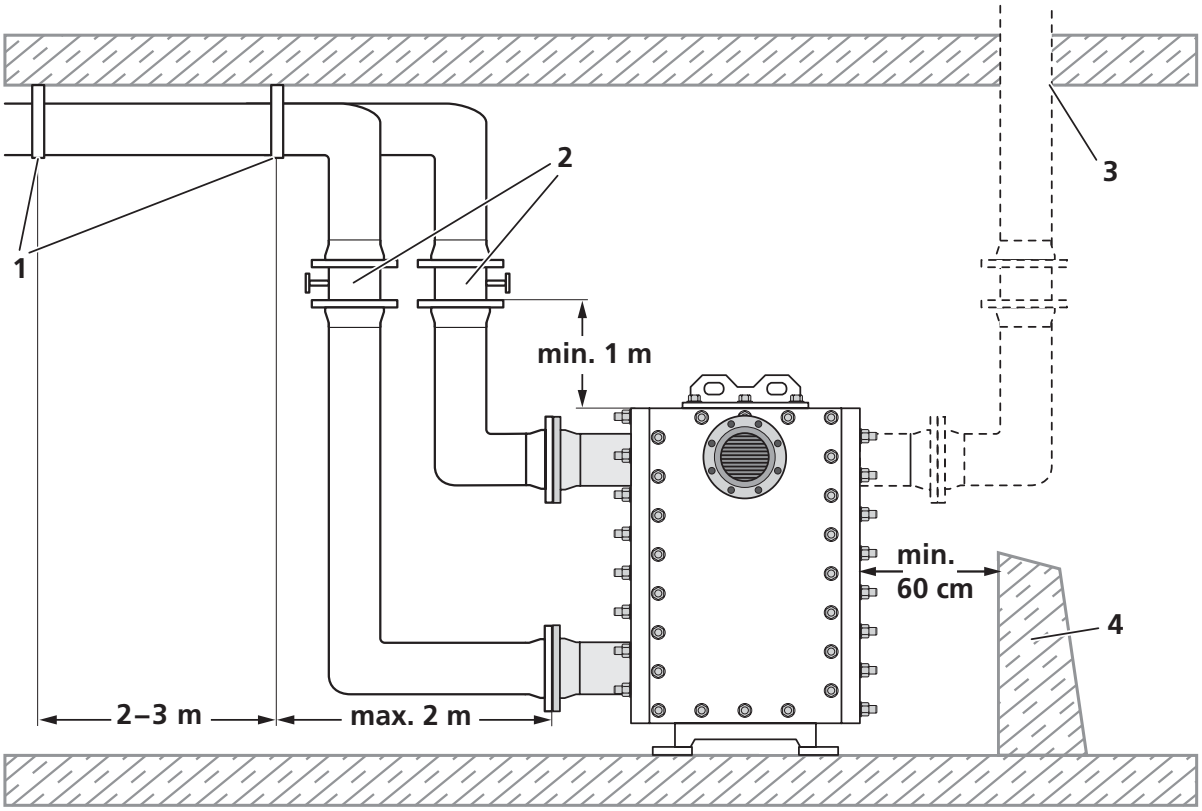


Figure 8.3 – General installation sketch

Designation:	**1**	Sliding support	**3**	Holder
	2	Shut-off valves	**4**	Separating wall

Filter

If the operating conditions so require or if there are particles in the medium, install a filter with a mesh size of 3 mm (1/8") max. in the feed line upstream of the plate heat exchanger. In the GEABloc plate heat exchanger with the "double dimple" pattern, filters with a much bigger mesh size can be used.

Control elements and settings

Valves opening and closing continuously should be used in order to avoid water hammers.

Settings and control elements as well as the process employed in the circuit must be thoroughly examined in order to avoid thermal or mechanical stress in start-up and transition phases.

When operating the heat exchanger with superheated water, the settings should be in line with the specifications in the corresponding installation manual.

CAUTION

Hazard from missing second liquid circuit

➔ The GEABloc unit must not be operated with just one liquid circuit.

Vents and drains

Usually, the pipe nozzles of GEABloc heat exchangers are positioned as far as possible at the top and at the bottom so that venting and draining can be automatic.

Large-size GEABloc heat exchangers are fitted with vents and drains on the side panels (3/8" NPT or 1" flange connection) which should always be connected to the drain and vent circuits via valves. This enables draining and venting the heat exchanger as required.

We urgently recommend keeping the vent valve open at all times so that permanent automatic venting is possible. When failing to connect the vents (especially when using liquids that produce gases), our warranty may expire. This is the case with most heat recovery units having their feed connection at the bottom where the cold medium usually releases substantial quantities of entrapped and/or dissolved gases.

8.5 Allowed loads on the pipe nozzles

CAUTION

Damage to the piping connections and on the heat exchanger!

➔ Ensure that the forces, torques and vibration loads transmitted from the piping to the plate heat exchanger connections are not too high.

Figure 8.1 shows the reference axes for maximum loads.

Table 8.1 shows the allowed connection loads relating to force “F”.
Table 8.2 shows the allowed connection loads relating to torque "M".

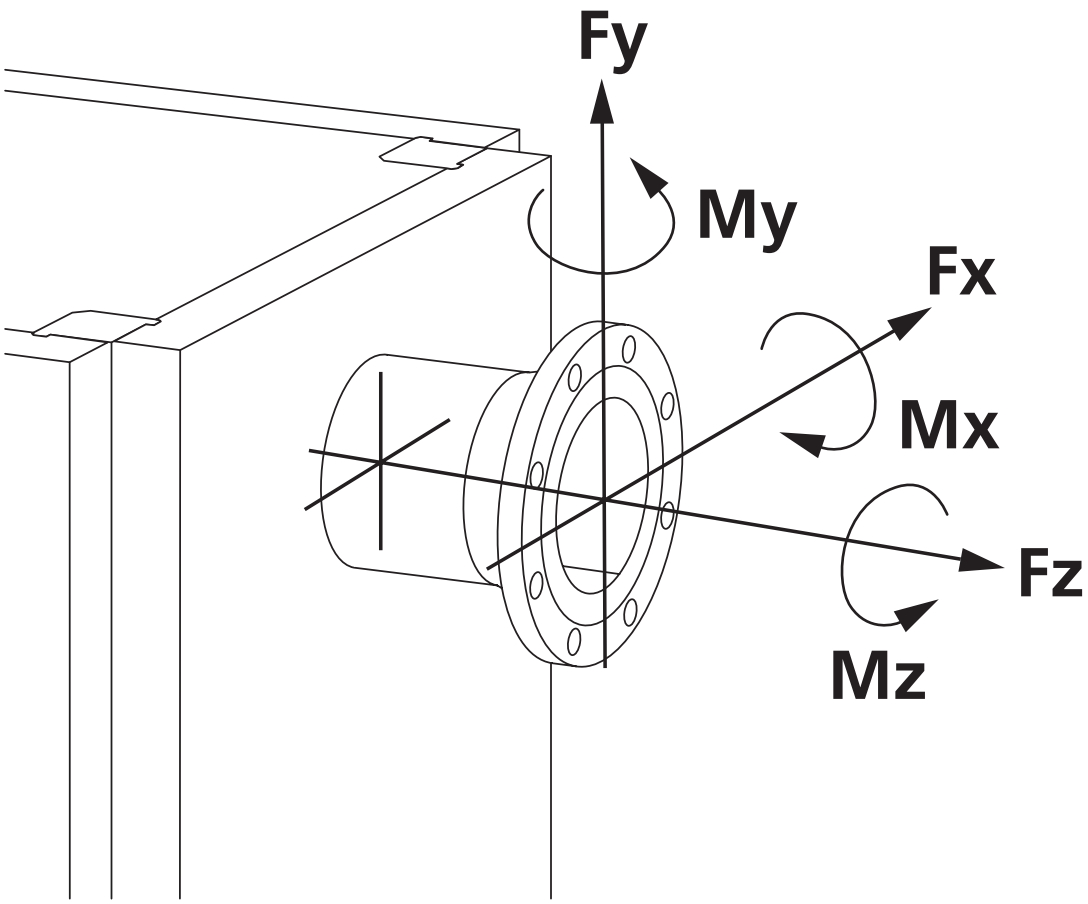


Figure 8.1 – Reference axes for maximum loads

Table 8.1 – Allowed connection loads for forces "F"

Allowed connection loads							
Rated diameter		**Forces**					
DN	***NPS***	**Fx**		**Fy**		**Fz**	
[mm]	*[inch]*	[N]	*[lbf]*	[N]	*[lbf]*	[N]	*[lbf]*
25	*1″*	-90	*-20*	90	*20*	-90	*-20*
40	*1 1/2″*	-159	*-36*	159	*36*	-159	*-36*
50	*2″*	-208	*-47*	208	*47*	-208	*-47*
65	*2 1/2″*	-285	*-64*	285	*64*	-285	*-64*
80	*3″*	-365	*-82*	365	*82*	-365	*-82*
100	*4″*	-477	*-107*	477	*107*	-477	*-107*
125	*5″*	-624	*-140*	624	*140*	-624	*-140*
150	*6″*	-776	*-174*	776	*174*	-776	*-174*
200	*8″*	-1096	*-246*	1096	*246*	-1096	*-246*
250	*10″*	-1433	*-322*	1433	*322*	-1433	*-322*
300	*12″*	-1784	*-401*	1784	*401*	-1784	*-401*
350	*14″*	-2146	*-482*	2146	*482*	-2146	*-482*
400	*16″*	-2519	*-566*	2519	*566*	-2519	*-566*
450	*18″*	-2901	*-652*	2901	*652*	-2901	*-652*
500	*20″*	-3292	*-740*	3292	*740*	-3292	*-740*
600	*24″*	-4098	*-921*	4098	*921*	-4098	*-921*

Table 8.2 – Allowed connection loads for torques "M"

Allowed connection loads							
Rated diameter		**Torques**					
DN	***NPS***	**Mx**		**My**		**Mz**	
[mm]	*[inch]*	[Nm]	*[lbf*ft]*	[Nm]	*[lbf*ft]*	[Nm]	*[lbf*ft]*
25	*1″*	0	*0*	0	*0*	0	*0*
40	*1 1/2″*	-37	*-27*	37	*27*	-37	*-27*
50	*2″*	-76	*-56*	76	*56*	-76	*-56*
65	*2 1/2″*	-146	*-108*	146	*108*	-146	*-108*
80	*3″*	-230	*-170*	230	*170*	-230	*-170*
100	*4″*	-358	*-264*	358	*264*	-358	*-264*
125	*5″*	-541	*-399*	541	*399*	-541	*-399*
150	*6″*	-750	*-553*	750	*553*	-750	*-533*
200	*8″*	-1236	*-912*	1236	*912*	-1236	*-912*
250	*10″*	-1809	*-1334*	1809	*1334*	-1809	*-1334*
300	*12″*	-2471	*-1823*	2471	*1823*	-2471	*-1823*
350	*14″*	-3220	*-2375*	3220	*2375*	-3220	*-2375*
400	*16″*	-4060	*-2995*	4060	*2995*	-4060	*-2995*
450	*18″*	-4993	*-3683*	4993	*3683*	-4993	*-3683*
500	*20″*	-6021	*-4441*	6021	*4441*	-6021	*-4441*
600	*24″*	-8379	*-6180*	8379	*6180*	-8379	*-6180*

8.6 Disposal

The disposal of the packaging is your responsibility as the customer.

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

NOTE

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

9 Commissioning, operation, shut-down

WARNING

Danger of injury!

The use of hazardous flow media (caustic, toxic, flammable, explosive, etc.), involves a hazard of chemical and thermal burns.

➔ Obtain information beforehand which flow media are used and ensure that a protective cover is provided is necessary.

CAUTION

Environmental damage! Damage to the plate heat exchanger!

Serious environmental damage can result when environmentally hazardous flow media escape.

➔ Ensure that the product can be drained and that a collecting container for the entire plate heat exchanger capacity is provided.

CAUTION

Damage to the plate heat exchanger!

➔ Quick switching processes (e.g. by valves located in the pipes connected to the plate heat exchanger) or process-related events (e.g. spontaneous evaporation, condensate hammers) may bring about serious liquid hammers.

9.1 Commissioning

To ensure a long service life of the heat exchanger, commissioning should be carried out continuously and evenly.

➔ Fill the secondary circuit while keeping the vent opening open.

➔ Start the pump of this circuit with the inlet valve closed and open this valve slowly.

➔ When the secondary circuit is in operation, open the primary circuit valves step-by-step while the vent opening is open (for at least 5 minutes).

CAUTION

Damage to the plate heat exchanger!

Opening valves suddenly may cause liquid hammers.

➔ Avoid liquid hammers during commissioning by opening the valves slowly.

➔ Run-down products must be directed to the bottom or be drained.

Important: After an extended storage period (2-3 months), check the tightening torques of all bolts and nuts, especially prior to commissioning the unit for the first time (except for Klingersil or equal-standard gaskets which have already been subject to a temperature of more than 100°C).

NOTE

If faults occur while commissioning the plate heat exchanger, see the “Troubleshooting” chapter (page 55).

NOTE

To avoid clogging of the plate heat exchanger during commissioning, GEA PHE Systems recommends using filters or bypass lines when flushing the piping system for the first time.

9.2 Operation

WARNING

Danger of injury! Damage to the plate heat exchanger!

While the plate heat exchanger is in operation, there is danger of injury while working on the plate heat exchanger and the danger of plate heat exchanger damage.

➔ Always shut down the plate heat exchanger first before carrying out maintenance and repair work.

Carry out visual inspections of the plate heat exchanger at regular intervals during operation and ensure

- that the plate heat exchanger is not operated with unpermitted flow media, pressure or temperature levels;
- that the minimum and maximum values specified on the rating plate are not exceeded. When exceeding these values, the operating permit expires and GEA PHE Systems will not be liable for any resulting damage;
- that liquid hammers are avoided. Proper operation of the plate heat exchanger may be endangered, flow media may escape.

NOTE

If faults occur during operation of the plate heat exchanger, see “Troubleshooting” chapter (page 55).

9.2.1 Operating pressure levels, differential pressure

The operating pressure levels must be kept as stable as possible. In any case, the pressure in one circuit must always be higher than in the other circuit. Repeated pressure variations which reverse the pressure conditions inside the unit (e.g. by opening/closing a restrictor valve) may damage the plate pack and cause leaks between the circuits.

The recommended differential pressure between the two circuits is 1 bar g (15 PSIG). The higher the pressure difference, the better!

9.2.2 Operation at low or high temperatures

When the surface temperature of the PHE is below –5°C or above 50°C, you must insulate the plate heat exchanger in order to protect persons against frostbites and burns.

NOTE

Fit suitable warning signs indicating a hazard from frostbites or burns in a well-visible way on the insulation and/or on the protective guard:



"Cold" warning sign (left)
"Hot surface" ISO warning sign (centre), ANSI adaption (right)

9.2.3 Operation as a process condenser

In the “Process condenser” mode, steam is condensed by a coolant (see figure 9.1).

In general, no control unit is built into the system as it is usually operated at a constant coolant flow rate, with the return flow temperature varying as a function of the thermal load.

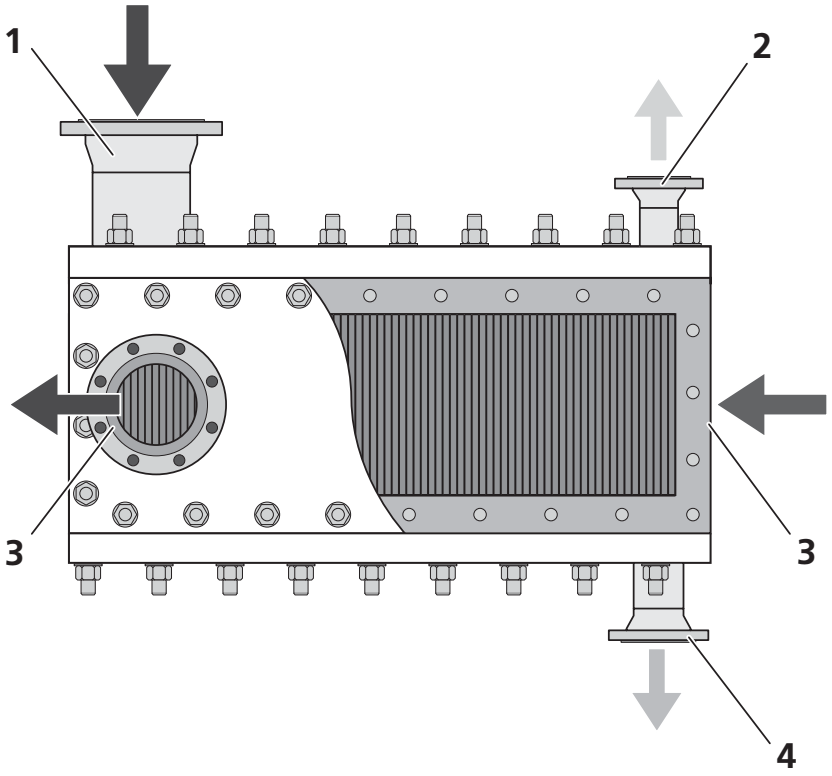


Figure 9.1 – Operation as a process condenser

Designation:	**1**	Steam	**3**	Cooling water
	2	Inert gas	**4**	Condensate

9.2.4 Operation under full vacuum

When the plate heat exchanger is installed or operated under vacuum or is subject to a vacuum at intervals (e.g. when faults occur), please ensure the following:

➔ Ensure that the circuit in question is designed to operate under full vacuum. This can be ascertained by a look at the rating plate fitted on the heat exchanger.

➔ If the circuit in question is not designed for vacuum operation, please contact your local GEA office prior to installation. (see the rear cover).

➔ Install a vacuum valve in order to avoid sudden and hard vacuum conditions when shutting down the unit.

9.3 Decommissioning

If the heat exchanger is shut down during winter, drain the liquids in order to avoid frost damage.

9.3.1 Long-term decommissioning

Stainless steel plates are sensitive to chlorides (pitting corrosion). When the plant is shut down for an extended period, the plates should be thoroughly cleaned with water with a low chloride content. This minimizes corrosion beneath deposits.

CAUTION

Premature component wear!

The plate heat exchanger components may be subject to premature wear due to unfavourable ambient conditions or flow media that have remained inside the plate heat exchanger.

➔ When shutting down the plate heat exchanger for an extended period, the pressure must be relieved and the unit must be completely drained.

➔ In addition, we recommend cleaning the unit thoroughly and storing it properly until it is started up again.

NOTE

Detailed information about storage conditions are available from the GEA PHE Systems service office in charge (see rear cover)..

10 Maintenance and repair

10.1 Removing the side panels

10.1.1 Preparatory precautions

WARNING

Danger of injury!

There is danger of injury during maintenance and repair work carried out on the plate heat exchanger. For this reason, always observe the following rules:

- ➔ Wear suitable protective clothing at all times.
- ➔ When opening a pressurized and/or filled plate heat exchanger, the flow media may escape in an uncontrolled way. This is a danger of injury for the operators and bystanders.
- ➔ Before beginning maintenance or repair work, ensure that the plate heat exchanger is empty and has reached ambient pressure.
- ➔ When using hot or very cold flow media there is a danger of burns, or respectively, frostbites. Before beginning maintenance or repair work, always ensure that the plate heat exchanger has reached ambient temperature.
- ➔ 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.

First of all, drain both circuits completely. Mark the side panels prior to removing them.

➔ Check if none of the two circuits is pressurized (and if the drains are open).

➔ Ensure that the side panel to be removed is properly safeguarded.

10.1.2 Removing a side panel

To avoid deformation of the columns, first slacken off the nuts marked with **#4**. Then slacken off all nuts of the side panel to be removed step by step. Start with nuts **#3** near the columns, then slacken off nuts **#1** and **#2** near the thrust plates (see figures 10.1 and 10.2).

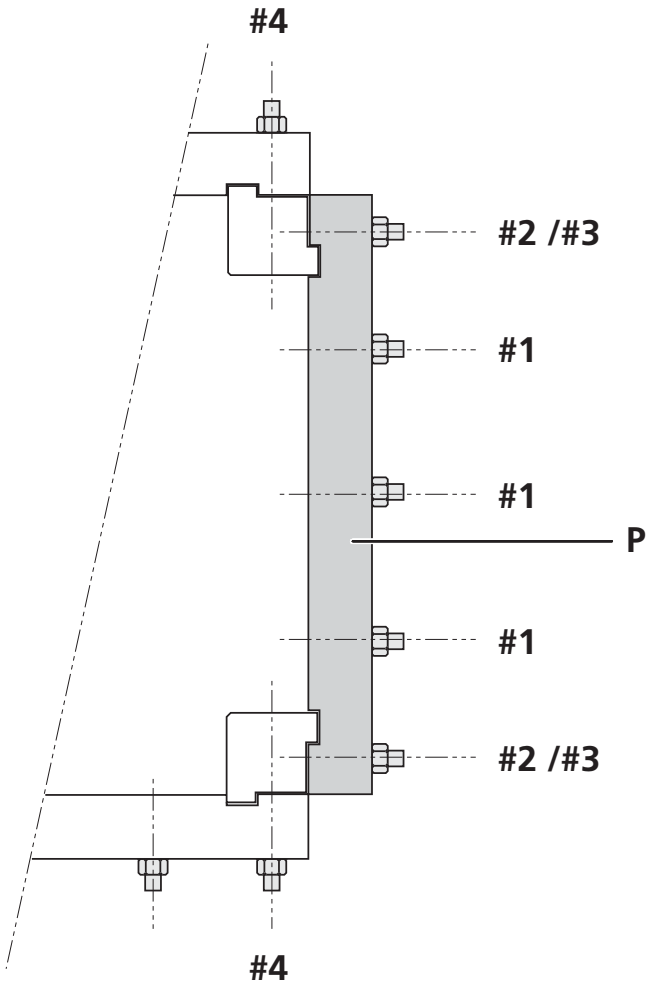


Figure 10.1 – Slackening off nuts

Designation: **P** Removable side panel

DANGER

The plate pack may be damaged.

➔ Never remove the threaded bolts marked with **#2**.

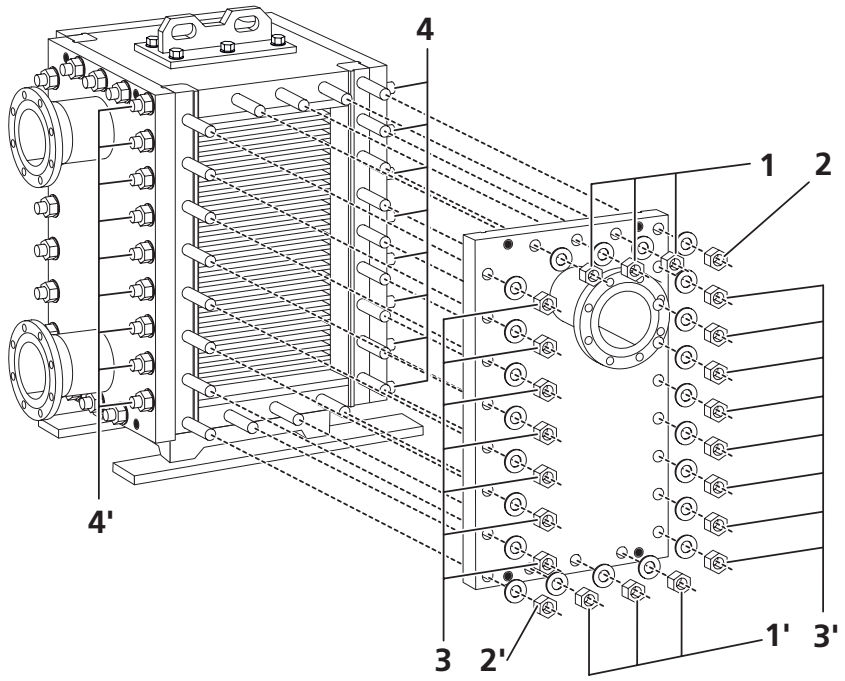


Figure 10.2 – BT20, BT30, BT40

10.1.3 Removal process with four side panels

➔ Slacken off the nuts near the columns step by step and do so on one column after the other. When all column nuts are slackened off, slacken off the thrust plate nuts of one side panel at a time.

On the BT50 and BT75 models, 3/4" threaded holes are provided on the side panels (see figure 10.3) which make removing the panels easier when the gaskets stick to both surfaces.

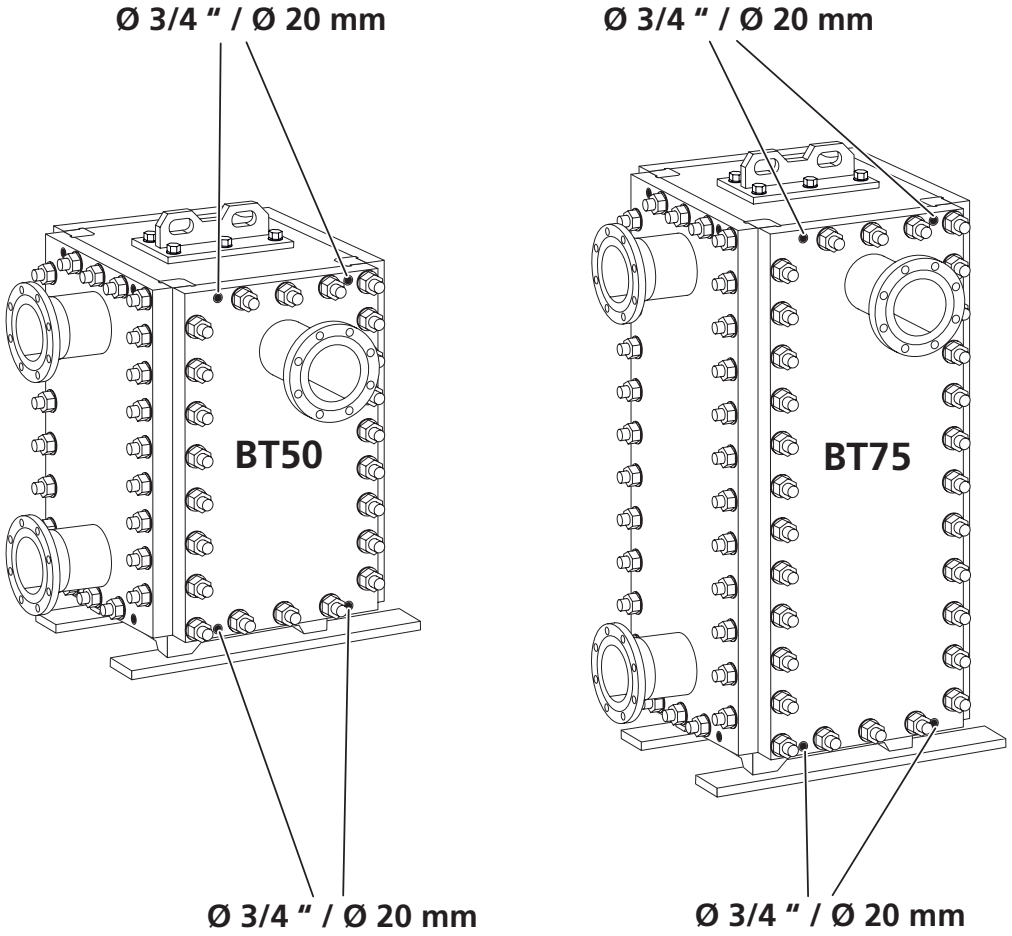


Figure 10.3 – BT50, BT75

10.1.4 Removal and installation of baffle plates

REMOVAL

➔ Take down the position of the baffle plates (see figure 10.4) in the GEABloc plate heat exchanger to enable correct installation at a later date.

➔ Remove the baffle plate cage consisting of two supports and the baffle plates.

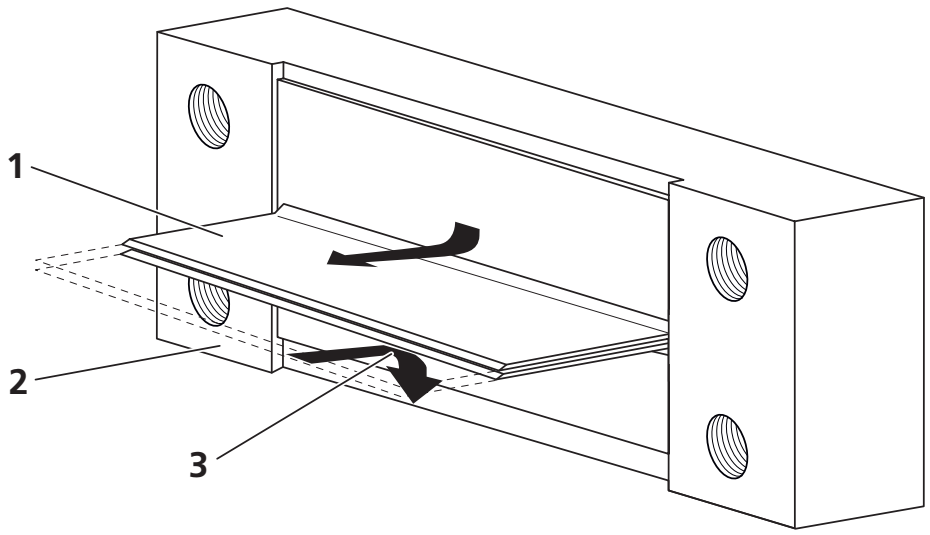


Figure 10.4 – Detailed view of baffle plate

Designation:

1 Baffle plate

2 Side panel

3 Flow direction

INSTALLATION

➔ Inset the baffle plates into the GEABloc plate heat exchanger, one after the other. Ensure that the installation position is the same as that taken down prior to removal.

➔ Ensure that the gasket is properly fitted and the baffle plates are firmly attached to the plates.

➔ Check the clearance between the frame and the sealing strips.

10.2 Installation of side panels

10.2.1 Installation of gasket

We recommend using new gaskets for every assembly. In general there are three types of gaskets (see section 7.5 “GasketsGaskets”, page 20).

Installing a PTFE gasket

- Dimensions: 15 x 3 mm for **BT20**, **BT30**, **BT40** and **BT50**
- Dimensions: 20 x 3 mm for **BT75** (20 x 6 mm special application)

➔ Force the gasket into the middle of the gasket surface of the GEABloc plate heat exchanger. Observe the instructions regarding the corners and the overlaps at the ends (see figure 10.5).

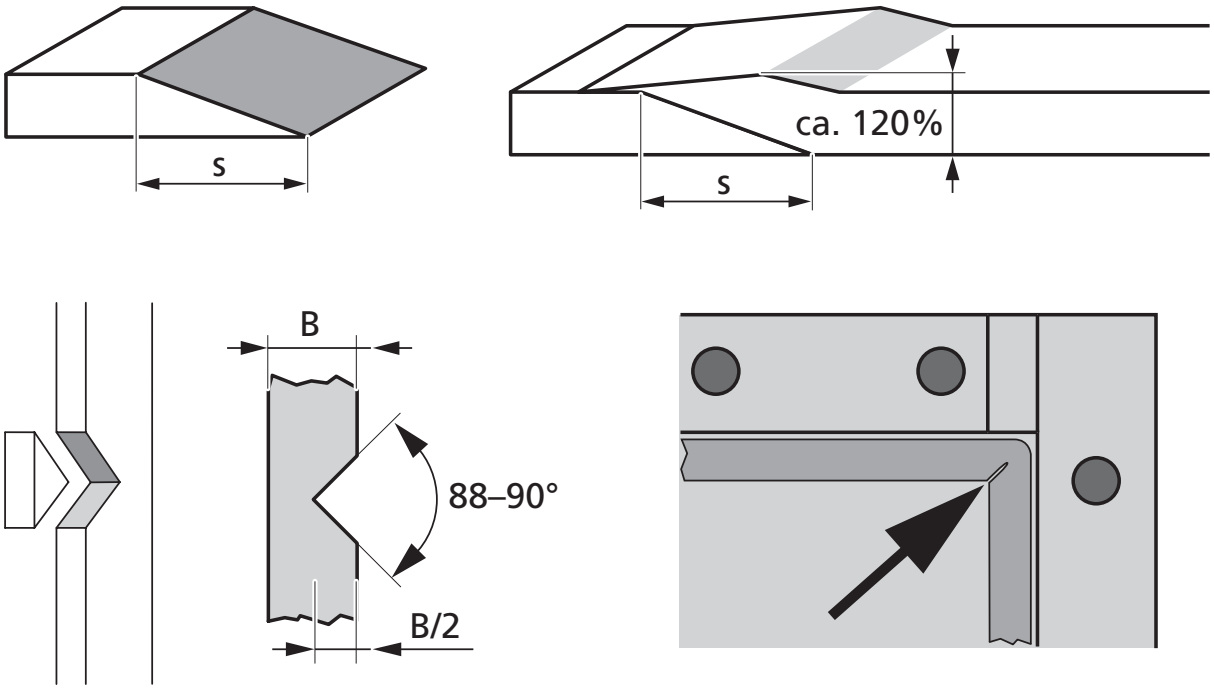


Figure 10.5 – Installation of PTFE gasket

NOTE

The tightness of the GEABloc plate heat exchangers can be assured only when using gaskets from GEA PHE Systems.

10.2.2 Fitting the side panels

➔ On the BT50 and BT75, place the side panel on the 6 mounting bolts 1 and 2 threaded bolts 2 (see figure 10.6).

➔ After positioning the side panel, insert the remaining bolts step by step and place the nuts in position without tightening them.

➔ Install the opposite side panel in the same way and then the two panels of the other circuit.

➔ Now tighten all four side panels at the same time; on heat exchangers with less than 100 plates, use only the bolts marked with #1 and #2 in the thrust plates. On units with more than 100 plates, the bolts marked with #3 can also be used for aligning the side panels properly in the frame (see figure 10.1). Ensure that the gasket will not get out of place and that the side panel will be fitted in parallel with the frame. Check the correct seat of the side panel on the frame and at the thrust plates.

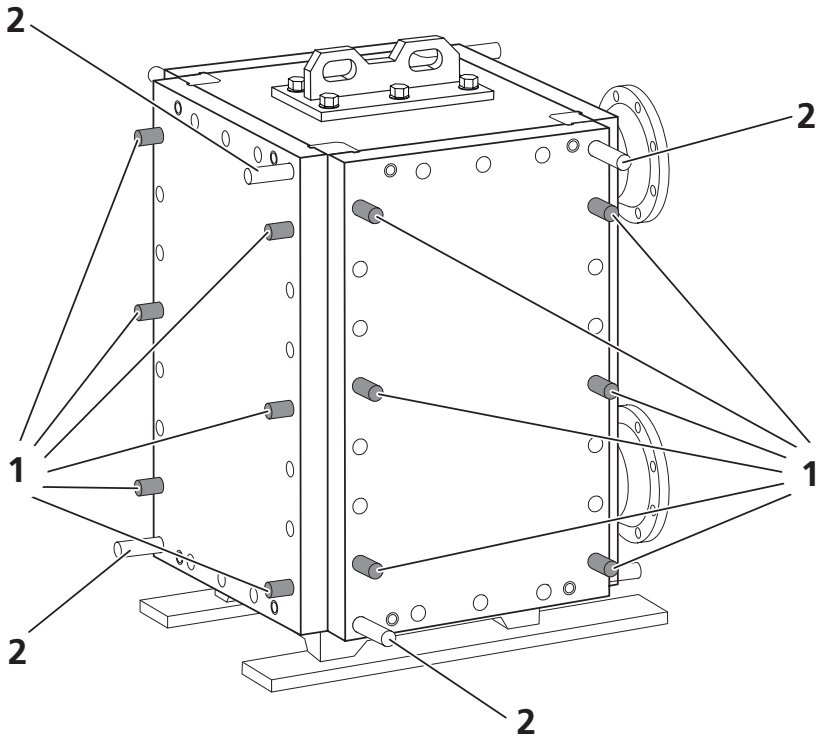


Figure 10.6 – Fitting the side panels

10.2.3 Tightening the side panels

➔ When the four side panels are properly fitted, tighten all frame nuts up to the side panels.

➔ Tighten the nuts marked 1 and 1' diagonally. When the side panels make contact, tighten the nuts marked 2 and 2'. After that, tighten nuts 3 and 3' in a St. Andrew's Cross pattern, starting at the corners (see figure 10.7).

➔ Tighten all nuts to half of their tightening torque.

➔ After that, tighten the nuts of standard gaskets to the tightening torques specified in chapter 10.2.4 "Tightening torques" (see page 47); for other gaskets, use the specific torques indicated in the drawing.

CAUTION

➔ Tighten all frame nuts again firmly before recommissioning the unit.

➔ When all **four** side panels were removed, repeat this process for all sides. // If only **one** side panel was removed, do not forget to tighten the frame nuts of the adjoining side panels as well.

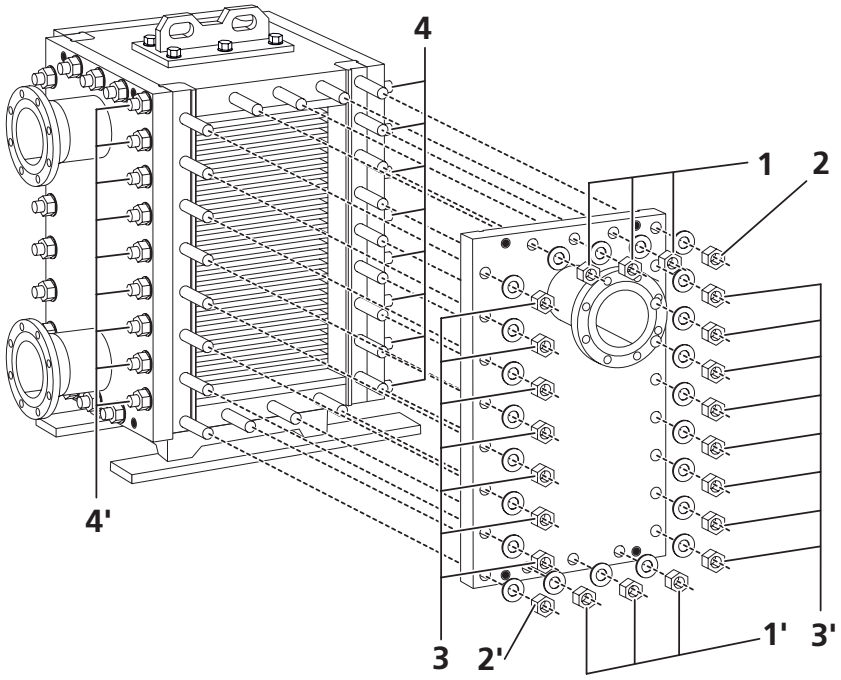


Figure 10.7 – Tightening the side panels

10.2.4 Tightening torques

IMPORTANT: The specified tolerances of tightening torques must absolutely be respected.

Insufficient tightening torques may result in leaks while excessive tightening torques create mechanical stress in the gasket area.

A tolerance of +/– 20% can be achieved when using a click-type torque wrench.

A tolerance of +/–10% can be achieved when using an indicating torque wrench.

Recommended tightening torques

The values in table 10.1 are guideline values. The precise values depend on the gaskets used. Information on tightening torques at higher test pressure levels are available from GEA PHE Systems.

Table 10.1 – Recommended tightening torques

480 PSIG (33 barg) max. test pressure		Rated tightening torque					
		GORE 300		Grafoil GHE		Klingersil C4430	
Model	Pin	Nm	*lb-ft*	Nm	*lb-ft*	Nm	*lb-ft*
BT 20-40	*3/4″* (M20)	200	*150*	200	*150*	240	*180*
BT 20-60	*3/4″* (M20)	200	*150*	200	*150*	240	*180*
BT 20-80	*3/4″* (M20)	200	*150*	200	*150*	240	*180*
BT 20-100	*3/4″* (M20)	200	*150*	200	*150*	240	*180*
BT 30-60	*3/4″* (M20)	200	*150*	200	*150*	240	*180*
BT 30-80	*3/4″* (M20)	200	*150*	200	*150*	240	*180*
BT 30-100	*3/4″* (M20)	220	*170*	220	*170*	270	*200*
BT 30-160	*3/4″* (M20)	220	*170*	220	*170*	270	*200*
BT 30-200	*3/4″* (M20)	240	*180*	240	*180*	300	*230*
A tolerance of +/– 20% can be used for galvanized bolts and nuts..							

480 PSIG (33 barg) max. test pressure		Rated tightening torque					
		GORE 300		Grafoil GHE		Klingersil C4430	
Model	Pin	Nm	*lb-ft*	Nm	*lb-ft*	Nm	*lb-ft*
BT 40-100	*1-1/4″* (M30)	530	*400*	500	*370*	650	*480*
BT 40-150	*1-1/4″* (M30)	530	*400*	500	*370*	650	*480*
BT 40-200	*1-1/4″*(M30)	600	*450*	570	*430*	730	*540*
BT 40-250	*1-1/4″* (M30)	600	*450*	570	*430*	730	*540*
BT 50-100	*1-1/4″* (M30)	620	*460*	600	*450*	750	*560*
BT 50-150	*1-1/4″* (M30)	620	*460*	600	*450*	750	*560*
BT 50-200	*1-1/4″* (M30)	700	*520*	680	*510*	800	*600*
BT 50-250	*1-1/4″* (M30)	700	*520*	680	*510*	800	*630*
BT 50-300	*1-1/4″* (M30)	750	*560*	720	*540*	900	*670*
BT 75-150	*1-1/2″* (M39)	1100	*820*	1050	*780*	1200	*890*
BT 75-200	*1-1/2″* (M39)	1100	*820*	1050	*780*	1250	*930*
BT 75-250	*1-1/2″* (M39)	1200	*890*	1150	*850*	1350	*100*
BT 75-300	*1-1/2″* (M39)	1200	*890*	1150	*850*	1400	*1040*
BT 75-350	*1-1/2″* (M39)	1300	*960*	1250	*930*	1450	*1080*
BT 75-400	*1-1/2″* (M39)	1300	*960*	1250	*930*	1450	*1080*
BT 75-450	*1-1/2″* (M39)	1350	*1000*	1300	*960*	1500	*1110*
BT 75-500	*1-1/2″* (M39)	1350	*1000*	1300	*9600*	1550	*1150*
A tolerance of +/– 20% can be used for galvanized bolts and nuts..							

10.3 Hydrostatic testing

CAUTION

➔ Carry out hydrostatic testing only after you have properly tightened all four side panels.

After assembly, hydrostatic testing at the test pressure indicated on the rating plate must be performed.

When there is no test pressure on the rating plate, the following shall apply: The test pressure is 1.3 times the max. operating pressure.

- During hydrostatic testing, one circuit is empty and the other one is filled and under test pressure.
- The pressure in the tested circuit may drop due to compression of entrapped gas or because of a slight plate movement. This does not mean that the heat exchanger is leaky. Set the test pressure one more time and after half an hour the pressure will have stabilised.

10.4 Search for leaks

10.4.1 External leaks

Gasket leak

Leaking gaskets can be identified by the outer gasket edge. Check the correct gasket seat, retighten the side panel (if possible) or replace the gasket.

Leak on the inside cover of the side panel or of the outer plate

This leak can in general be identified from the other side. A leak in the inside cover of the side panel occurs between the cover and the carbon steel frame. In some cases, this may be confused with a gasket leak. The same leak occurs when the outer plate of the heat transfer plate pack is damaged. (Further information is available from GEA PHE Systems upon request.)

10.4.2 Internal leaks

An internal leak results in mutual contamination of the two circuits. In this case, shut down the unit immediately. Contact the nearest GEA PHE Systems office without delay (see the rear cover).

10.5 Cleaning

WARNING

Hazard to persons and the environment!

The use of aggressive cleaning media involves a poisoning hazard and danger of chemical and 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 plate heat exchanger after the cleaning process is complete.

10.5.1 CIP cleaning

This method is particularly recommended for processes involving a good deal of fouling and requiring regular cleaning. It is particularly recommended when using highly corrosive fluids.

In the CIP cleaning process (“Cleaning in place”), a cleaning medium flows through the plate heat exchanger 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.

CIP process:

Carry out the following work steps:

1. Drain the liquids on both sides of the plate heat exchanger and flush the process circuit with cold water. If the coolant contains a salt solution, ensure that both circuits have been thoroughly flushed with cold water before starting the cleaning process.
2. Flush both sides of the plate heat exchanger with warm water (100–120 °F, 38–49 °C) until the water coming out contains no more process liquids.
3. The selection of the cleaning solution as well as temperature and pressure of the cleaning process depend on the type of deposit to be removed and must be suitable for the plate and gasket material. A confirmation of compatibility of the materials in question should be requested from the supplier of the cleaning liquid.
4. When preparing the cleaning solution, use water without chloride or with a low chloride content and low hardness. Before starting the circulation, concentrated cleaning solution must be added to the water.

CAUTION

➔ Never add any chemicals while CIP cleaning is in progress.

5. As far as possible, the cleaning solution should circulate at up to 1.5 times the usual flow velocity. However, the velocities at the pipe nozzle must not get too high (nozzle made of carbon steel: 4.5 m/s or lined nozzles: 7.6 m/s). As far as possible, the cleaning solution should be pumped through the unit opposite to the normal flow direction. This procedure uses the benefits of back flushing.
6. On apparatus with high operating flow velocities, it may be difficult to achieve a high CIP flow velocity. In such cases, a solution which is able to dissolve the deposits even at lower flow velocities should be used and/or the duration of CIP cleaning should be extended accordingly.
7. Centrifugal pumps should be used for circulating the cleaning solution. The flow velocity and the operating pressure must be increased step by step in order to avoid damage to the gaskets or the plates by pressure peaks.
8. After flushing with cleaning solution, the plate heat exchanger and the adjoining piping must be flushed with clear water.

CAUTION

Serious injuries from acids!

Caustic soda and concentrated nitric acid can cause serious injuries of the skin and of mucous membranes.

- ➔ Always add the acid to the water when mixing acids and water.
- ➔ Do not use hydrochloric acid for cleaning stainless steel plates.
- ➔ Always wear safety goggles and rubber gloves when handling these substances.

CIP for removing lime and similar deposits

The precipitation of calcium compounds from the cooling water and from other sources is a fairly widespread form of fouling.

➔ Follow the corresponding instructions for circulating a 2 to 3% by vol. phosphoric acid solution for two hours at 70 °F (20 °C).

➔ Flush the unit with cold water until the cleaning solution is completely removed from the plate pack.

10.5.2 Mechanical cleaning

If chemicals cannot be used for cleaning, the side panels must be removed in order to make the heat exchanger surfaces accessible.

Clean the surfaces with steam or a high-pressure water jet (high-pressure water cleaner with up to 3000 psi g or 200 bar g).

Plates with a corrugated pattern

As the corrugations are arranged in a 45° angle, good access to the heat exchanger surface is possible when the cleaner (high-pressure cleaner or cleaning brush) works at an angle of 45° (see figure 10.6).

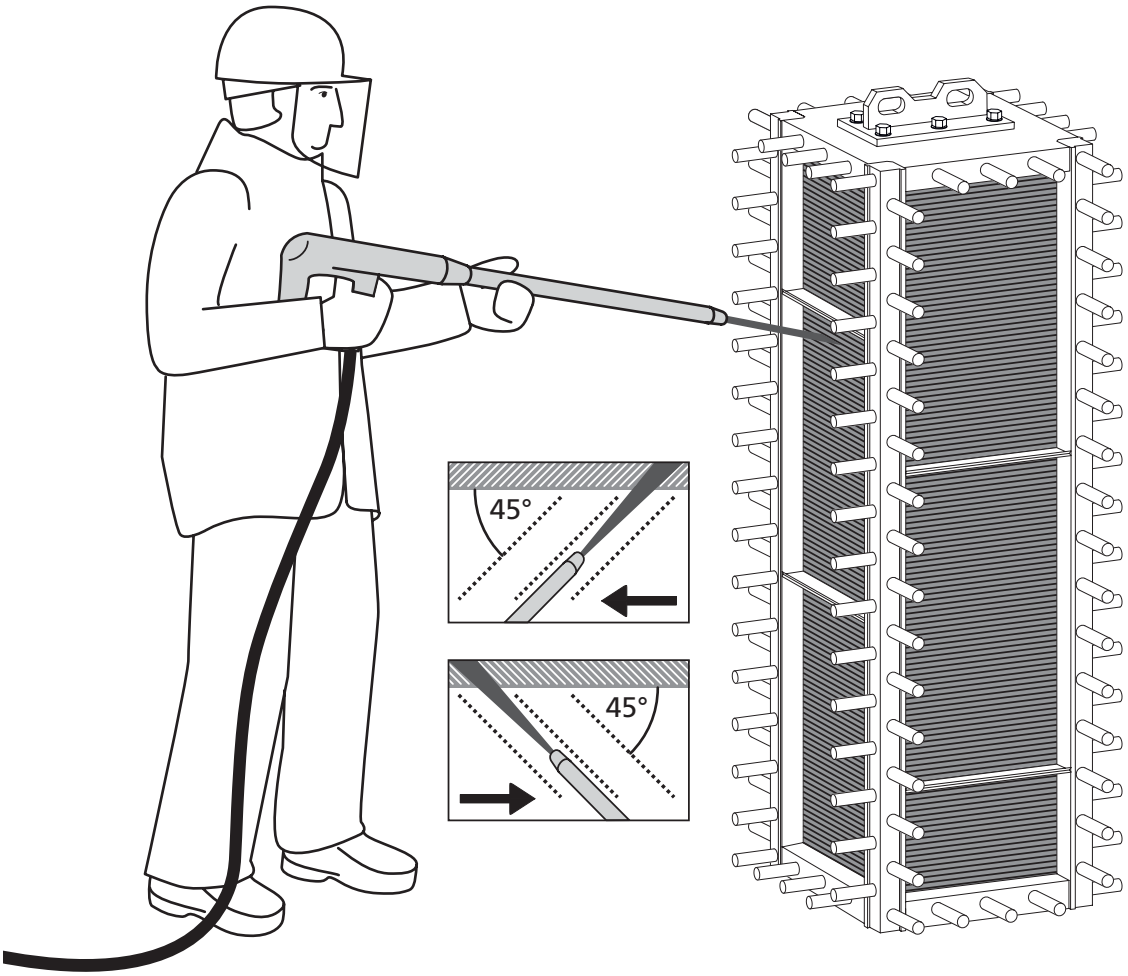


Figure 10.6 – Mechanical cleaning

Plates with “double dimple” pattern

These corrugations offer sufficiently large spaces; high-pressure cleaning is possible from any direction. Plates with a “double dimple” corrugation are easier to clean.

10.6 Technical information and customer service

Further information about operation, maintenance and care of GEABloc plate heat exchangers is available from your nearest GEA PHE Systems office (see the rear cover).

11 Troubleshooting

Someypical faults that may occur when operating a GEABloc plate heat exchanger are listed below.

NOTE

As a basic rule, you should contact the GEA PHE Systems service office in charge (see the rear cover) before removing faults in order to avoid improper work on the GEABloc plate heat exchanger and its consequences.

11.1 Output deficit

Fault	Cause	Remedy
Extremely low thermal output and very high pressure drop. Possible cause: Channels are plugged by deposits or by lime from the liquids.	Measure the pressure drop on both sides of the heat exchanger as precisely as possible in order to ensure that the problem is not caused at another point in the system..	Clean the heat exchanger if required. See section 5 of this manual. Replace the gaskets and refit the side panels, see 10.1 and 10.3.
Gradual deterioration of heat transfer performance. Possible cause: Slow formation of fouling on the plate.	Remove the side panels and examine the heat transfer surfaces.	Clean the heat exchanger if required. See section 5 of this manual. Replace the gaskets and refit the side panels, see 10.1 and 10.3.

Remarks: It is important to introduce an appropriate cleaning schedule in order to avoid unplanned downtimes.

11.2 Leaks

Fault	Cause	Remedy
External leak on side panels Possible cause: Gasket leak	Locate the origin of the leak (visual inspection)	Retighten the bolts/nuts Check if the tightening torques are in line with the gaskets used

Remark: If the leak cannot be removed by tightening the bolts/nuts, remove the side panels and replace all gaskets.

12 Technical terms

Term	Meaning
Connection (pipe)	Pipe connections provided at the side panels. The piping connections can be realised in different ways, depending on the application.
Bottom thrust plate	Elementary component of the pressure vessel.
CIP process (Cleaning in Place)	A cleaning process in which the flow channels of the closed plate heat exchanger are flushed with specific cleaning solutions.
Gaskets	An elementary component for sealing the flow channels towards the surroundings. There are different gaskets, depending on the application (temperature, pressure, medium).
Flow media	The term for the media that are involved in the heat transfer in the plate heat exchanger.
Top thrust plate	Elementary component of the pressure vessel.
Rating plate	An information attached to the unit, giving the basic data of the plate heat exchanger (adhesive label).
Multi-pass plate heat exchanger	A special design of the plate heat exchanger with internal deflection of the flow media. In a multi-pass configuration with an even number of passes, the connections are usually always fitted on a side panel. In a multi-pass configuration with an uneven number of passes, one connection each is usually fitted on the front and the rear side panel.
PHE	The short form of the term Plate Heat Exchanger.
Columns	An elementary component of the pressure vessel. It is located in the column covering. The top and bottom thrust plates as well as the four side panels with the tensioners are fixed to this element.

Term	Meaning
Tensioner	The frame component tensioning the heat exchanger plate pack and fixing the top and bottom thrust plates and of the four side panels on the columns.
Heat exchanger plates	An elementary component that keeps the flow media separated from each other and transfers the heat.
Heat exchanger plate pack	The collective term for all of the heat exchanger plates located between the frame plates, including the gaskets.

13 Spare part and service request order form

Order no.:		
Shipping address Company name: Address: City, country: Postcode: Contact person: Phone:	**Invoice address** Company name: Address: City, country: Postcode: Contact person: Phone:	
Heat exchanger model:	Serial no.:	Order no.:
If the plate heat exchanger was modified since it was set up, please provide the following additional information:		
New plate gaskets:		
Available gasket material:		
Requested material:	[ ] Set of plate gaskets	
[ ] Material	[ ] Service request / Remarks / Problems	

Ordering parts

When ordering parts and services, please always indicate the serial no. of the heat exchanger. You can find this information in the outline drawing and on the rating plate of the GEABloc unit.

NOTES

GEA PHE Systems
Competence in Heat Transfer

With emphasis on the highest quality standards and constant innovations, GEA PHE Systems continues to expand its market position: Within the GEA Process Equipment Division, GEA Ecofl ex together with GEA Ecobraze, GEA WTT, GEA PHE Systems NA, GEA ViEX and GEA EcoServe forms GEA PHE Systems, the Center of Competence and Service Center for gasketed, fully welded and brazed plate heat exchangers of GEA Group:

- HVAC
- refrigeration
- sugar
- chemical
- paper
- food
- life science
- marine
- power
- renewable energy



Argentina	China	Finland	Iceland	Korea	Poland	South Africa	Thailand
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Austria	Czech Republic	Germany	Indonesia	Netherlands	Russia	Sweden	United Arab Emirates
Brazil	Denmark	Great Britain	Iran	New Zealand	Singapore	Switzerland	USA
Bulgaria	Dubai	Greece	Italy	Pakistan	Slovakia	Taiwan	Venezuela
Chile	Estonia	Hungary	Japan	Philippines	Slovenia	Turkey	Vietnam

Contact details at:

www.gea-phe.com

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The specifi cations contained in this printing unit are intended only to serve the non-binding description of our products and services and are not subject to guarantee. Binding specifi cations, especially pertaining to performance data and suitability for specifi c operating purposes, are dependent upon the individual circumstances at the operation location and can, therefore, only be made in terms of precise requests.

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