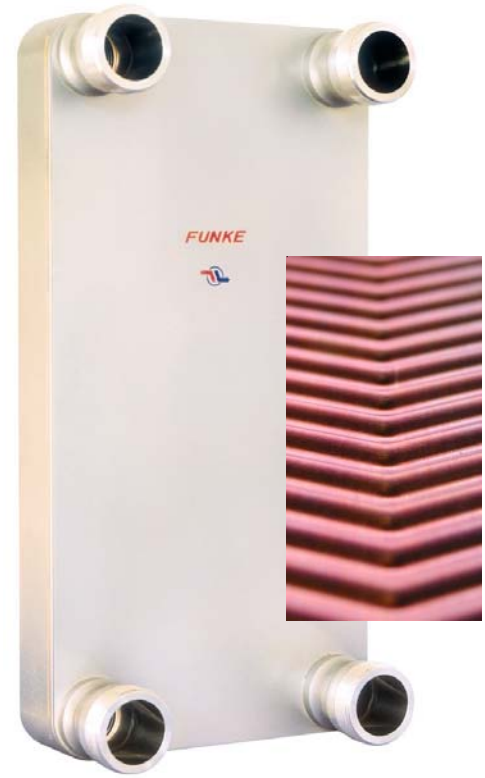
Brazed Plate Heat Exchangers
Models TPL, GPL, NPL, GPLS, SPL, APL

General presentation of model TPL



General presentation of model GPL

Fig. 1

Edition 11/2006

Operating instructions

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1.0 General

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1.1 User instructions

These instructions relate to the standard versions of the brazed FUNKE plate heat exchanger (PWT).
Supplementary operating and servicing instructions may be needed for special versions. Please observe the order-related specifications in every case!
Operation and servicing of plate heat exchangers are allowed only if carried out by experty trained operating and qualified servicing personnel. In particular, please observe national and international specifications on pressure systems, hazardous fluids and gases, as well as on accident prevention and operating safety. (In Germany: Law on operating safety and pertinent directives.)

Text sections, where the working procedure and specifications are to be strictly adhered to, to eliminate endangerment of persons or damage to the systems, are designated with the warning triangle shown below.

Text sections, in which working procedure, operating conditions and servicing specifications must be adhered to strictly, to ensure proper functioning of the heat exchanger as well as an economical operation, are identified with the following symbol.

The operator must instruct the staff appropriately **before** the commissioning. The operating instructions must be accessible at all times. If work beyond these instructions needs to be carried out on plate heat exchanger or instructional texts are not understood, consult with FUNKE **before** beginning the work.

1.2 Proper usage

FUNKE plate heat exchanger are - if not redefined order-related - laid out for the special operating conditions mentioned by the operator with respect to temperature, pressure, volumetric flow und flow media and are manufactured according to the conformity procedure of the EU pressure equipment devices (PED) guide lines 97/23/EC.

Written approval must be obtained from FUNKE for design changes on the equipment as well as for operating method deviating from these instructions or the order-related product specifications, otherwise guarantee and liability claims can be invalidated.
An operation with heavy temperature jumps as well as pressure jerks can cause mechanical or material damage and is generally not allowed!

1.3 Identification/Name plate

Every FUNKE plate heat exchanger is delivered with a name plate, accessibility and readability for which must be ensured at all times. The name plate is fixed on the outside of the connecting plate and contains the following data:

- **Plate heat exchanger type/ model**
- **Serial number (to be mentioned for all queries)**
- **Year of manufacture**
- **Drawing number**
- **max. operating pressure PS**
- **Minimum operating temperature TS min.** (if required)
- **Maximum operating temperature TS max.**
- **Volume**
- **Test pressure PT**
- **Fluid group** (acc. to EU PED 97/23/EC)
  Additional, if required as per PED
- **CE symbol**
- **Ident. number of the „certified body“ acc. to PED**
- **Inspection date**

Principal structure of the name plate:
(Two-part version also possible)

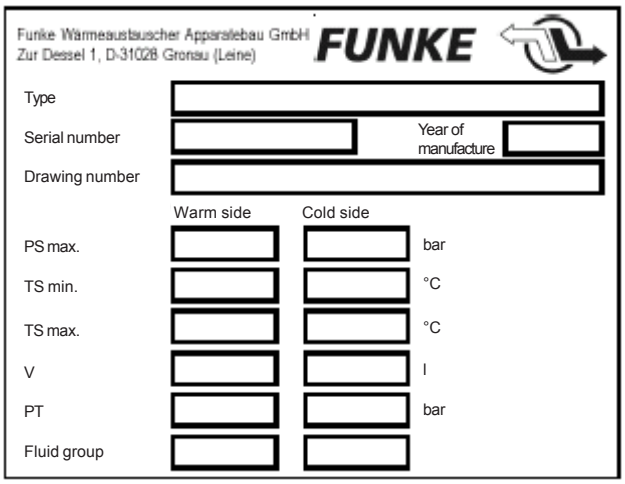


Fig. 2

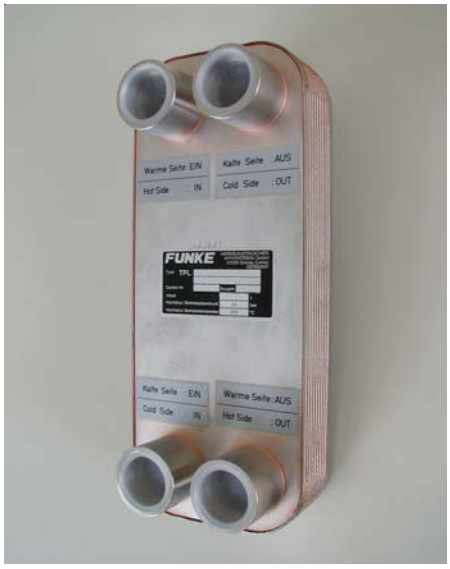


Fig. 3

Standard equipment - front view
All connections are on the front plate (the name plate identifies the front plate). The allocation of the connections can vary according to the type and order. The main differentiation is between parallel (GPL series) and diagonal flow (TPL series). (Refer to section 3.0)

Fig. 4

Special version of the connections - side view
In this example, the connections of the „warm side“ are placed shifted diagonally on the front plate and those on the „cold side“ shifted diagonally on the end plate.

2.0 Fundamental safety specifications

Caution!

Plate heat exchangers (PWT) are pressure systems and may be connected, operated and serviced only by technically qualified operating and servicing personnel! National and international specifications on pressure systems (Europe: EU PED 97/23/EC), hazardous fluids and gases as well as on operating safety and accident prevention must be observed. (In Germany: Law on operating safety and pertinent directives.)
If the plate heat exchanger is operated with fluids from group 1 (EU) or with hazardous fluids or gases, additional special safety measures according to the hazardous substances class may be needed!
The operator installing the plate heat exchanger must observe specifications in this regard!

The plate heat exchanger may be operated only with the media which have been confirmed in the order specifications by the manufacturer.
Before changing the media, please obtain written approval from FUNKE. The general restrictions for media and water constituents mentioned in section 7 must be observed.

Work may be done on plate heat exchanger only if the equipment is not under pressure, if it has been emptied and if the temperature is not above 40° Celsius!

Suitable protective gloves must be worn for working on the plate heat exchanger, the sharp edges of the plate packet (necessary for the engineering) pose a risk of injury!

If the plate heat exchanger is mounted in areas where the leakages can injure persons (e.g. next to or above gangways and workplaces), place a spray guard or drip cover!
At operating temperatures higher than 60°, a contact guard (e.g. plate paneling) must be placed or the area should be blocked. This can be dispensed with if the equipment has a heat insulation protection (FUNKE hard foam insulation boxes)!

3.0 Structure and functioning

3.1 Design/materials

The brazed FUNKE-plate heat exchangers (standard model Series GPL) consist of intertwined, embossed stainless steel plates, which are brazed with copper or nickel by vacuum process to a compact and pressure-tight unit.
While joining, every 2nd plate is rotated by 180°, which gives rise to two separate flow chambers, which are counter-flooded by the media involved in the heat exchange. A parallel flow direction can also be designed for the media in special applications (depending on the type). The embossing in the plates or in the inserted turbulence plates (in type TPL) generates a high turbulence passage. This allows a very effective heat transfer, even at low volumetric flows and reduces the risk of contamination to a minimum.

Materials (standard versions) :

Plates : Stainless steel 1.4401 / AISI 316

Solder : Copper (99.9 %) models GPL,TPL,SPL,APL
Nickel (99.9 %) models NPL

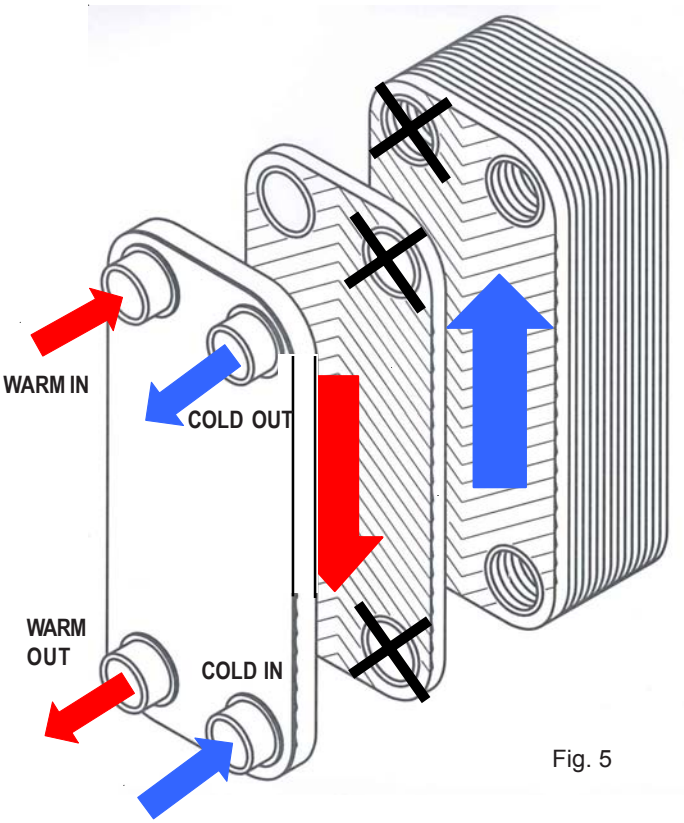


Fig. 5

Principle sketch with the example of GPL equipment

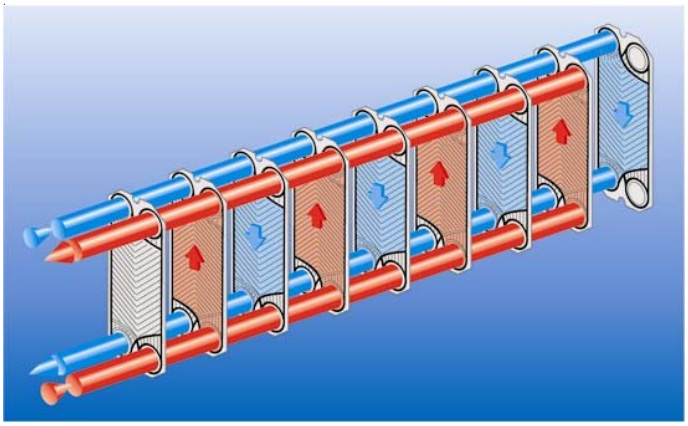


Fig. 6

General flow scheme **single-way** - the connections are on the front plate (left in the scheme, see also page 3, Fig. 3).

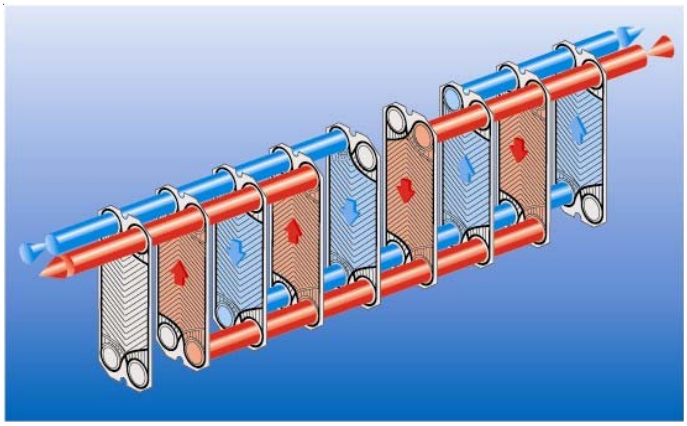


Fig. 7

General flow scheme **multi-way** - the connections are on the front plate and the end plate (left **and** right in the scheme).

3.2 Specialities of the models GPL, TPL, SPL, GPLS, NPL, APL

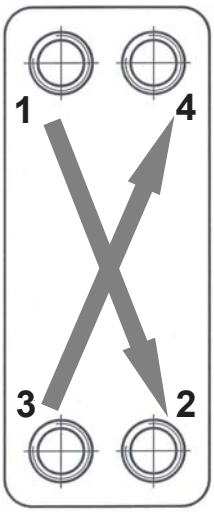
Model GPL

Universally usable standard model with plates in V-corrugation embossing as described under 3.1 (also refer to title figure).

Model TPL

The brazed plate heat exchangers of the TPL and SPL models consist of intertwined, unprofiled stainless steel plates. The flow chambers contain special embossed fixed turbulance fittings made of stainless steel and based on high thermal efficiency, which are brazed by a vacuum process to the base plates forming a compact and pressure-tight unit. Different versions of the fixed equipment as well as the thermodynamically effective diagonal media conduction in the flow columns allow optimal adaptation to the different applications.
The connections can be on the front plate or front as well as end plate, according to the order.

Diagonal flow in TPL



1 Warm side IN
2: Warm side OUT

3. Cold side IN
4: Cold side OUT

Fig. 8

Model SPL

The safety heat exchanger with spatially separated product columns. There is a corrugated spacer sheet between the cold and warm product column, which forms the leakage space. This helps achieve a high degree of safety, especially in drinking water applications. Leakages if any can escape on both the longitudinal sides.

Model GPLS

The standard safety heat exchanger with double wall. „One“ heat exchanger plate consists of two plates one on top of the other, which are not brazed to the circumscribing outer wall, so that leakage can escape from all sides of the unit.

Model NPL

Structure and functioning basically as described under 3.1. The difference is the brazing with nickel.

Caution!

The maximum allowable operating pressure is max.16 bar in the NPL standard version!

The NPL can be designed for operation with ammoniac, deionate, synthetic oils etc (the order specifications must be observed in each case).

Model APL

The APL model is conceived specially for use with gas/ water applications. As in case of the TPL model, the flow columns contain fixed turbulence equipment for obtaining an optimal heat transfer. The connections can be on the front plate or on the front as well as end plate. (Refer to Fig. 9)

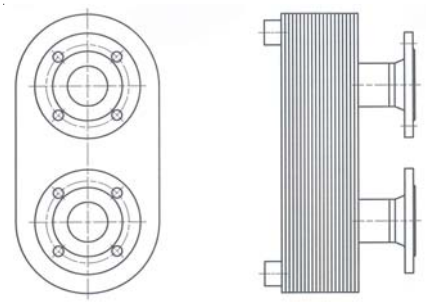


Fig. 9

3.3. Technical data

Caution!

The data mentioned in the table below are the limits for the respective standard versions.
The data mentioned on the type name plate and/or in the order-related technical documentation are however binding. There could be lower values, according to the order!

Model	max. operating pressure (bar)	max. operating temperature (°C)
GPL	30	200
TPL	30	200
GPLS	30	200
NPL	16	200
SPL	16	200
APL	16	200

4.0 Installation

4.1 Handling and erection - Mounting positions

Suitable protective gloves must be worn during work on the plate heat exchanger - technology-related sharp edges on the plate packages pose a risk of injury!

In case of brazed plate heat exchangers which need to be moved using cranes or lifting devices notice: Connection nozzles must not be used as suspension!

Figures 11-13: Transport suspended.

Caution!

Wear protective gloves!

Fig. 10

Fig. 11,12,13

Fig. 14

Larger brazed plate heat exchangers are usually delivered inclined or standing anchored n a wooden plate. (Fig. 14)
While transporting the equipment next to and over each other, have separators of packing materials.
The connecting nozzles should be loaded during transport only after consulting FUNKE.

Mounting positions:

The brazed FUNKE-plate heat exchangers have been conceived basically for a vertical mounting position (Fig.15/a) In this position, the standard connection „WARM IN“ is at top left on the front plate.
A horizontal mounting is also allowable (Fig.15/b), as well as inclined (Fig.15/c front plate facing up).

Important!

Mounting with the connections pointing down(Fig. 15/d) is not recommendable owing to reduced performance! (No venting)

While selecting the mounting position, take care that the plate heat exchanger must be drained and vented.
(For example, it is possible that air bubbles may build up while using it with water, which can lower the performance of the plate heat exchanger)

If used as condenser or boiler in refrigerating units, the functioning would be correct only in the vertical mounting position! The same is applicable for all applications with steam and gases, where condensation can build up.
(Any other placement must be made only after consulting FUNKE)

Furthermore, sufficient space must be provided for servicing jobs and for protective or isolation hoods.
(Insulations can be supplied as accessories)

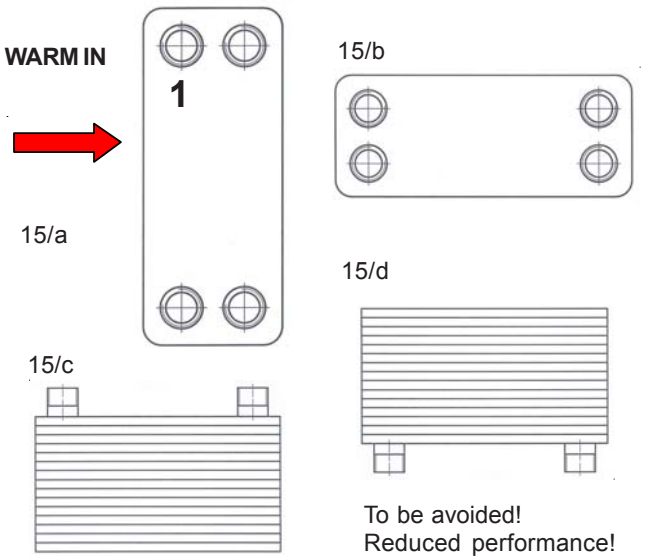


Fig. 15 a-d

Suspension:
The plate heat exchanger should be fixed on legs, a bracket or by means of wall mounting. A suspension only on the pipelines is not sufficient!
Note: FUNKE plate heat exchangers can optionally be delivered with legs or extended base plate (with appropriate fastening holes).

4.2 Environmental conditions

The plate heat exchanger standard versions are designed for usage in closed rooms without impact of frost; if operated in open air, special protective equipment or special versions are required!

Caution!

Especially while operating the plate heat exchanger with fluids of the group I (hazardous substances as given in EU-PED), the special safety and fire specifications at the erection site must be observed.
If the plate heat exchanger is mounted in areas where the leakages can injure persons (e.g. next to or above gangways and workplaces), place a spray guard or drip cover!
At operating temperatures higher than 60°, a contact guard (e.g. plate paneling) must be placed or the area should be blocked. This can be dispensed with if the equipment has a heat insulation protection (FUNKE-hard foam insulation boxes)!

Heat insulation:
Plate heat exchanger TPL with insulator hood

Fig. 16

4.3 Piping mounting

The brazed plate heat exchangers are supplied according to the order with threaded nipples, brazed nozzles or flange joints.

Pipelines should be laid in such a manner that no vibrations, impacts or pulsations can act on the connections and the entire plate heat exchanger.
The piping system must be secure against sudden pressure jerks or temperature variations. Quick action valves are to be avoided, pumps which generate higher pressure than the maximum allowed for the HE are to be provided with appropriate control valves. Pumping devices working by the piston principle must be fitted with vibration dampers.
A suspension only on the pipelines is not sufficient!
(Also refer to 4.1)

The most effective heat transfer takes place if both the volumetric flows pass through the vertically mounted plate heat exchanger in counter flow (Fig. 5-7, pages 5 and 7).
The connections to the plate heat exchanger are factory-identified appropriately. (Fig.3, page 3)
Check valves must be mounted in all pipelines for inlets and outlets, so that the plate heat exchanger can be taken out of service without disturbing the adjacent systems. Similarly, **venting valves** must be provided in the pipelines for both the connected sides to ensure proper venting of the plate heat exchanger.

The piping systems are to be rinsed before commissioning the plate heat exchanger.
Piping and valve arrangement must be done in such a manner that the plate heat exchanger cannot run dry if there is a brief switch-off (for operational reasons), for avoiding pressure jerks on restarting. Otherwise, you have to proceed as given under 5.2 „Starting operation“ for starting.

Changing the connections?
Change of the IN and OUT piping within the warm or cold side as well as change between warm and cold side is possible for the following models: GPL, GPLS, NPL.
In case of the models TPL,SPL and APL, only the direction of flow can be changed within the „cold“and „warm“sides.

Approval must be obtained from FUNKE before changing over from „cold“and „warm“side in these types!

In all subsequent usages deviating from the factory defaults, FUNKE does not assume any liability for any change in the performance data of the plate heat exchanger.

To prevent contamination, we recommend providing appropriate filters at the media entry to the plate heat exchanger
(mesh size 0.5 mm for closed, max. 0.1 mm for open plants / systems).

Caution! Contamination in the plate heat exchanger can cause corrosion and in a few applications even cause the unit to freeze.

Wrong or insufficient control engineering reduces the life of the plate heat exchanger sharply. Here are a few of the errors, which could adversely affect the life of the plate heat exchanger:

-Overdimensioned control valves
-Control valves with too long a response time
-Incorrect control settings
-Oversize pressure variations
-Incorrect placement of the measuring sensor

4.4 Brazed connections

In case of plate heat exchangers with brazed connections, pay attention to the following while connecting to the piping system:
- Cleaning, degreasing and polishing of the surfaces of the connections and copper tube
- Remove the oxide layer
- Apply the flux

Note !
- The plate heat exchanger is to be filled with nitrogen inside, to avoid oxidation.
- Do not aim the flame in the direction of the plate heat exchanger ; Braze at max. 650°C
- Braze material : 45 – 55 % silver solder
- Use a wet lap or something similar, to protect the plate heat exchanger from overheating.

Too strong a heating causes copper to melt, which can destroy the plate heat exchanger.

The plate heat exchanger must not accept any deeper colours except straw yellow; otherwise there is risk of corrosion.

No forces and torques should act on the connections.

5.0 Operating specifications

5.1 Commissioning

Before commissioning, ensure that the allowed operating data mentioned on the name plate or in the technical documentation must not be exceeded and that the media to be connected match the media mentioned in the order-related specifications!
Check if the connecting lines are bolted tightly.
The pumps feeding the plate heat exchanger must have check valves. Pumps or systems generating higher operating pressures than the ones given for the plate heat exchanger, are to be equipped with safety valves. The pumps must not suck in any air so that there would not be any operational disturbances due to water hammers. To avoid pressure knocks, pumps should be started against closed valves.

5.2 Starting operation (Starting)

1 Close inflow valves between plate heat exchanger and pumps
2 Open valves on discharge connections, if any.
3 Open venting valves
4 Start pumps.
5 Open valves in the forward and reverse flows as slowly as possible
6 Close venting valves, when air stops escaping.

Inadequately drained heat exchangers do not provide full power, because the full heating surface is not available. The air remaining in the plate heat exchanger increases the risk of corrosion.

5.3 Operation

If the plate heat exchanger is in operation, the operating parameters must not be changed. The maximum operating conditions indicated on the name plate must not be exceeded.
Ensure that no pressure pulsations work on the equipment.
If the plate heat exchanger is mounted between a servo valve and a differential pressure controller, no depression should build up on simultaneous closing of both the control devices, in order to prevent steam knocks.

In district heating systems, pay particular attention that the secondary pressure maintenance is designed for the maximum advance district heating temperature. Otherwise there could be steam jerks in the partial load area. Always check the functioning capability of the control devices.
Ensure generally that there would not be any operating conditions contradicting to these Operating instructions.

Steam knocks as well as pressure and temperature pulsations can cause leakages in the plate heat exchanger. Ensure sufficient potential balancing so as not to endanger the corrosion protection.

5.4 Switching off/Shutting down

Brief switching off:
If the plate heat exchanger is to be put out of service temporarily (pump stop etc), proceed as follows:
1. Slow shut off of the inflow valves – Feed with the higher pressure first.
2 Switching off the pumps
3 Closing the valves in the exit pipelines – if present!

While running down the system, see that the warm product side (primary) is shut down first and then the cold product side (secondary). While starting, the process in reverse to prevent overheating of the plate heat exchanger.
Shutting down – longer operating pauses
If the plate heat exchanger is put out of operation for a long period (several weeks/months), pay attention to the following:
1.–3. Proceed as mentioned above (brief switching off)
4 Ventilate the plate heat exchanger and empty the product rooms

Draining is always important when there is risk of frost, aggressive media, as well as media, which are prone to biological fouling.

Renewed commissioning
Process as described under the **Pt. 5.2.**

6.0 Maintenance

6.1 Contamination/Fouling

The DIN guidelines for drinking and heating water, Vd-TÜV-guidelines , guidelines by AGFW as well as the FUNKE guidelines for water constituents are to be observed. (described on the following page)
Important factors, which affect the contamination and fouling :

- Temperature
- Media quality (e.g. lime content of the water)
- Velocity of flow
- Distribution
- Turbulence

The operating method can influence the degree of contamination and the life of the plate heat exchanger considerably.
The media should be run flown with the highest possible volumetric flow (according to the equipment specifications).
If the volumetric flows (partial load operation) are too low - the turbulence in the plate heat exchanger can reduce, while the tendency for contamination rises.

In particular, there could be lime scaling at operating temperature of more than 60°C, depending on the water quality, which can reduce the heat transfer performance of the plate heat exchanger distinctly.
An operation with maximum volumetric flow or lower temperatures reduce the risk of lime scaling/deposition distinctly.

6.2 Cleaning

The need for cleaning the plate heat exchanger depends on the concerned application.
If deposition is expected in the flow columns due to the quality of water or media (e.g. higher hardness or heavy contamination), cleaning should be done at regular intervals.

Cleaning of the plate heat exchanger can be carried out only by rinsing; preferably in reverse flow, i.e. opposed to the actual direction of flow.

If chemicals are used for cleaning, see that they are compatible with stainless steel, copper or nickel. Neglecting this can destroy the plate heat exchanger! Subsequently a general recommendation regarding the cleaning medium.

For lime scaling or similar encrustations:

Cleaning medium:	**Phosphatic acid**
Concentration:	**max. 2 %**
Temperature:	**max. 20°C**
recommended reaction time:	**About 1 h**

For oils, grease, biological contaminations, e.g. due to algae or bacteria:

Cleaning medium:	**Caustic soda**
Concentration:	**max. 4 %**
Temperature:	**85°C**
recommended reaction time:	**up to 24 h**

The safety specifications and recommendations of the cleaning medium manufacturer must be adhered to absolutely!

Use only chloride-free or low chloride water with low hardness for all cleaning work!
Subsequently rinse with sufficient water, till the acid has been washed off completely from the plate heat exchanger and the adjacent pipelines.

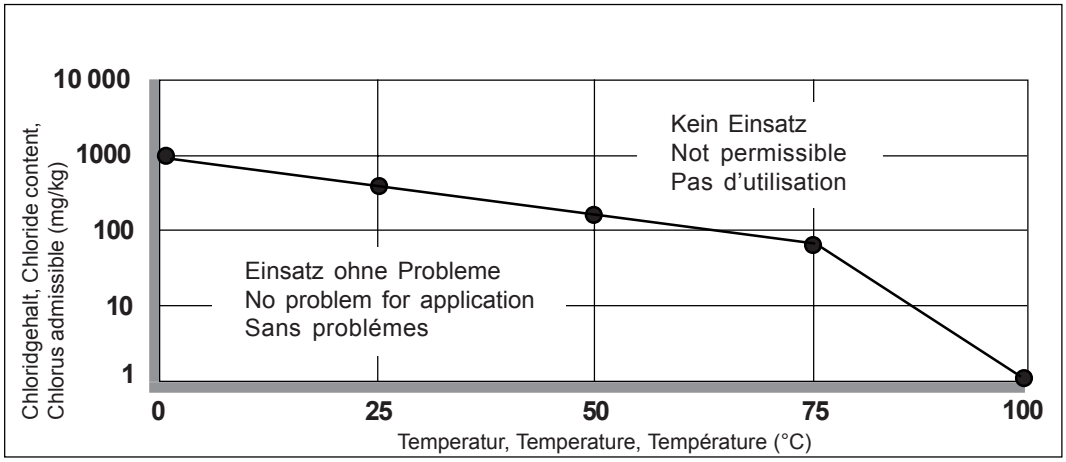
7.0 General Restrictions for media/water constituents

The brazed plate heat exchangers are not at all suitable for sea water! The same is applicable (with the exception of the NPL model) for the operation with ammoniac and deionate.

Synthetic oils (e.g. silicone oils) may be used only in plate heat exchanger with nickel brazing (model NPL).
In any case the order-related specifications must be observed!

Wasserinhaltsstoff / Kennwerte Water constituent / Parameters Eléments contenus dans L ´eau	**Einheit Unit Unité**	**PWT-kupfergelötet Heat Exchanger-copper brazed Echangeurs avec brasure au cuivre**	**PWT-nickelgelötet Heat Exchanger-nickel brazed Echangeurs avec brasure au nickel**
pH-Wert pH-Value Valeur pH		7-9 (unter Beachtung SI Index)	6-10
Sättigungs-Index SI (delta pH-Wert) Saturation-Index SI (delta pH-value) Indes de saturation SI (valeur delta pH)		-0,2 < 0 <+0,2	Keine Festlegung No specification Pas de recommandation
Sauerstoff Oxygen Oxygène	mg/l	2,0	Keine Festlegung No specification Pas de recommandation
Gesamthärte Total hardness Dureté	°dH	6-15	6-15
Leitfähigkeit Conductivity Conductibilité	µS/cm	> 50	Keine Festlegung No specification Pas de recommandation
Abfilterbare Stoffe Filtered substances Substances filtrées	mg/l	<30	<30
Chloride Chlorides Chlorures	mg/l	Siehe Diagramm Seite 12 See diagramm page 12 Voir diagramme page 12	Siehe Diagramm Seite 12 See diagramm page 12 Voir diagramme page 12
Freies Chlor Free Chlorine Chlore libre	mg/l	<0,5	<0,5
Schwefelwasserstoff Hydrogen sulphide Sulfure d´hydrogène	mg/l	<0,05	Keine Festlegung No specification Pas de recommandation
Ammoniak Ammonia Ammoniaque	mg/l	<2,0	Keine Festlegung No specification Pas de recommandation
Sulfat Sulphates Sulfates	mg/l	<60	<300
Hydrogenkarbonat Hydrogen carbonate Carbone d´hydrogène	mg/l	<300	Keine Festlegung No specification Pas de recommandation
Hydrogenkarbonat/Sulfat Hydrogen carbonate/Sulphates Carbone d´hydrogène/Sulfates	mg/l	>1,0	Keine Festlegung No specification Pas de recommandation
Sulfid Sulphide Sulfures	mg/l	<1,0	<5,0
Nitrat Nitrate Nitrates	mg/l	<100	Keine Festlegung No specification Pas de recommandation
Nitrit Nitrite Nitrites	mg/l	<0.1	Keine Festlegung No specification Pas de recommandation
Eisen Iron Fer	mg/l	<0,2	Keine Festlegung No specification Pas de recommandation
Mangan Manganese Manganèse	mg/l	<0,1	Keine Festlegung No specification Pas de recommandation
Freie aggressive Kohlensäure Free agressive carbonic acid Acide carbonique libre	mg/l	<20	Keine Festlegung No specification Pas de recommandation

Annex for Table under 7.0
Allowable chlorine content in relation to the temperatures (AISI 316/EN 1.4401)



Type key for plate heat exchanger for model 'TPL' (refer to name plate and specification)

In order to be able to differentiate the brazed plate heat exchangers TPL, with special turbulence fittings, uniquely, the following type keys have been defined:

TPL XX – Y – ZZZ – AB

Meaning:

XX	: Size	: 00, 01, 02
Y	: Version	: L=long, K=short
ZZZ	: Number of plates total	: 4.....120
A	: Turbulence insert warm side	: 1 := Installation in flow direction with lower flow loss : 2 := Mounting across the direction of flow with higher flow loss
B	: Turbulence insert cold side	: 1 := Installation in flow direction with lower flow loss : 2 := Mounting across the direction of flow with higher flow loss

Example:
TPL 02-K-30-12

- TPL of the size 02, short (short OCB length) with 30 plates
- Turbulence fittings on the warm side Type 1
- Turbulence fittings on the cold side Type 2

Identification: Operating instructions plate heat exchanger - brazed - 2006 / 11

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