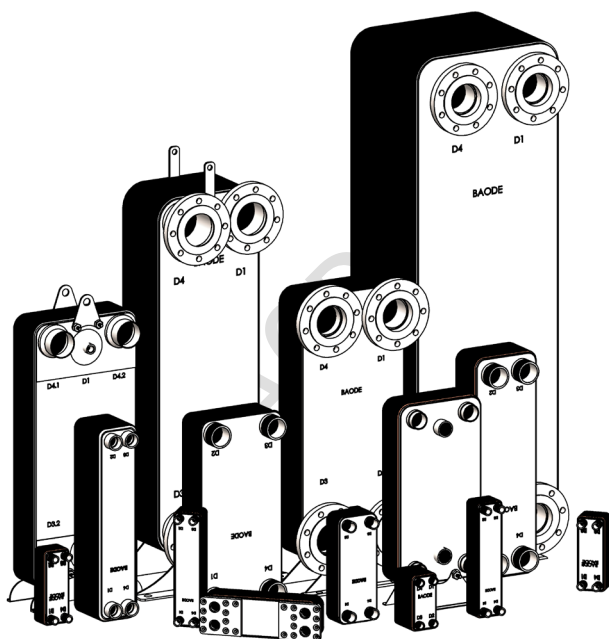


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# BPHE Instruction Manual



--BAODE HEAT EXCHANGER CO., LTD

Preface .....	2
Description .....	3
Function .....	3
Name plates .....	4
Installation .....	5
Mounting .....	5
Installation in general applications .....	10
Installation as evaporator or condenser .....	11
Leaking test .....	12
Insulation .....	12
Operation .....	13
Start-up .....	13
During operation .....	14
Shut-down .....	17
Maintenance .....	18
Warranty Claim .....	19

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## **PREFACE**

This manual provides information needed to install, operate and carry out the maintenance of the BPHE

The individuals who will operate this BPHE have to study the instructions in this manual and have knowledge of the process. The knowledge includes media, pressures, the temperatures in the BPHE as well as specific precautions required for the process.

The person who will install or maintain the BPHE must have the knowledge and authorization according to the local regulations. This includes performance work such as piping, welding and maintenance.

### **General information**

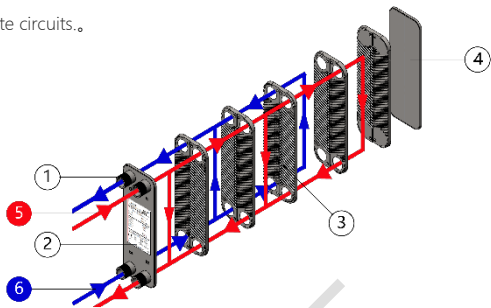
The BPHE has been designed to meet the requirement for heat transfer applications such as refrigeration, heating, and cooling. The plate heat exchanger must be used and maintained in accordance with the instructions in this manual. Faulty handling of the plate heat exchanger may result in serious with injuries and/or property damage. BAODE will not accept responsibility for any damage or injury caused as a result of not following the instructions in this manual.

The plate heat exchanger must be used in accordance with the specified configuration of material, media, temperatures and pressure for the specific plate heat exchangers.

For any information not described in this manual, please contact BAODE for advice.

BPHE CONSTRUCTION

The BPHE is in principle built up by a plate package of corrugated channel plates between front and end plate packages. The connections can be customized to meet specific need and application requirements. During the vacuum-brazing process, a brazed joint is formed at every contact point between two plates. The design creates a heat exchanger that consists of two separate circuits.◦



Connections(1)、 Front cover plate(2) 、 Middle flow plate(3) 、 End cover plate(4)、 Media 1 (5) 、 Media 2 (6)

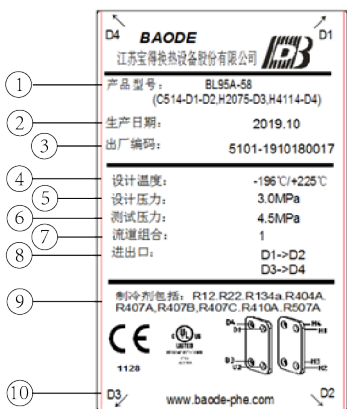
MATERIAL

Baode BPHE have 304 and 316 stainless steel. Please refer to the following chloride concentration table to select the appropriate material.

Chloride Concentration	Max Temperature			
	60℃	80℃	120℃	130℃
10 ppm	SS304	SS304	SS304	SS316
25 ppm	SS304	SS304	SS316	SS316
50 ppm	SS304	SS316	SS316	NO
80 ppm	SS316	SS316	SS316	NO
150 ppm	SS316	SS316	NO	NO
300 ppm	SS316	NO	NO	NO
>300 ppm	NO	NO	NO	NO

\*Note: SS= Stainless steel grade, NO = not suitable

## NAME PLATE



1. Product model
2. Production Date
3. Series No
4. Design temperature: Min and Max temperature for the BPHE
5. Design pressure: The Max working pressure.
6. Testing pressure: 1.5 times pressure of Design pressure
7. Plates group:
8. Flow direction: : D1->D2 means D1 in, D2 out
9. Product approval: for example: UL, CE
10. Connections Mark: the "-->" direct the connection.

### Warning!



The mechanical design pressures and temperatures are marked on the name plate. These must not be exceeded.

## MOUNTING



### Caution!

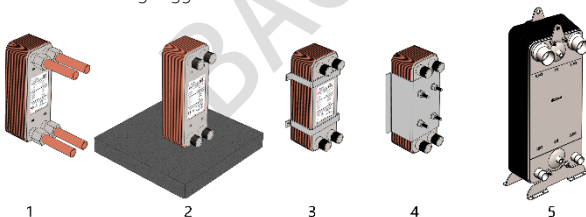
Please wear Protective gloves when handling the plate heat exchanger to avoid hand injuries caused by sharp edges..

The BPHEs are not suitable for the applications which have pulsation or excessive cycling pressure or temperature changes, and it is very important to avoid vibrations are transferred to the heat exchanger. Install vibration absorbers in such cases. For large connection diameters, an expanding device in the pipeline is advised.

A rubber mounting strip should be used as a buffer between the BPHE and the mounting clamp.

In **single-phase applications**, e.g. water-to-water or water-to-oil, the mounting direction has little or no effect on the performance of the heat exchanger, but in **two-phase applications**, the orientation of the heat exchanger becomes very important. In two-phase applications, BAODE's BPHEs should be mounted vertically.

Several mounting suggestions for BPHEs are shown below



- 1) Suspended directly in the pipework. (small models )
- 2) Supported from the bottom
- 3) Sheet metal bracket (rubber insert between bracket and BPHE)
- 4) Equipped with mounting stud bolts on the front or end plate
- 5) Support legs are available for big BPHEs

### Note!

Regardless of the mounting method minimize the pipe loads at installation.

*\* Maximum tightening torques for the mounting bolts*

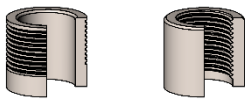
Bolt Dimension	Torque	
	Nm	lbf*ft
M5	2.3	1.7
M6	3.8	2.8
M8	9.5	7
M10	19	14
M12	33	24.3

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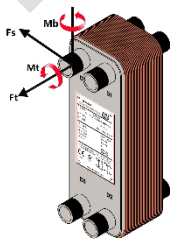
CONNECTION TYPES

● Threaded connections –

Threaded connections can be female or male of standards such as ISO-G, NPT and ISO 7/1. Use a torque wrench when connecting the pipe and observe the specified limits below



Thread size	Shear Force, $F_s$		Tension Force, $F_t$		Bending Moment, $M_b$		Torque, $M_t$	
	(KN)	(kp)	(KN)	(kp)	(Nm)	(kpm)	(Nm)	(kpm)
1/2"	3.5	357	2.5	255	20	2	35	3.5
3/4"	12	1224	205	255	20	2	115	11.5
1"	11.2	1142	4	408	45	4.5	155	16
1.25"	14.5	1479	6.5	663	87.5	9	265	27
1.5"	16.5	1683	9.5	969	155	16	350	35.5
2"	21.5	2193	13.5	1377	255	26	600	61
2.5"	44.5	4538	18	1836	390	40	1450	148
4"	73	7444	41	4181	1350	138.5	4050	413.5



● Soldering Connections

All BPHEs are vacuum-brazed with either a pure copper filler or a nickel-based filler. Under normal soldering conditions (no vacuum), the temperature should not exceed 800 °C. Too much heat could change the material structure resulting in internal or external leakage at the connection. Because of this we recommend that all soldering is made with silver solder containing



min. 45% silver. This type of solder has a relatively low soldering temperature and high moistening and fluidity properties. Soldering flux is used in order to remove oxides from the metal surface, and thereby its property makes the flux potentially very aggressive. Consequently, it is very important to use the correct amount of flux. Too much might lead to severe corrosion, so no flux should be allowed to enter the BPHE.

### Soldering Procedure

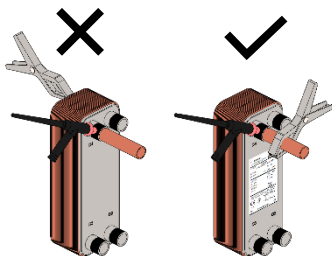
Degrease and polish the surfaces. Apply flux. Insert the copper tube into the connection, hold in place and braze with min. 45% silver solder at max. 650°C. Do not direct the flame at the BPHE. Use a wet rag to avoid overheating the BPHE. Protect the BPHE's interior from oxidation with N<sub>2</sub> gas.

#### Warning!

Excessive heating can lead to fusion of the copper and thus to the destruction of the heat exchanger!

- **Welding connection**

Protect the unit from excessive heating by **using a wet cloth around the connection**. Use TIG or MIG/MAG welding. When using electrical welding circuits, connect the ground terminal to the joining tube, not to the back of the plate package. Internal oxidation can be reduced by a small nitrogen flow through the unit.



#### Note!

Protect the heat exchanger from overheating by wrapping a piece of wet cloth around the connection while soldering or

welding. Excessive heating could melt the internal soldering metal inside the heat exchanger.

### **Filter (Strainer)**

If any of the media contains particles larger than 1 mm (0.04 inch), we recommend that a filter with a size of 16-20 mesh (number of openings per inch) is installed before the exchanger. The particles could otherwise block the channels, causing bad performance, increased pressure drop and risk of freezing.

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## INSTALLATION

### ◆ Installation in general purpose

#### Note!

Make sure all foreign objects have been flushed out of the system before connecting any piping.

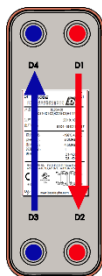


Normally, the circuit with the highest temperature and/or pressure should be connected on the left side of the heat exchanger. This is because the right-hand side of the heat exchanger contains one channel more than the left-hand side, and the hot medium is thus surrounded by the cold medium to prevent heat loss. For example, in a typical water to- water application, the two fluids are connected in a counter-current flow, i.e. the hot water inlet in connection D4, outlet D3, cold water inlet D2, outlet D1.

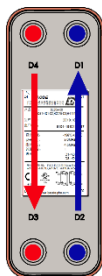
### ◆ Evaporator and Condenser Installation

#### Note!

In phase changing applications, the heat exchanger must be installed vertically



**A**

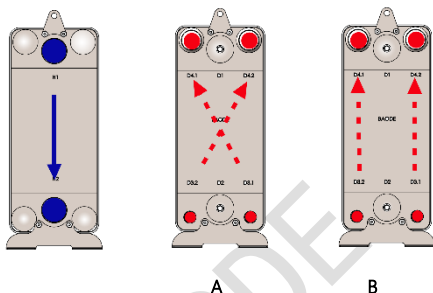


**B**

**Single Circuit:** **A** Evaporator (refrigerant in D3 and out D4) ; **B** Condenser. (refrigerant in D4 and out D3)

The heat exchanger could be of single or dual circuit type. Flow direction of a single circuit heat exchanger is normally parallel, while on dual circuit heat exchanger could be diagonal or parallel. Make sure that the heat exchanger is installed correctly according to the current flow direction for the heat exchanger. For detailed information about flow direction see the name plate.

Connections can be placed in the front or rear of the heat exchanger. Typical installation of a dual circuit heat exchanger as an evaporator:



**Dual circuit:** **A** is diagonal flow; **B** is parallel flow.

Water/Brine inlet and outlet are typically positioned on the back side.

### Freezing Protection

- 1) Use a filter < 1 mm, 16 mesh
- 2) Use an antifreeze when the evaporation temperature is close to liquid-side freezing.
- 3) Use a freeze protection thermostat and flow switch to guarantee a constant water flow before, during and after compressor operation.
- 4) Avoid "pump-down" function.
- 5) When starting up a system, wait a moment before starting the condenser (or have reduced flow through it).



## ■ Condenser Installation

The refrigerant (gas) should be connected to the upper left connection, D4, and the condensate to the lower left connection, D3. The water/brine circuit inlet should be connected to the lower right connection, D2, and the outlet to the upper right connection, D1.

## LEAKING TEST

Leakage test before placing the plate heat exchanger in operation.

## INSULATIONS

If the heat exchanger will be operated at very hot or very cold temperature, take protective actions, such as insulation, to avoid injuries.

### ◆ Insulation for Refrigerant Applications

BPHE insulation is recommended for evaporators, condensers or district heating applications, etc. For refrigeration, use extruded insulation sheets,

### ◆ Insulation for Heating Applications

For heating applications, various types of insulation boxes can be used. The working temperature range defines which insulation is recommended.

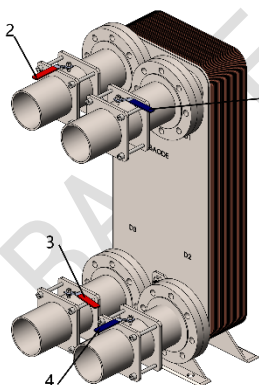
BAODE offer EPP insulation for certain models.

## RUNNING HEAT EXCHANGER

### ■ Start Up

#### Note!

Adjustments of flow rates should be made slowly in order to avoid the risk of water hammer. Water hammer is a short-lasting pressure peak that can appear during start-up or shut-down of a system, which causing liquids to travel along a pipe as a wave at the speed of sound. This can cause considerable damage to the equipment



- 1) Check that the Inlet valves **(2, 4)** for both fluids should be closed, if there are outlet valves **(1, 3)**, make sure that they are fully opened.
- 2) Start the pump.
- 3) Open the inlet valve **(2)** slowly
- 4) Repeat steps 1–3 for the second media.

## ■ During operation

### Note!

Adjustments of flow rates should be made slowly in order to protect the system against sudden and extreme variations of temperature and pressure.

### ◆ *Protection against connection loads*

Make sure that the heat exchanger is fastened to avoid or minimize connection loads during operation.

### ◆ *Protection against freezing*

Bear in mind the risk of freezing at low temperatures. Plate heat exchangers that are not in operation should be emptied and blown dry whenever there is a risk of freezing.

### Note!

To avoid damage due to freezing, the medium used must include an anti-freeze agent when operating conditions are below 5 °C (41 °F) and/or when the evaporating temperature is below 1 °C (34 °F)

### ◆ *Protection against blocking*

Use a filter as protection against the possible occurrence of foreign particles. If you have any doubt concerning the maximum particle size, please consult your BAODE.

### ◆ *Protection against thermal or/and pressure fatigue*

Sudden temperature and pressure changes could cause fatigue damage to the heat exchanger. Therefore, the following must be taken into consideration

to ensure that the heat exchanger operates without fluctuating pressures/temperatures.



#### Warning!

The plate heat exchanger is not intended for cyclic processes, please contact an BAODE Representative for advice.

- Locate the temperature sensor as close as possible to the outlet from the heat exchanger.
- Choose valves and regulation equipment which give stable temperatures/pressures for the heat exchanger.
- To avoid water hammer, quick-closing valves must not be used, e.g. on/off valves.
- Make the amplitude and frequency of the pressure variation are as low as possible. In automated installations, stopping and starting of the pumps and actuation of valves must be programmed.

#### ◆ *Protection against corrosion*



#### Caution!

- Do not use the heat exchanger for de-ionized water which can chemically affect the copper brazing material.
- Do not install BPHE with galvanized pipes that could chemically or electrochemically affect or be affected by the stainless plates and the copper brazing material.
- Avoid **ammonia** that could be corrosive the BPHE material.



Recommended limits for Chloride ions,  $\text{Cl}^-$  at pH 7.5 1

Temperature	SS304	SS316
25 °C	$\leq 100$ ppm	$\leq 1000$ ppm
65 °C	$\leq 50$ ppm	$\leq 200$ ppm
80 °C	$\leq 20$ ppm	$\leq 100$ ppm

Other Element (2-50°C) :

$\text{Cl}_2$	$\leq 1.0$ ppm
$\text{SO}_4^{2-}$	$\leq 70$ ppm
$\text{NH}_3$	$\leq 2$ ppm
Hardness	4.0~8.5°dH
$\text{H}_2\text{S}$	$\leq 0.05$ ppm
$\text{H}_2$	$\leq 0.5$ ppm
$\text{HCO}_3^-$	$\leq 70$ ppm
$\text{CO}_2$	$\leq 5$ ppm

## ■ Shut-down

- 1) Slowly reduce the flow rate in order to avoid water hammer.
- 2) When the valve is closed, stop the pump.
- 3) Repeat steps 1–2 for the other medium/media.
- 4) If the plate heat exchanger is shut down for a long period, it should be drained. Also drain the heat exchanger if the process is shut down and the ambient temperature is below the freezing temperature of the media. Depending on the media processed, rinse and dry the heat exchanger and its connections.

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## MAINTENANCE

Turbulence in BPHEs there is a self-cleaning effect in the channels. However, in some applications the fouling tendency can be very high, e.g. when using extremely hard water at high temperatures. In such cases it is always possible to clean the exchanger by circulating a cleaning liquid (CIP Cleaning In Place). Use a tank with weak acid, 5% phosphoric acid or, if the BPHE is frequently cleaned, 5% oxalic acid. Pump the cleaning liquid through the BPHE.

For optimum cleaning, the cleaning solution flow rate should be a minimum of 1.5 times the normal flow rate, preferably in a back-flush mode. After use, do not forget to rinse the heat exchanger carefully with clean water. A solution of 1-2% sodium hydroxide (NaOH) or sodium bicarbonate (NaHCO<sub>3</sub>) before the last rinse ensures that all acid is neutralized.

### Type of cleaning:

- Acidic cleaning removes inorganic deposits such as limestone.
- Alkaline cleaning removes organic deposits. During the process it is important to control the pH value and the recommended pH value is 7.5 - 10. Higher pH values increase risk of the copper oxidizing.
- Neutralization of cleaning liquids before draining and flushing the unit with potable water.

#### NOTE!

Plate Sheet material Stainless steel can corrode. Chloride ions are hazardous. Avoid cooling brines containing chloride salts as NaCl and, most harmful, CaCl<sub>2</sub>.



#### Warning!



Use proper protective equipment, such as safety boots, safety gloves and eye protection, when using cleaning agents.

## **WARRANTY AND DISCLAIMER**

### **Storage**

BPHEs are to be stored dry. The temperature should not be below 17°C and not over 50°C. keep the heat exchanger in a protective environment away from corrosive substances and dust which may affects its performance.

Keep the plastic plugs or caps for the connections in place during storage.

### **Warranty**

BAODE offers a 12-month warranty from the date of installation, but in no case longer than 15 months from the date of delivery. The warranty covers only manufacturing and material defects.

### **Disclaim**

BPHE performance is based on installation, maintenance and operating conditions done in conformance with this manual. BAODE cannot assume any liability for BPHEs that do not meet these criteria.