

# INSTRUCTION MANUAL FOR BRAZED PLATE HEAT EXCHANGERS

## TECHNICAL DATA AND APPROVALS

See the type label on the product.  
For more details on approvals, please contact SWEP or see the appropriate product sheets on [www.swep.net](http://www.swep.net).

**2 14 11 715 2 0001** Serial number

| Number in series  
 | Number of circuits  
 | Product code  
 | Month 11, i.e. November  
 | Year 14, i.e. 2014  
 | Production entity

## WARRANTY

SWEP 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.

## DISCLAIMER

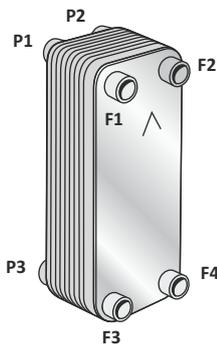
The performance of SWEP BPHEs is based on their installation, maintenance, and operating conditions being in conformance with this manual. SWEP cannot assume any liability for BPHEs that do not meet these criteria.

**The BPHE is not type-approved for fatigue loading.**

## GENERAL INFORMATION

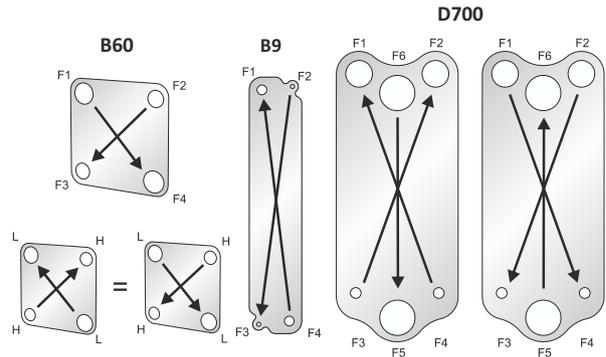
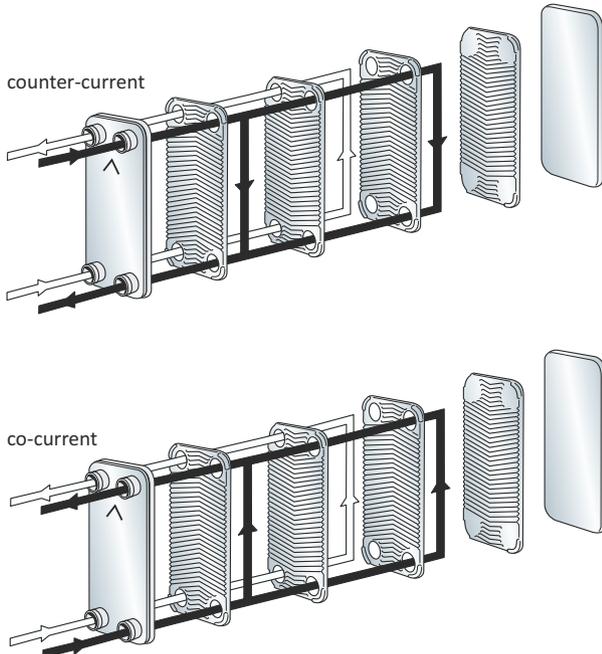
The front plate of SWEP BPHEs is marked with an arrow, either on an adhesive sticker or embossed in the cover plate. This marker indicates the front of the BPHE and the location of the inner and outer circuits/channels. With the arrow pointing up, the left-hand side (ports F1, F3) is the inner circuit and the right-hand side (ports F2, F4) is the outer circuit.

Ports F1/F2/F3/F4 are on the front of the BPHE. Ports P1/P2/P3/P4 are on the back. Note the order in which they appear.



## FLOW CONFIGURATIONS

Fluids can pass through the BPHE in different ways. For parallel-flow BPHEs, there are two different flow configurations:



The B9, B60 and D700 have a cross-flow configuration, instead of the parallel flow normally found in BPHEs. In the B9 and B60, ports F1-F4 are equivalent to the outer circuit, and ports F2-F3 to the inner circuit. For the D700, ports F5-F6 are the outer circuit and ports F1-F4 and F2-F3 are the inner circuits.

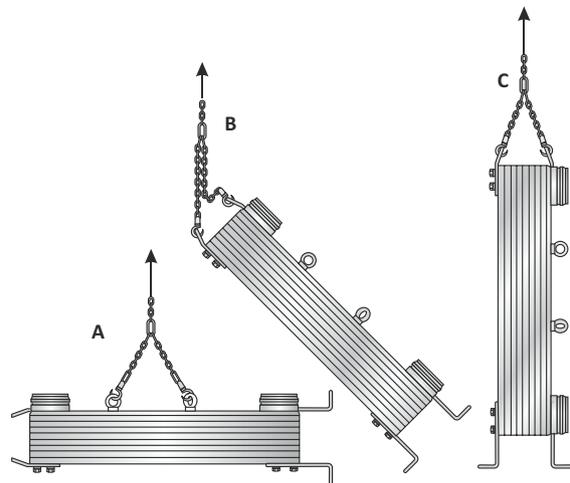
When using the B60 in single-phase applications, you achieve the same thermal performance regardless of the inlet/outlet arrangement due to its quadratic shape and cross-flow arrangement. However, the choice of fluid stream on the H and L sides depends on the thermal and hydraulic performance requirements. When using the B60 as a condenser, it is important that the refrigerant enters through port F2 and leaves through F3.

## LIFTING INSTRUCTIONS FOR LARGER BPHEs

- A. Lifting in horizontal position
- B. Lifting from horizontal to vertical position
- C. Lifting in vertical position

### WARNING.

**Risk of personal injury.** Maintain a safety separation of 3 m (10 ft) when lifting.



## MOUNTING

Never expose the BPHE to excessive pulsations (i.e. cyclic pressure or temperature changes). It is also important that no vibrations are transferred to the BPHE. If there is a risk of this, install vibration absorbers. For large connection diameters, we advise you to use an expanding device in the pipeline. It is also suggested that a buffer (e.g. a rubber mounting strip) be installed between the BPHE and the mounting clamp.

### Mounting direction

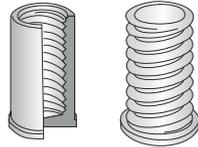
In single-phase applications (e.g. water-to-water or water-to-oil), the mounting orientation has little or no effect on the performance of the BPHE. However, in two-phase applications the BPHE's orientation becomes very important. In two-phase applications, SWEP BPHEs should be mounted vertically, with the arrow on the front plate pointing upwards.

**A**

Pipe size	Shear force, F <sub>s</sub> (kN)	Tension force, F <sub>t</sub> (kN)	Bending moment, Mb (Nm)	Torque, Mt (Nm)
½"	3.5	2.5	20	35
¾"	12	2.5	20	115
1"	11.2	4	45	155
1 ¼"	14.5	6.5	87.5	265
1 ½"	16.5	9.5	155	350
2"	21.5	13.5	255	600
2 ½"	44.5	18	390	1450
3"	55.5	18.4	575	2460
4"	73	41	1350	4050
6"	169	63	2550	13350

**Allowable loads for stud bolt assembly conditions**

Mounting stud bolts for BPHEs are available as an option. These stud bolts are welded to the BPHE. The maximum allowable loads on the stud bolts during assembly are stated in Table B.



**B**

Stud bolt	Stress area A <sub>s</sub> (mm <sup>2</sup> )	Tension force F <sub>t</sub> (N)	Torque Mt (Nm)
M6	20.1	1400	3
M8	36.6	2600	8
M12	84.3	6000	27

UNC Stud bolt	Stress area A <sub>s</sub> (in <sup>2</sup> )	Tension force F <sub>t</sub> (lbf)	Torque Mt (lbf·in)
1/4"	0.032	315	27
5/16"	0.053	585	71
1/2"	0.144	1349	239

**INSTALLING BPHEs IN DIFFERENT APPLICATIONS**

**Single-phase applications**

Normally, the circuit with the highest temperature and/or pressure should be connected on the left-hand side of the BPHE when the arrow is pointing upwards. 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 is connection F1, the outlet F3, the cold water inlet F4, and the outlet F2. This is because the right-hand side of the BPHE contains one channel more than the left-hand side, and the hot medium is thus surrounded by the cold medium to prevent heat loss.

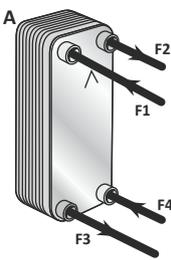
**Two-phase applications**

It is very important that in all refrigerant applications every refrigerant channel has a water/brine channel on both sides. Normally, the refrigerant side must be connected to the left-hand side and the water/brine circuit to the right-hand side of the BPHE. If the refrigerant is connected incorrectly to the first and last channels, instead of water/brine, the evaporation temperature will drop, with the risk of freezing and very poor performance. SWEP BPHEs used as condensers or evaporators should always be fitted with adequate connections on the refrigerant side.

**Condensers (Picture A)**

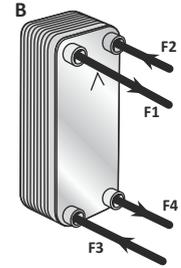
The refrigerant (gas/steam) should be connected to the upper left connection, F1, and the condensate to the lower left connection, F3. The water/brine circuit inlet should be connected to the lower right connection, F4, and the outlet to the upper right connection, F2.

BPHEs with UL approval for use with CO<sub>2</sub> according to UL files section II or VI. When used with CO<sub>2</sub>, the system should include a pressure relief valve on each side of the BPHE. The pressure relief valve must open if the system pressure reaches 0.9 × design pressure.



**Evaporators (Picture B)**

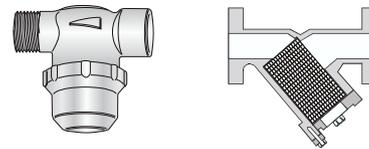
The refrigerant liquid should be connected to the lower left connection (F3) and the refrigerant gas outlet to the upper left connection (F1). The water/brine circuit inlet should be connected to the upper right connection (F2), and the outlet to the lower right connection (F4).



**Expansion Valves**

The expansion valve should be placed close to the evaporator inlet. The recommended distance is 150-300 mm, or with the ratio of the pipe length to the pipe's inner diameter equal to 10-30. The pipe diameter between the expansion valve and the BPHE is important for the thermal performance. The pipe should normally have the same diameter as the connection. The correct diameter can be selected with SWEP's software tool SSP. The expansion valve bulb should be mounted about 500 mm from the vaporized refrigerant outlet connection.

For evaporators, the total pressure drop is the pressure drop in the internal distribution system plus that in the expansion valve. Selecting the next larger size valve will normally give satisfactory performance.

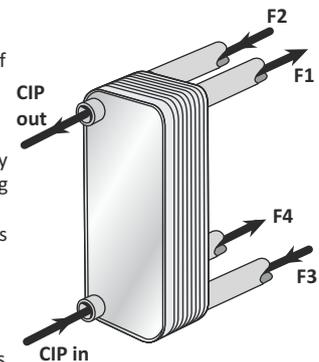


**Freezing Protection**

- Use a filter < 1 mm, 16 mesh
- Use an antifreeze when the evaporation temperature is close to the liquid-side freezing point
- Use a freeze protection thermostat and flow switch to guarantee a constant water flow before, during, and after compressor operation
- Avoid using the "pump-down" function
- When starting up a system, pause briefly before starting the condenser (or have a reduced flow through it)
- If any of the media contain particles larger than 1 mm (0.04 inch), a strainer should be installed before the BPHE

**CLEANING OF THE BPHEs**

The normally very high degree of turbulence in BPHEs produces 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 BPHE by circulating a cleaning liquid (CIP – Cleaning In Place). Use a tank with weak acid, 5% phosphoric acid, or if the BPHE is cleaned frequently, 5% oxalic acid. Pump the cleaning liquid through the BPHE.

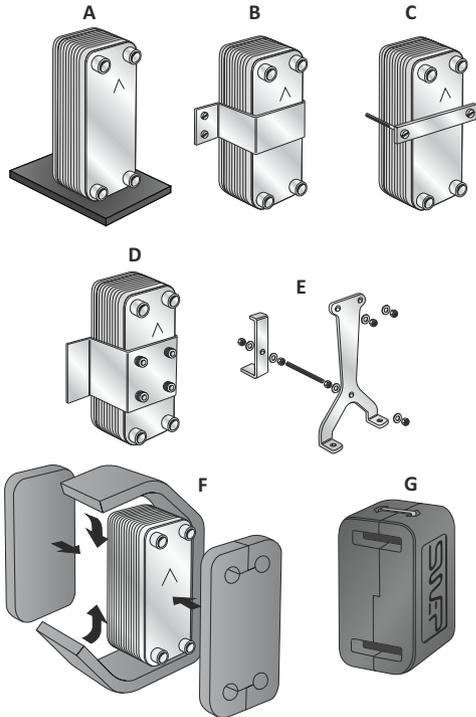


For demanding installations, we recommend factory-installed CIP connections/valves for easy maintenance. When cleaning, pump the cleaning solution through the BPHE from the lower connection to vent air. For optimal cleaning, the flow rate should be at least 1.5 times the normal flow rate, preferably in a back-flush mode. Reverse the flow direction every 30 min if possible. After cleaning, remember to rinse the BPHE carefully with clean water. A solution of 1-2% sodium hydroxide (NaOH) or sodium bicarbonate (NaHCO<sub>3</sub>) before the final rinse ensures that all acid is neutralized. Clean at regular intervals. For further information about cleaning BPHEs, please consult SWEP's CIP information or your local SWEP company.

### Mounting suggestions

Mounting suggestions are shown below. Support legs, brackets, and insulation are available as options.

- A. Supported from the bottom
- B. Sheet metal bracket (x = rubber insert)
- C. Crossbar and bolts (x = rubber insert)
- D. With mounting stud bolts on the front or back cover plate
- E. Support legs are available for some larger BPHEs
- F. Insulation for refrigerant applications
- G. Insulation for heating applications



### CONNECTIONS

All connections are brazed to the BPHE in the general vacuum-brazing cycle, a process that gives a very strong seal between the connection and the cover plate. However, note the following warning.

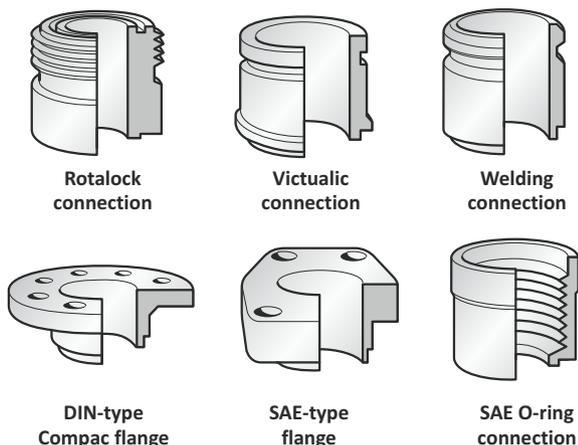
#### WARNING

##### Risk of damaging the connection

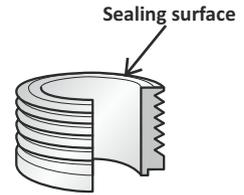
Do not join the counterpart with such force that the connection is damaged.



Depending on the application, many options are available for the types and locations of the connections (e.g. Compac flanges, SAE flanges, Rotalock, Victualic, threaded, and welding). It is important to select the correct international or local standard of connection, because they are not always compatible.



Some connections are equipped with a special plastic cap to protect the connection's threads and sealing surface (X) and to prevent dirt and dust from entering the BPHE. This plastic cap should be removed with care to avoid damaging the thread, sealing surface, or any other part of the connection. Some connections have an external heel whose purpose is to facilitate pressure and leakage testing of the BPHE in production.



### Soldering Connections

The soldering connections (sweat connections) are in principle designed for pipes with dimensions in mm or inches. The measurements correspond to the internal diameter of the connections. Some of SWEP's soldering connections are universal, i.e. fit both mm- and inch-denominated pipes. These are denominated xxU. For example, the 28U fits both 1 1/8" and 28.75 mm pipes.

All BPHEs are vacuum-brazed with either a pure copper or a stainless steel filler. Soldering flux is used to remove oxides from the metal surface. The flux's properties make it potentially very aggressive. Consequently, it is very important to use the correct amount of flux, because too much might lead to severe corrosion. No flux must be allowed to enter the BPHE.

### Soldering procedure

Degrease and polish the surfaces. Apply flux. Insert the copper tube into the connection, hold it in place and braze with min. 45% silver solder at max. 450 °C (840 °F) when soft soldering and 450-800 °C (840-1470 °F) when hard soldering. Do not direct the flame at the BPHE. Use a wet rag to avoid overheating the BPHE. Protect the BPHE's interior (refrigerant side) from oxidation with N2 gas.

#### WARNING

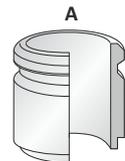
Excessive heating can lead to fusion of the copper and thus to the destruction of the BPHE.



When SWEP supplies an adapter or flange that is soldered to the BPHE by the customer, SWEP does not assume any responsibility for incorrect soldering nor for any accidents that may occur during the process.

### Welding connections

Picture A. Welding is only recommended for specially designed welding connections. All SWEP's welding connections have a 30° chamfer on the top of the connection. Do not weld on pipes on other types of connections. The measurement in mm corresponds to the external diameter of the connection.



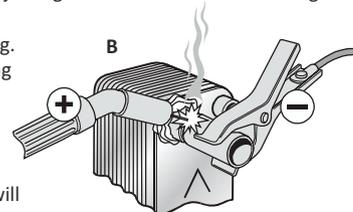
### Welding procedure

Protect the BPHE from excessive heating by:

- a) using a wet cloth around the connection
- b) making a chamfer on the joining tube and the connection edges as shown (Picture B)

Use TIG or MIG/MAG welding.

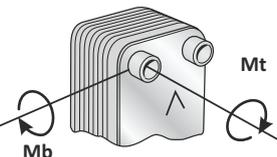
When using electrical welding circuits, connect the ground terminal to the joining tube, not to the back of the plate package. A small flow of nitrogen through the BPHE will reduce internal oxidation.



Make sure there are no traces of copper adjacent to the prepared joint. If the joint is prepared by grinding, take appropriate measures to prevent copper from being ground into the stainless surface.

### Allowable connection loads for pipe assembly conditions

The maximum allowable connection loads given in Table A are valid for low cycle fatigue. If high cycle fatigue is involved, a special analysis should be performed.



**Bleeding the BPHE**

A bleeding valve must be assembled on the warm side of the BPHE, where the gas is least soluble in water. Make sure it is positioned high relative to the BPHE. Depending on the need, the frequency of bleeding required will vary.

**STORAGE**

BPHEs must be stored dry. In long-term storage (longer than two weeks), the temperature should be between 1 °C and 50 °C.

**APPEARANCE**

Extensive copper stains may occur on the BPHE's surface following brazing. This discoloration is not corrosion and does not affect the BPHE's performance or way of use.

For further information, please consult SWEP's technical information or your local SWEP company.



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