FREEZING PROTECTION
- Use air with +1°C, 15 mesh (see previous chapter on Strainers).
- Use an antifreeze when the evaporation temperature is close to liquid-side outlet.
- Use a freeze protection thermostat and flow switch to guarantee a constant water flow before, during and after compressor operation.
- When starting up a system, wait a moment before starting the condenser (or have reduced flow through it).

CONDENSERS
The refrigerant (gas) should be connected to the upper left connection, F1, and the condensate to the lower left connection, F3. The water/heating circuit 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 CO2, according to UL flex section II or VI. For use with CO2, the system should include a pressure relief valve on each side of the brazed plate heat exchanger. The pressure relief valve must be opened if the system pressure reaches 0.3 x design pressure.

CLEANING OF THE BPHEs
Thanks to the normally very high degree of turbulence in BPHEs there is a self-cleaning effect in the channels. However, in some applications the bolting tendency can be too 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). For tough installations we recommend factory-installed CIP connections/valves for easy maintenance.

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 open the heat exchanger carefully with clean water. A solution of 1-2% sodium hydroxide (NaOH) or sodium chloroacetate (NaClO2) before the last time ensures that all acid is neutralized. Clean at regular intervals.

DRAINING OF HEAT EXCHANGER
A drainage valve shall be positioned at a low position in relation to the heat exchanger. Make sure that all relevant pumps are shut off. Shut off primary side’s valves. Shut off secondary side’s valves. Empty the exchanger using drainage valve.

BLEEDING OF HEAT EXCHANGER
A bleeding valve shall be assembled on the upper side of the heat exchanger, where the water has its lowest subcool of the gas. Make sure it’s positioned at a high position in relation to the heat exchanger. Depending on the size, the frequency of ventilation will differ.

For further information about cleaning of the BPHEs, please consult SWEP’s CIP information or your local SWEP company.

STORAGE
BPHEs are to be stored dry. The temperature should not be below 1°C and not over 50°C for long term storage (more than 2 weeks).

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

The heat exchanger is not type-approved for fatigue loading.

For further information, please contact SWEP’s technical information or your local SWEP company.

INSTALLATION AND MAINTENANCE MANUAL FOR BPHEs

GENERAL INFORMATION
Depending on material combinations, pressure ratings and functions, there are several different types of Compact Brazed Heat Exchangers (BPHEs). The standard materials are stainless steel, vacuum-brazed with a copper or copper-brazed filler. The basic materials of construction indicate the type of fluids that SWEP’s BPHE can be used with. Typical examples are synthetic or mineral Oil, organic solvents, water (not sweater), glycol mixtures (aliphatic and propylene glycol), refrigerants (e.g. R12, R134A). Please note that of natural refrigerants (e.g. ammonia) are employed, BPHEs with nickel-based brazed materials are used.

The front plate of SWEP’s BPHE is marked with an arrow. Either of an adhesive or a sticker is on the cover plate. The purpose of the sticker or in this case arrow is to indicate the fluid direction for the inlet and outlet. The BPHEs are designed so that the fluid flows in the same direction through the upper and lower circuit/channels. With the arrow pointing up, the left plate (P1-P4) is the inner circuit and the right plate (P5-P8) the outer circuit.

The outer circuit has a slightly lower pressure drop as it contains fewer channels. Ports P1 F1/F4 are situated on the front of the heat exchanger. Ports P1 F1/F4 are situated on the back. Note the order in which they appear.

CONSTRUCTION
The BPHE is normally built up by plate packages of corrugated channel plates between front and rear cover plate packages. The plate cover packages consist of sealing plates, blind rings and cover plates. The connections can be customized to meet specific market and application requirements. During the vacuum brazing process, a brazed joints formed at every contact point between two plates. The design creates a heat exchanger that consists of two separate circuits.

The BPHE is in principle built up by a plate package of corrugated channel plates. However, in some applications the turbulence in BPHEs can be very high, e.g. when using applications the fouling tendency is extremely hard water at high temperatures. In such cases it is important that the gas inlet is port F1 and the outlet F4.

When using the B60 exchanger in single-phase applications, you get the same results with these two different installations, but as a condenser it is very important that the gas inlet is port F1 and the outlet F4.

TABLE 1: Examples of BPHEs with various material and design pressures

BPHE Categories | Description | Explanation
--- | --- | ---
Standard BPHEs | | B25T with stainless steel plates brazed with copper, Standard pressure rating.
High Pressure BPHEs | | B25T with stainless steel plates brazed with copper, High pressure rating.
Nickel brazed BPHEs | | B25T with stainless steel plates brazed with nickel alloy, Standard pressure rating.
Mo-steel BPHEs | | B25T with stainless steel plates brazed with copper, Standard pressure rating.
SUS steel BPHEs | | B25T with stainless steel plates brazed.

Plate: H | Channel: H | M (M4/M4L)

FLOW CONFIGURATIONS
The fluids can be sent through the heat exchanger in different ways. For parallel-flow BPHEs, there are two different flow configurations: co-current or counter-current.

CO-CURRENT FLOW
- B120, B60 and C750 have a cross-flow configuration, instead of the parallel flow normally found in BPHEs. In B120 and B60 the ports F1/F4 are equivalent to the outer circuit and the ports F2/F3 are equivalent to the inner circuit. For C750 there is one circuit and F1/F4 is the outer circuit and F2/F3 is the inner circuit.

When using the B60 exchanger in single-phase applications, you get the same results with these two different installations, but as a condenser it is very important that the gas inlet is port F1 and the outlet F4.
Different versions available

There are several different versions of the channel plate packages. Below are a couple of examples.

Dual-Circuit BPHE (C-C)

Two-Pass BPHE (CJP), which connects to two units connected in series.

Dual-circuit Two-Pass BPHE (C-JCP)

DESIGN CONDITIONS AND APPROVALS

The following table gives guidance for SWEP® BPHEs, i.e. maximum operating pressures, i.e. 31 bar (3.1 MPa, 450 psi). SWEP®’s standard maximum operating temperature is 400°C (752°F).

© Notable branded BPHEs. however, as temperature and pressure are closely coupled, this will increase the pressure if the temperature is reduced. For details, please refer to the local technical documentation.

SWEP®’s BPHEs are approved by a number of independent bodies, e.g.

- Europe: Pressure Equipment Directive (PED)
- USA: Underwater Licensing Act
- Japan: The High Pressure Gas Safety Institute of Japan (KIKK)

SWEP®’s approvals are from Lloyd’s Register, Great Britain; Det Norske Veritas (DNV), Norway; American Bureau of Shipping (ABS), USA; Korean Register (KRS), etc.

A number of SWEP®’s BPHEs are approved by the European approved PED (Pressure Equipment Directive). For approved units the data on the label must be used.

For operating conditions exceeding the European approved PED, please see Product sheets on www.swap.net. For more details on the respective approvals, please contact SWEP.

LABELING SYSTEM AND OPERATING CONDITIONS

All BPHEs are equipped with a label which includes vital information about the unit, e.g. type of heat exchanger which indicates the basic BPHE design. In the following, see the example of a BPHE from SWEP®. This includes the serial number which is described below. The Operating Conditions take the maximum operating temperature and pressure per the respective approvals.

NEED TO KNOW

Mounting studs, in different versions and locations, are available on the BPHEs as an option. M12 studs are welded to the unit. The M10 and M8 studs during assembly are stated below.

Allowable Loads for Stud Bolt Assembly Conditions

<table>
<thead>
<tr>
<th>Bolt Diameter</th>
<th>Shear Force, Fs (N)</th>
<th>Tension Force, Ft (N)</th>
<th>Bending Moment, Mb (Nm)</th>
<th>Torque, Mt (Nm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>M10</td>
<td>115</td>
<td>103</td>
<td>50</td>
<td>15</td>
</tr>
<tr>
<td>M8</td>
<td>71</td>
<td>68</td>
<td>35</td>
<td>10</td>
</tr>
</tbody>
</table>

Allowable Loads for different pipe assembly conditions

<table>
<thead>
<tr>
<th>Pipe Diameter</th>
<th>Shear Force, Fs (N)</th>
<th>Tension Force, Ft (N)</th>
<th>Bending Moment, Mb (Nm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5/8&quot;</td>
<td>44.5</td>
<td>45.0</td>
<td>18.5</td>
</tr>
<tr>
<td>3/4&quot;</td>
<td>66.8</td>
<td>66.5</td>
<td>25.5</td>
</tr>
<tr>
<td>1&quot;</td>
<td>99.1</td>
<td>98.5</td>
<td>38.0</td>
</tr>
<tr>
<td>1 1/8&quot;</td>
<td>131.4</td>
<td>130.5</td>
<td>51.0</td>
</tr>
<tr>
<td>1 1/4&quot;</td>
<td>173.7</td>
<td>172.5</td>
<td>64.0</td>
</tr>
<tr>
<td>1 1/2&quot;</td>
<td>216.0</td>
<td>214.5</td>
<td>77.0</td>
</tr>
</tbody>
</table>

STRAINERS

If any of the media contains particles larger than 1 mm (0.04 inch), we recommend the use of a strain (the number of opening per inch) is installed before the exchanger. The particles could otherwise block the channels, causing heat-performance, increased pressure drop and risk of fouling.

INSULATIONS

Insulation for Refrigerant Applications

BPHE insulation is recommended for evaporators, condensers or district heating applications. The insulation may be supplied by SWEP® in addition to the BPHE.

Insulation for Heating Applications

For heating application, various types of insulation boxes can be used. The working temperature range defines which insulation is recommended. SWEP® can supply a range of insulation types as optional accessories.

INSTALLATION OF BPHEs IN DIFFERENT APPLICATIONS

Single-Phase Applications

Normally, the connection to the liquid temperature and pressure should be connected on the left side of the heat exchanger when the flow is in a clockwise direction from the bottom.

Two-Phase Applications

In all refrigeration applications it is very important that every refrigerant channel is surrounded by a condenser. The condenser should be connected to the right-hand side and the condenser tube to the right-hand side of the unit.

Evaporators; Three evaporator types (V, P, S)

The V-series BPHEs are equipped with a special distribution device at the refrigerant inlet, i.e. normally port F3. The purpose of the distribution is to equally distribute the refrigerant in the channel.

Expansion Valves

The expansion valve should be placed close to the inlet connection, where the bulb should be mounted about 650 mm from the vaporized refrigerant outlet connection. The pipe diameter between the expansion valve and the BPHE should be the same as the diameter of the refrigerant line.

For the evaporator, the pressure drop in the internal connection system must be added to the pressure drop in the expansion valve to arrive at the total pressure drop. Normally, selecting the next larger size valve will give satisfactory performance.