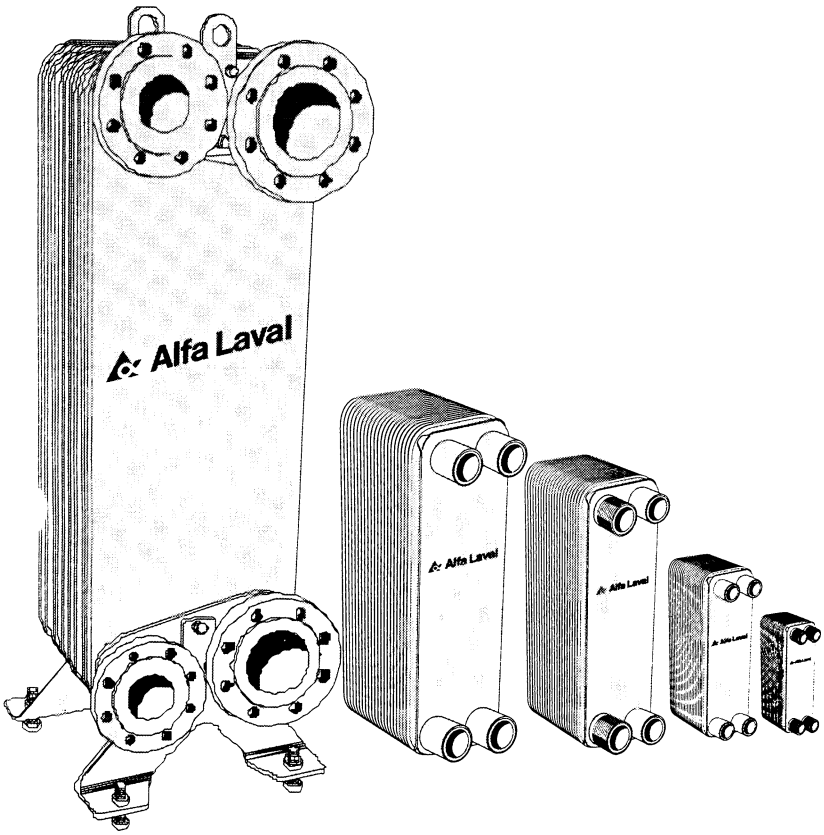
CB

Brazed Plate Heat Exchanger



Installation Manual

Alfa Laval

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I. INTRODUCTION

The Brazed Plate Heat Exchanger (BPHE)

Alfa Laval is credited with inventing the original brazed plate heat exchanger. The brazed heat exchanger is a compact variation of the traditional plate heat exchanger. The BPHE does not have a carbon steel frame, gaskets, tightening bolts, or carrying bar. It simply consists of AISI 316 stainless steel corrugated channel plates, pressure plate and frame plate with connections which are brazed together in a vacuum furnace.

How It Works

When the package of plates is pressed together, it creates continuous chambers through the ports in each corner. The media enters the inlet connections and is distributed into the narrow channels between the plates. The passages between the plates and corner ports are arranged so that the two heat transfer media can travel in alternate channels, always in countercurrent flow. A brazed seal around the outer edge of the plates retains the media within the channels. As the warmer medium passes through the unit, it releases heat energy to the thin plate wall, which instantly transfers it to the colder medium on the other side. The media exit the plate pack through the outlet connections on the same side of the heat exchanger.

The thin plates have a uniquely designed herringbone geometry which allows for high turbulence and low pressure loss. This optimal plate pattern gives the BPHE an extremely high overall heat transfer coefficient. This pattern has been developed through theoretical consideration, checked by laboratory tests and proven itself in the field.

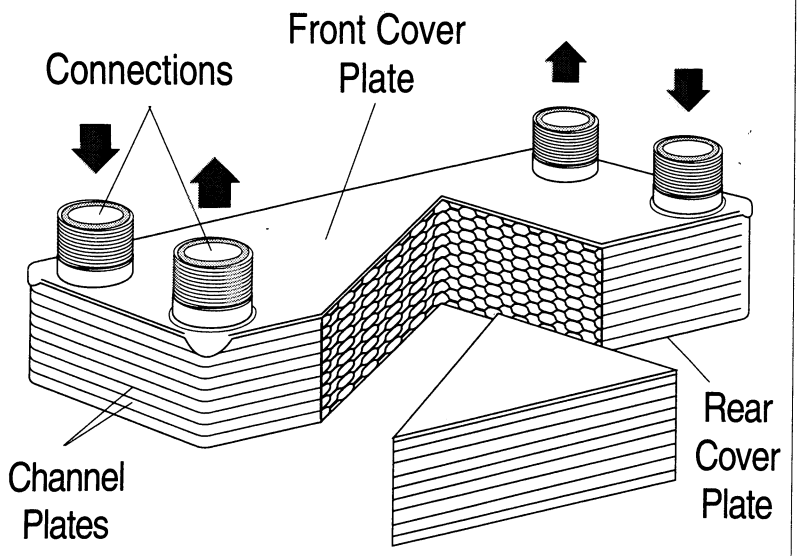

Figure 1. Cross section of a BPHE

II. THE ALFA LAVAL COPPER BRAZED HEAT EXCHANGER SERIES

The Copper Brazed Heat Exchanger Line

Alfa Laval has developed a standard line of BPHE's to encompass different applications and heat loads. These heat exchangers, from the smallest unit, the CB14, to the largest, the CB300, are brazed with 99.9% pure copper.

The Nickel Brazed Plate Heat Exchanger is an alternative for applications where copper is not appropriate, such as deionized water or ammonia.

Brazed Plate Heat Exchangers are suitable for liquid/liquid, steam/liquid, and gas/liquid applications.

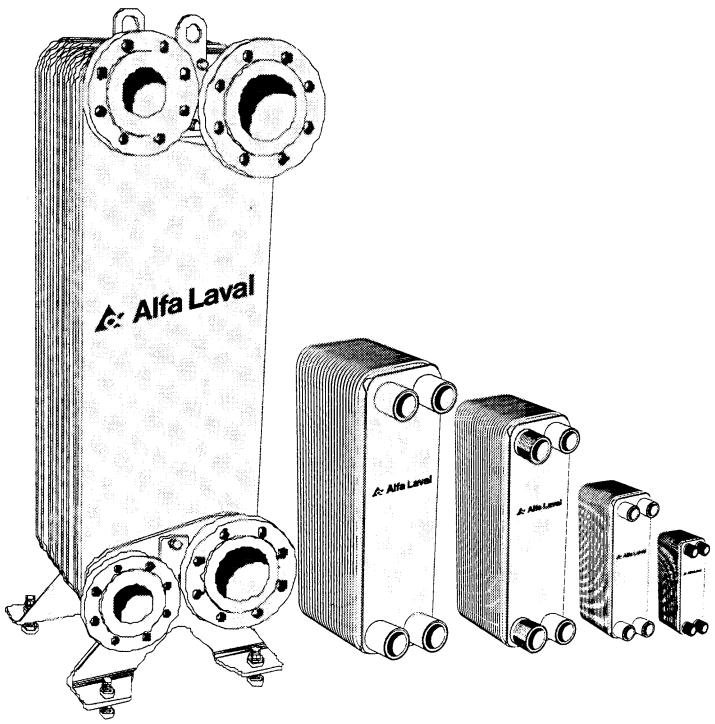

Figure 2. CB200, CB76, CB50, CB26, CB14

CB300—the largest Alfa Laval BPHE, is custom designed to offer the optimal heat transfer surface. It comes equipped with mounting feet and lifting lugs due to its size. Flanges (ANSI or DIN), are also provided. JIS connections are available by request. The CB300 can transfer up to 7000 kBtu/hr.

Symmetrical—channel design are identical for both media.

Asymmetrical—one channel has wider spacing than the other. Narrow spacing gives a higher overall heat transfer coefficient, but also a higher pressure drop. This asymmetrical BPHE is used when each media requires a different volume flow.

Table 3. BPHE Model Data

Model Type	Channel Design	Heat Transfer Coefficient	Spacing
CB14	Symmetrical	High	Normal
CB26 H	Symmetrical	High	Normal
CB26 M	Symmetrical	Medium	Normal
CB26 L	Symmetrical	Low	Normal
CB50	Symmetrical	High	Normal
CB76 E	Symmetrical	High	Narrow
CB76 H	Symmetrical	Low	Wide
CB76 A	Asymmetrical	Medium	Wide/Narrow
CB300 H	Symmetrical	High	Normal
CB300 M	Symmetrical	Medium	Wide/Narrow
CB300 L	Symmetrical	Low	Normal

Standard BPHE's

Since there are a great number of possible BPHE design combinations, Alfa Laval offers standard and custom designed BPHE's. The standard BPHE's have a preset number of plates. (See Table 5). These units are available off-the-shelf, and can be delivered within a few days. The standard line is ideal for the customer who requires only a small number of units. The custom designed BPHE is designed exactly according to the customer's specifications. The delivery time is therefore initially longer than a standard BPHE to allow time for production.

Custom BPHE's

Custom-designed BPHE's can be equipped with:

- multiple passes*
- different connection positions
- non-standard connections

* *Some multi-pass models are available in the standard line*

Multi-pass BPHE's

Multi-pass units are used to increase the thermal length of the heat exchanger. With this design, more heat is transferred from the hot medium to the cold medium, at the expense of a higher pressure drop. Figure 4 illustrates the difference between a one and two pass design.

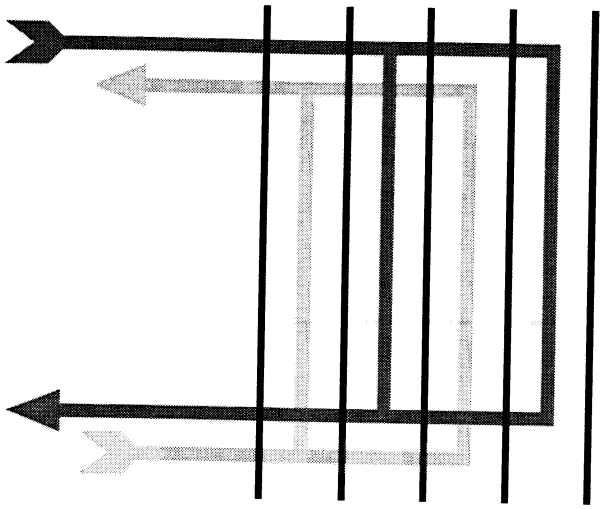

Figure 4a. A one-pass BPHE

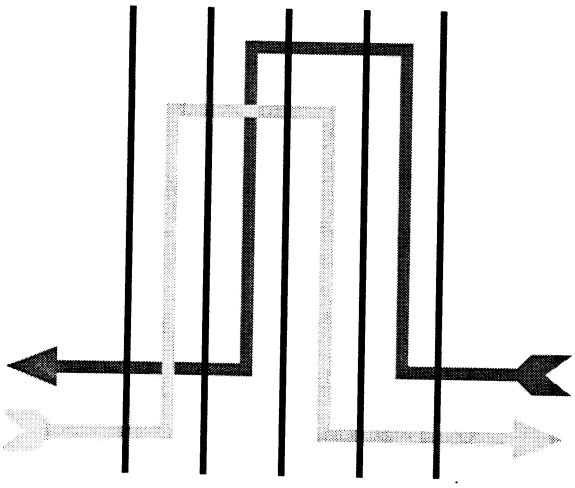

Figure 4b. A two-pass BPHE

III. BPHE SPECIFICATIONS

Table 5. Design Data

	CB14	CB26	CB50	CB76	CB300
Minimum working temperature	-319°F	-319°F	-319°F	-316°F	-256°F
Maximum working temperature	437°F	437°F	437°F	437°F	437°F
Minimum working pressure	Vacuum	Vacuum	Vaccum	Vacuum	Vacuum
Maximum working pressure	435 psig	435 psig	435 psig	435 psig	232/362 psig*
Test pressure	653 psig	653 psig	653 psig	653 psig	304/479 psig*
Maximum flow rate	20 GPM	40 GPM	40 GPM	150 GPM	615/265 GPM*
Standard # of plates (n)	14,28	10,12,14,18, 24,28,34,40, ,44,50,54,60, 70,100	10,12,16,18, 20,24,30,38, 50,60	20,30,40,50, 60, 70, 80, 90, 100,110	—
Hold-up volume (gal)	n • 0.005	n • 0.024	n • 0.024	H: n • 0.033 A: n • 0.026 E: n • 0.024	n•0.172
Weight (lbs)	1.54 + (n • 0.13)	2.20 + (n • 0.22)	3.97 + (n • 0.37)	15.43 + (n • 0.97)	125.66 + (n • 2.78)

n = number of channels

* Channel S1-S2/Channel S3-S4.

Fluid quality

To minimize risk of corrosion, the media pH values shall be neutral.

The media must not contain chemicals corrosive to stainless steel (AISI 316) or the brazing material (copper or nickel). Stainless steel is especially sensitive to localized spot and crevice corrosion due to chloride, sulfite and sulfate ions. Above a critical ion concentration the passivity of the steel breaks down and local spot corrosion occurs.

Materials

Plates and connections AISI 316
Brazing material
CB units Copper 99.9%
NB units Nickel Alloy

Approval

Sweden	Statens Anläggningsprovning (SA)
Germany	Technische Überwachungsverein (TÜV)
USA	Underwriters Laboratories (UL)
Canada	Canadian Standards Association (CSA)

Data Plate

Example: CB26-70H $F_{21}F_{21}$ F_1

CB	Brazing Material (CB= Copper Brazed, NB= Nickel Brazed)
26	Model Type
70	Number of Plates
H	Type of Plate in Model
F_{21}	Primary Side Connection Type(s)
F_{21}	Secondary Side Connection Type(s)
F_1	Sealed Plate

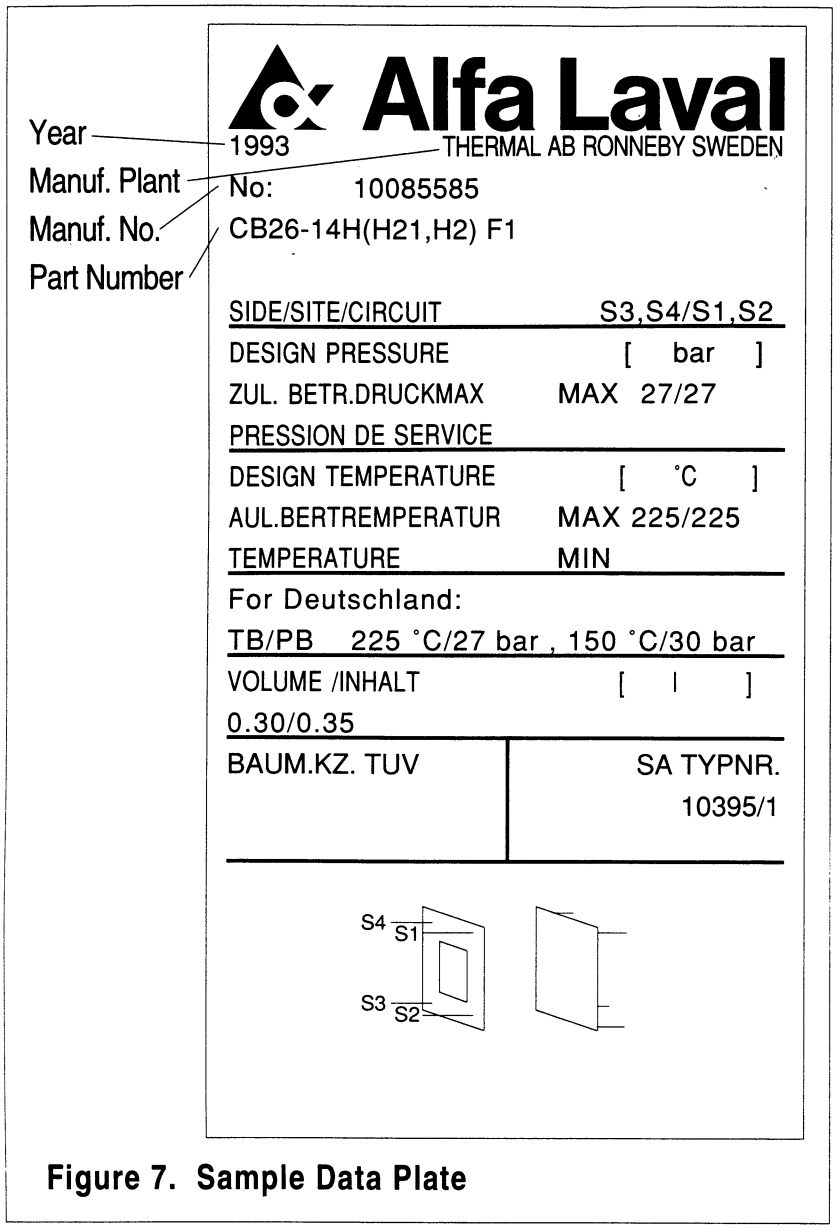

Figure 7. Sample Data Plate

Conversions:

°F = (°C • 1.8) + 32
psig = bar • 14.504
gallons = liters • 0.264

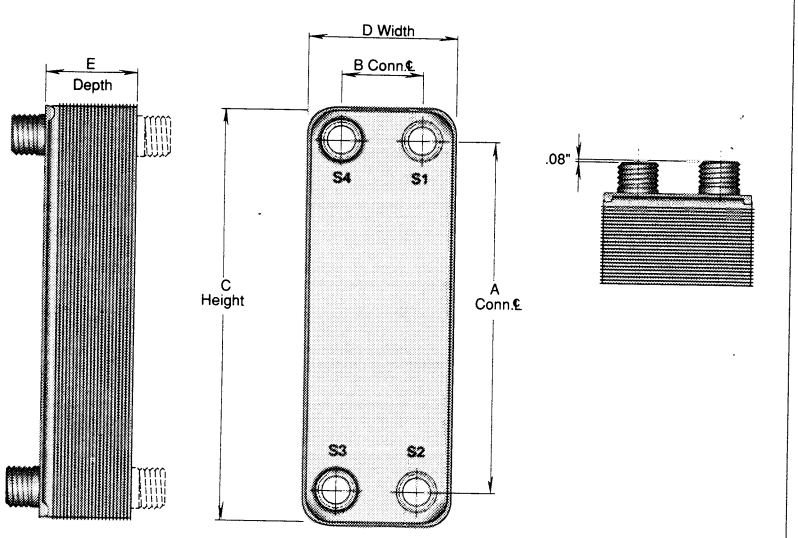

Figure 7: CB14, CB26, CB50* and CB76

* CB50 does not include 2 mm offset

able 8: Dimensions

	CB14	CB26	CB50	CB76
A	6.77"	9.84"	18.35"	20.43"
B	1.65"	1.97"	1.97"	3.62"
C	8.15"	12.24"	20.47"	24.29"
D	3.03"	4.41"	4.06"	7.56"
E	0.35" + (n • 0.09")	0.39" + (n • 0.09")	0.35" + (n • 0.09")	**H**: 0.55" + (n • 0.11") **A**: 0.55" + (n • 0.04") **E**: 0.55" + (n • 0.09")

= number of plates

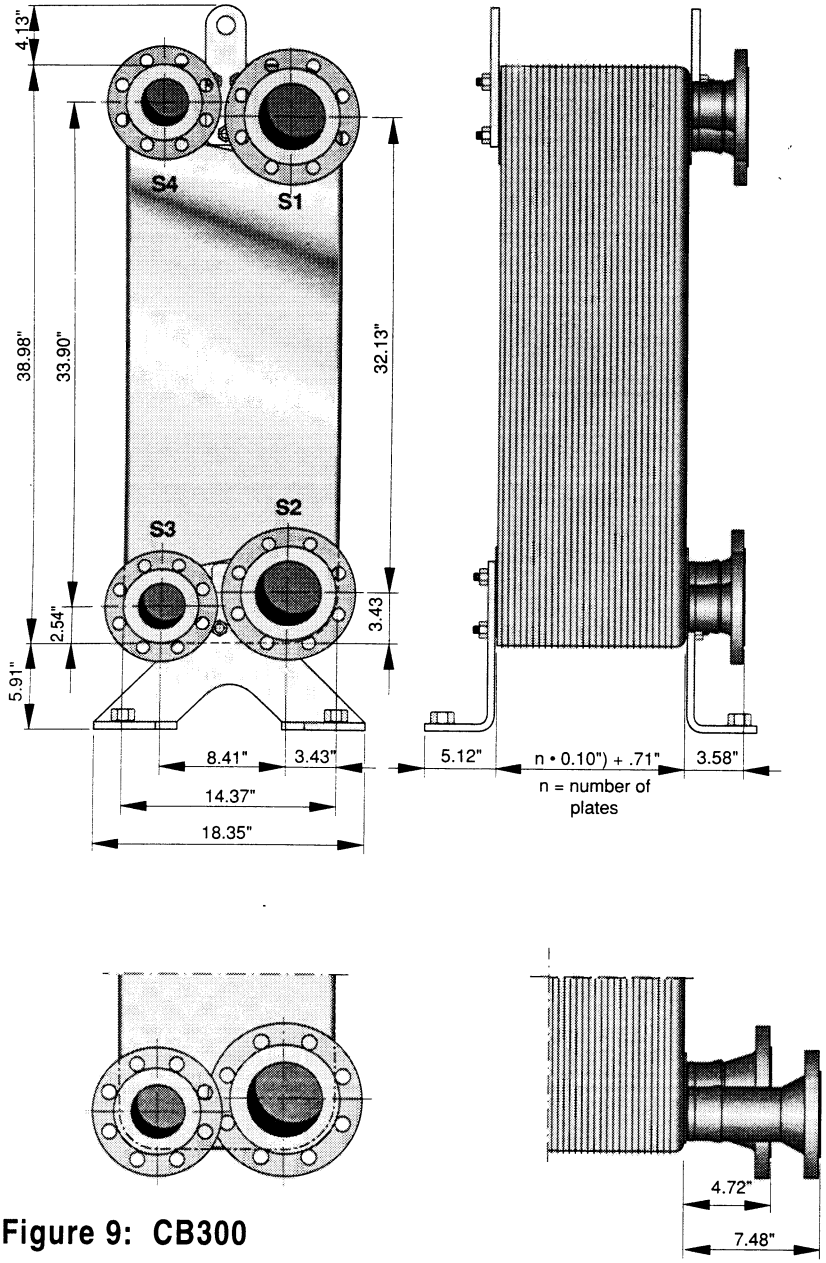

Figure 9: CB300

BPHE Connections

The CB14, CB26, CB50 and CB76 have NPT threaded connections. Sweat connections for soldering and welding are also available. The CB300 is equipped with flanges (DIN or ANSI), and can be ordered with JIS connections on request. Please contact Alfa Laval Thermal for connection specifications.

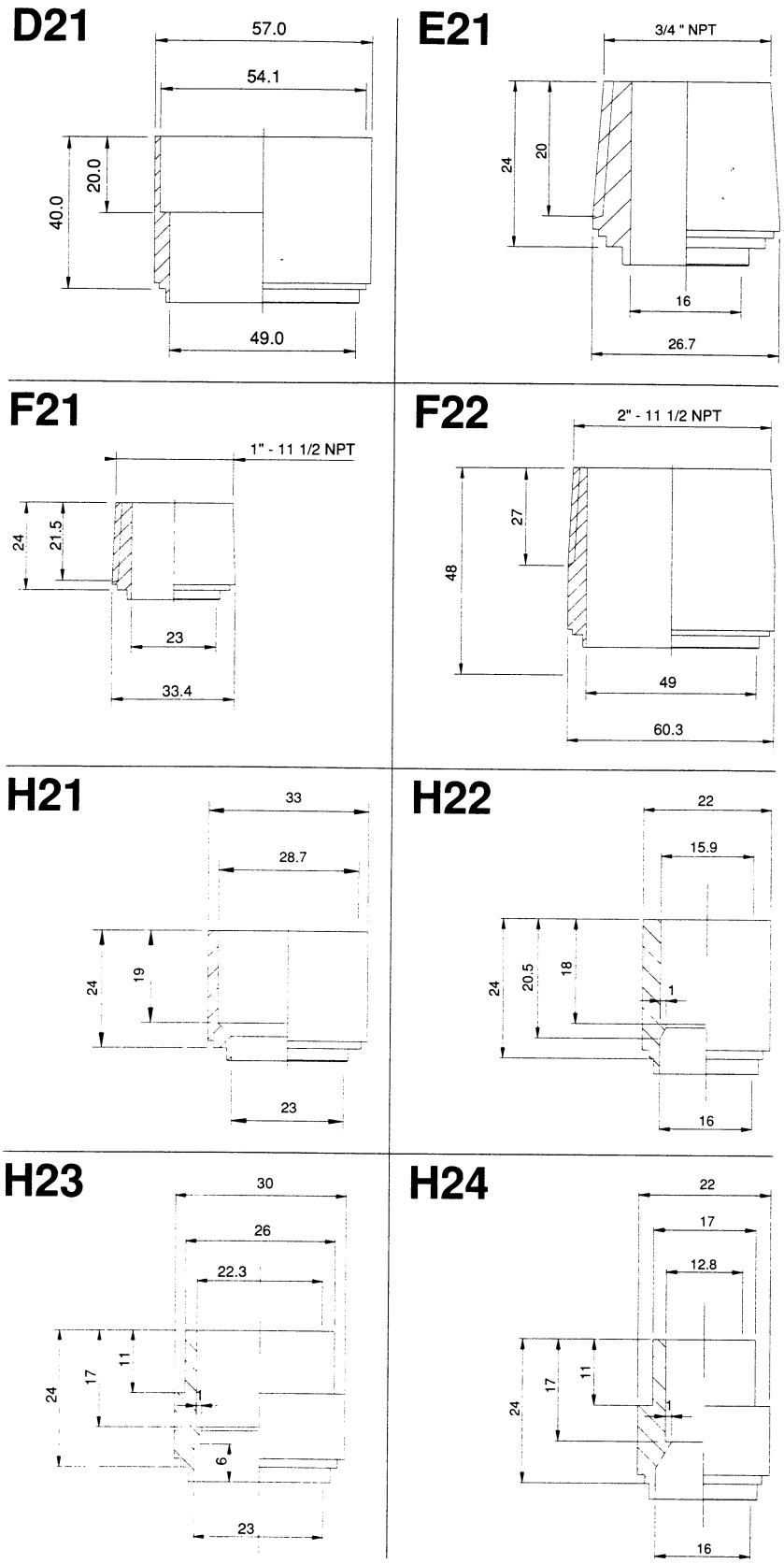

Figure 10. US Standard Connections (mm)

IV. INSTALLATION

General Information

For optimum performance, always connect the unit so that a countercurrent flow is obtained. Flexible hoses, or vibration eliminators, should be installed in both horizontal and vertical planes to deter vibrations through the pipes. This also reduces the stresses between the pipes and the BPHE. (See figure 11). The unit can be stablized by either sheet metal brackets or a crossbar and bolts. (See figure 12). The CB14 and CB26 (under 30 plates) can be mounted directly to the pipes. For refrigeration duties (evaporation and condensation), the BPHE must be mounted vertically for proper operation. For single-phase applications the BPHE can be mounted horizontically or vertically without affecting the function.

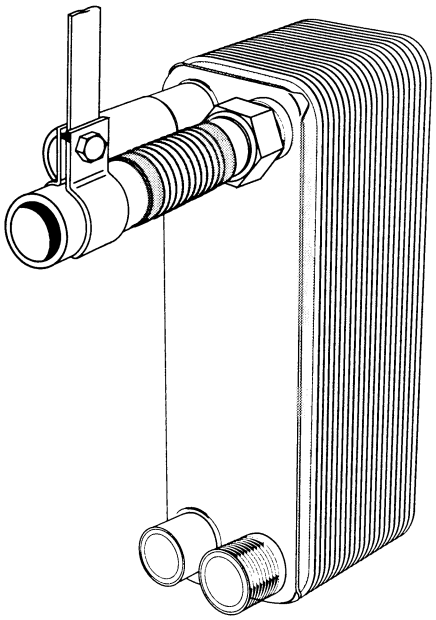

Figure 11. BPHE mounted with a flexible hose

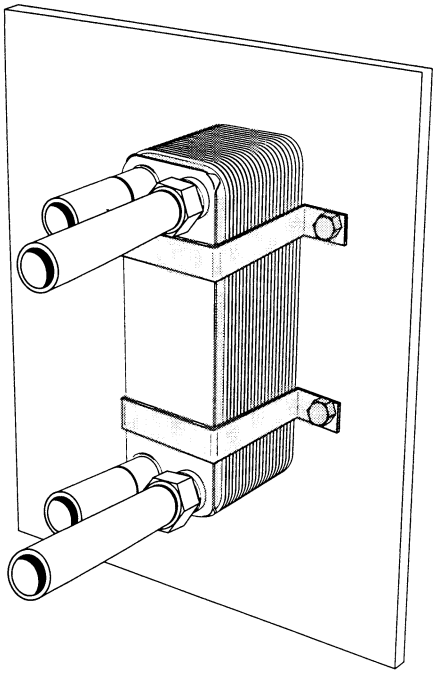

Figure 12. BPHE with crossbar and bolts

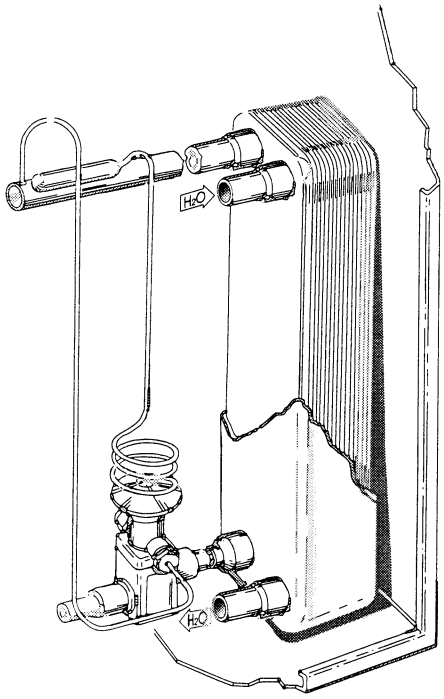

Figure 13. An example of a refrigeration installation

Threaded Connections

To avoid damage of the threaded connections it is important to mount the BPHE on the pipes within the recommended design limits. (See table 14 and figure 15). (See figure 16).

Table 14: Connection Data

	CB14	CB26	CB26, CB50	CB26, CB50
Connection Size	3/4"	3/4"	1" external thread	1" external thread
Torque kN/lbf	15/3375	25/5625	25/5625	25/5625
Force kN/lbf	8(-6)/ 179.84 (-134.88)	8(-6)/ 179.84 (-134.88)	9.6(-7)/ 215.81 (-157.36)	23(-18)/ 517.04 (-404.64)
Mb Nm/ft.lbs.	37/27.29	61/44/99	61/44.99	61/44.99
Mv Nm/ft.lbs.	170/ 125.39	170/ 125.39	385/ 283.98	764/ 563.53

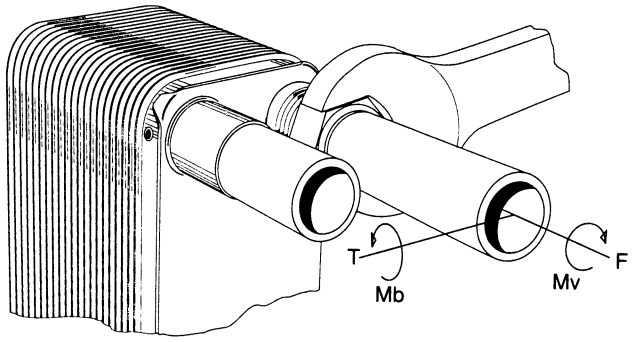

Figure 15. Maximum allowed nozzle forces and movements

Soldered and Welded Connections

The temperature must not exceed the melting point of the brazing material. Use a wet towel around the connection and the plate pack to reduce the heat transferred to the BPHE plate pack during installation.

Soldering

Filling material: 30-55% silver alloy
Flux material: Black Flux for silver soldering:

1. Clean the soldering assembly surface at the copper tubes and BPHE connections.
   - Remove oil or other build-up with degreasing solvent
   - Polish the surfaces to remove oxides
2. Apply the flux to the surface with a brush to remove and prevent oxidation.
3. For refrigeration installations, use a dry Nitrogen gas on the refrigerant side to prevent oxidation
4. Heat the soldering area to the soldering temperature of about 1200 °F. (Higher temperatures will melt the brazing material.) Use a wet cloth to minimize the heating zone.
5. Keep the tube in a fixed position and add the filler material.

Welding

1. Prepare the edge of the tube for welding with a 30° chamfer.
2. Place the piping into the connection.
3. TIG- or MIG- weld the tube to the connection, filling the groove formed by the two edges. This method minimizes the heating zone.

WARNING: Unnecessary heating (1200 °F+) can melt the brazing material!

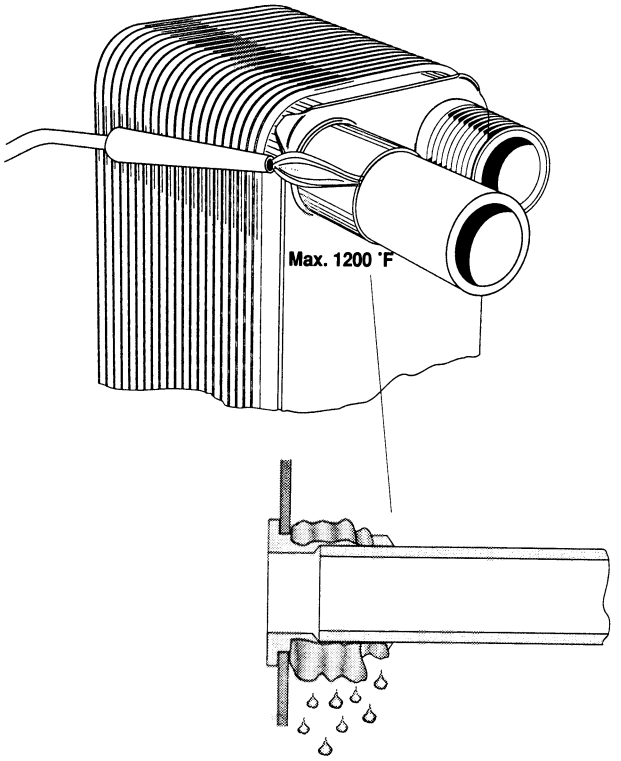

Figure 17. A soldered connection

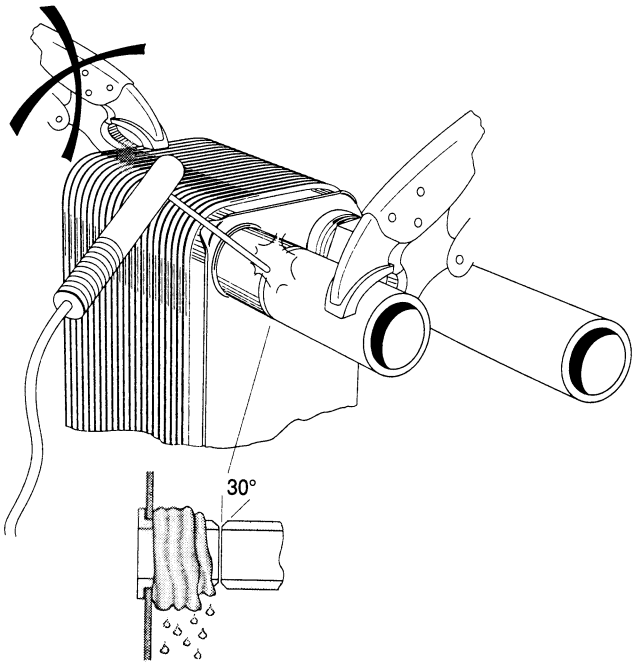

Figure 18. A welded connection

V. REGULATION

The efficient design of plate heat exchangers allows the total hold-up volume of the system (pumps, valves, piping and controls) to be much smaller than that of systems using conventional heat exchangers. This high efficiency results in a quick response time. The valve and regulation equipment should be designed accordingly.

The valve with the shortest response time should be placed close to the outlet. This will give a faster response when small loads are consumed. Follow the instructions from the valve manufacturer and if possible, use a PI regulator with a logarithmic response. This is especially recommended in steam applications.

Thermal dynamic stresses are caused by large fast temperature changes (50°F+) and can damage the BPHE. An ON/OFF valve that causes pressure pulsation in the BPHE must be avoided. To minimize thermal fatigue, it is especially important to avoid pressure and temperature pulsations in steam applications.

VI. OPERATION

A liquid in motion in a pipe system generates a high level of energy. When a valve is closed or opened, causing the fluid to stop or continue, it must be done slowly to avoid shocking the system.

WARNING: Do not use fast-closing valves unless the pipes of the system are very short!

Starting Up

Note: Consult equipment manufacturer's start-up procedures for refrigeration applications.

- Before starting any pump, consult system instruc tions to determine which pump should be started first.
- Make sure the control valve between the pump and the unit is closed.
- If there is a valve at the exit, make sure it is completely open.
- Open the vent.
- Open the valve SLOWLY.
- Close the valve after all of the air is let out.
- Repeat for the other side of the heat exchanger.

Unit in Operation

If an adjustment to the flow rate is required to maintain correct temperatures or pressure drops, it must be made slowly to prevent shocks to the system.

Changes in the performance of the heat exchanger may be caused by a change in: temperature conditions, media flow rates, or fouling.

Shut Down

- Consult system instructions to determine which pump should be stopped first.
- SLOWLY, Close the valve controlling the flow rate of the pump being stopped.
- When the valve is closed, stop the pump.
- Repeat for the other side.

(Shut Down Continued...)

- If for any reason the heat exchanger is shut down for a long period, it should be drained. If the media processed is corrosive, contains particles, or has a tendency to coagulate, it is recommended to rinse the heat exchanger with water and dry it to avoid damage.

VII. MAINTENANCE

Heat Transfer

The purpose of the BPHE is to transfer heat from one medium to another. Heat passes very easily through the thin walls separating the two media. The pattern pressed into the plates makes the plate strong and rigid, and increases the rate that heat is transferred. This high rate of heat transfer can be inhibited by the formation of deposits on the plate surfaces. The corrugated pattern on Alfa Laval plates induces turbulent flow. Turbulence provides strong resistance to deposit build-up, but it can not always eliminate fouling. The deposits may increase the total "wall thickness," and consist of materials of a much lower thermal conductivity that of the metal plate. Thus, a layer of deposits can severely reduce the overall heat transfer rate. Corrosion can also occur under the deposits. For corrective action please see **Cleaning** below.

Pressure Drop

Pressure drops are wasted energy. All pipe systems, and equipment included in them, offer resistance to the media flowing through them. Some pressure drop is inevitable, but it should be kept as close as possible to the designed value for the BPHE. The formation of deposits on the heat transfer surfaces reduces the free

space between the plates. This means that more energy is required to achieve the desired flow in the BPHE. Large particles and fibers may also clog the heat exchanger if it is not equipped with a strainer. A reduced ability to maintain the desired temperatures along with an increased pressure drop on either media, are symptoms of fouling or clogging. For corrective action please see **Cleaning** below.

Cleaning

Alfa Laval has a worldwide service network. Service is available in 130 countries and at 15 major service centers. Alfa Laval BPHE's can be cleaned in place with the Cleaning-In-Place (CIP) system, which chemically removes calcium deposits and other forms of scaling from plate surfaces. Different solutions can be used, depending on the type of deposits. Every application has to be considered separately. The Cleaning-In-Place procedure is generally the same, regardless of the solution used.

CIP Procedure

1. Drain the unit.
2. Rinse with fresh water.
3. Drain water.
4. Fill with fresh water.
5. Add cleaning agent (solution and concentration depend on the type of fouling)
6. Circulate the cleaning solution (if feasible).
7. Drain the cleaning solution.
8. Add and circulate the passivating liquid for corro sion inhibition of plate surfaces.
9. Rinse with fresh water.
10. Drain.

CAUTION: Do not use liquids that are corrosive to stainless steel or the brazing material (Copper or Nickel)! Do not leave the unit on stand-by after cleaning!

Contact your nearest Alfa Laval After Sales and Service Center for more information about cleaning-in-place equipment, detergents or service.

VIII. ASSISTANCE AND FIELD SERVICE

Alfa Laval maintains a large highly specialized engineering staff to handle your questions and problems. Your nearest Alfa Laval representative will be happy to provide you with quotes or answers to your questions. To assist your representative in finding the best solution, please provide the following sizing information along with your inquiry:

	Hot Side	Cold Side
Fluid		
Mass Flow	GPM	GPM
Temperature In	°F	°F
Temperature Out	°F	°F
Maximum Pressure Drop	psig	psig
Design Pressure	psig	psig

For Refrigeration Applications:

Condensing Temperature	°F	°F
Evaporator Temperature	°F	°F
TX Valve Superheat	°F	°F
Total Heat of Rejection	kBTU/H	kBTU/H
Total Evaporator Tons	TR	TR

Consult your invoice for general terms and conditions.

For further information on Brazed Plate Heat Exchangers, contact:

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919 HIGHWAY 33
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FREEHOLD, NJ 07728
(908) 308-3300
(908) 308-4337 FAX

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After Sales Service Center
2314 S. Clinton Avenue
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Phone: (908) 769-0070
FAX: (908) 769-0074
(800) 345-1546

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