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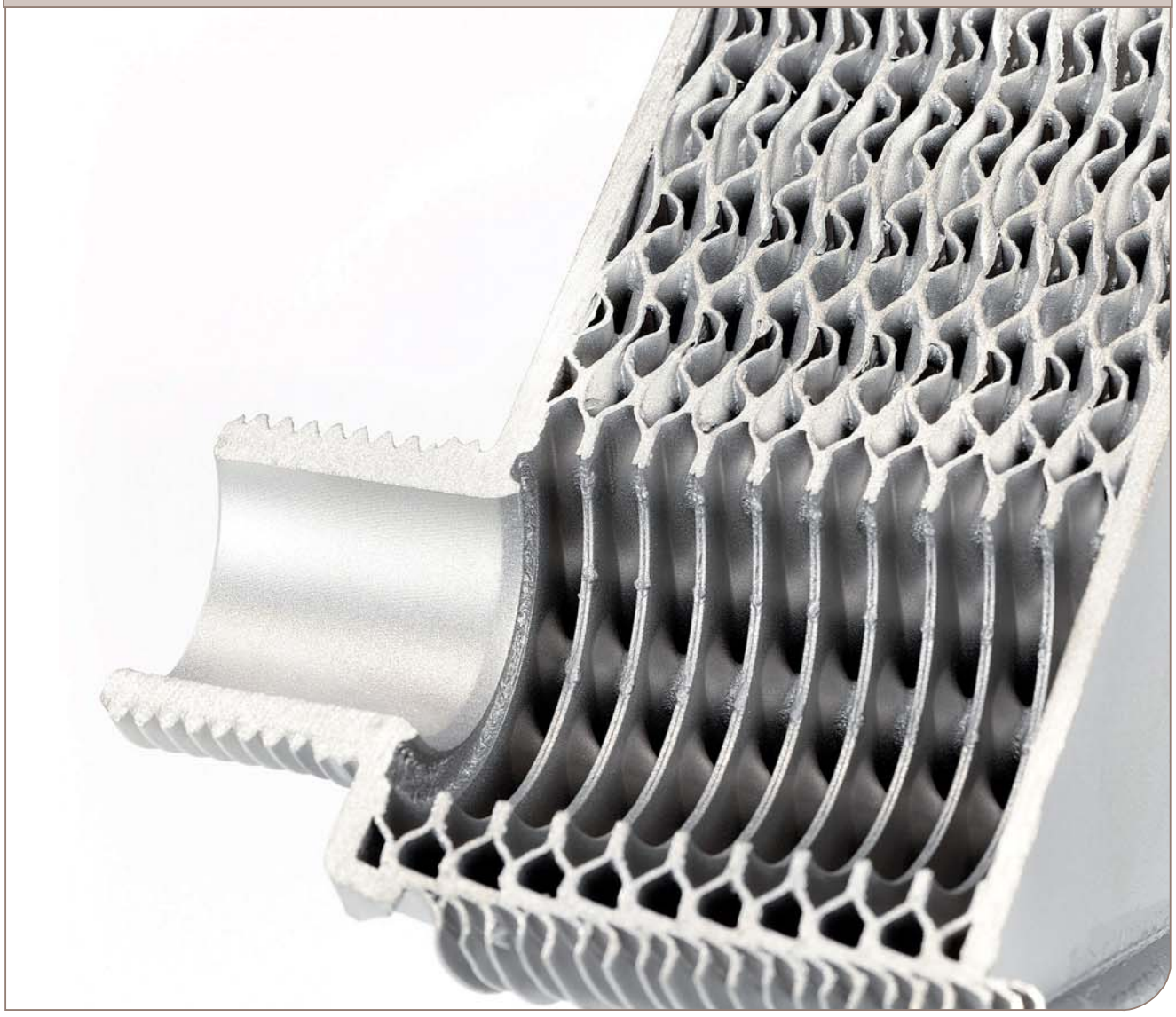
Instruction Manual - Fusion-bonded plate heat exchangers

Alfa Nova 76-400



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Original manual

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How to contact Alfa Laval
Contact details for all countries are
continually updated on our website.
Please visit www.alfalaval.com to access the information directly.

Environmental compliance

AlfaLaval endeavours to perform its own operations as cleanly and efficiently as possible, and to take environmental aspects into consideration when developing, designing, manufacturing, servicing and marketing its products.

Unpacking
Packing material consists of wood, plastics, cardboard boxes and in some cases metal straps.

- Wood and cardboard boxes can be reused, recycled or used for energy recovery.
- Plastics should be recycled or burnt at a licensed waste incineration plant.
- Metal straps should be sent for material recycling.

Maintenance
- All metal parts should be sent for material recycling.
- Oil and all non metal wear parts must be taken care of in agreement with local regulations.

Scrapping
At end of use, the equipment shall be recycled according to relevant, local regulations. Beside the equipment itself, any hazardous residues from the process liquid must be considered and dealt with in a proper manner. When in doubt, or in absence of local regulations, please contact the local Alfa Laval sales company.

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Description

Definitions

AlfaFusion™
One-material process that results in an all-stainless steel fusion-bonded plate heat exchanger, gives joints superior to welded joints

Fusion plate heat exchanger
A number of corrugated plates and its frame bonded to a plate pack at high temperature. Figure 1 shows typical components of a fusion plate heat exchanger.

Heat transfer area
The area of the plate which is in contact with both fluids.

Plate
A sheet of 100% stainless steel plate pressed into a corrugated pattern and equipped with port holes for media inlet and outlet.

Plate pack
An assembly of plates bonded together to a unit with internal channels in which two or more fluids can be handled.

Port
Inlet or outlet opening in the plates and in the cover plates. Most plates have four ports.

Total heat transfer area
The total surface area of all the bonded plates, which are in contact with both fluids.

Main components

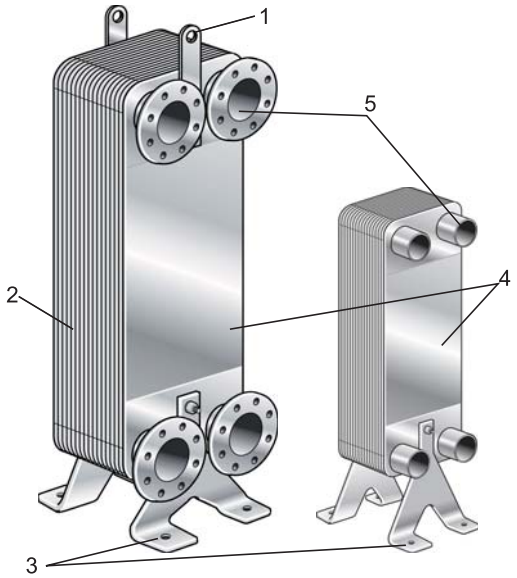

Figure 1. Typical components

1	Lifting device	For correct and safe lifts during transportation and installation
2	Bonded seal	Keeping the media within the unit
3	Support	Can as an option be equipped with earthing lugs.
4	Cover plates	Front and rear cover plates to protect the channel plates and increase the design pressure.
5	Connections	Equipped with carbon steel or stainless steel fittings, permitting the media to enter into the heat exchanger.

Warning!
The FHE must not be opened.

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Function

Fusion plate heat exchangers consist of a pack of bonded corrugated metal plates with ports for the passage of the two fluids between which heat transfer will take place.

The media in the heat transfer are led into the bonded plate pack through portholes at the corners and are distributed into the passages between the bonded, corrugated plates.

The heating surface consists of thin corrugated plates stacked on top of each other. In the fusion process at high temperature channels are formed between the plates and corner ports are arranged so that the two media flow through alternate channels, always in counter-current flow. The contact points are also bonded to withstand the pressure of the media handled.

The fusion plate heat exchanger is typically used for heating or cooling media with low to medium viscosity. A specific fusion plate heat exchanger is dimensioned for a specific duty, set out in the product documentation, and should not be used in any other way without consulting the supplier.

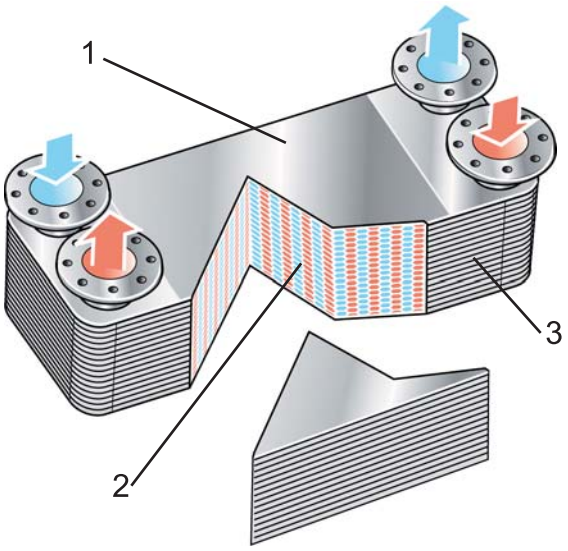


Figure 2. Function: Cover plate (1), Bonded corrugated plates (2) and Bonded seal (3).

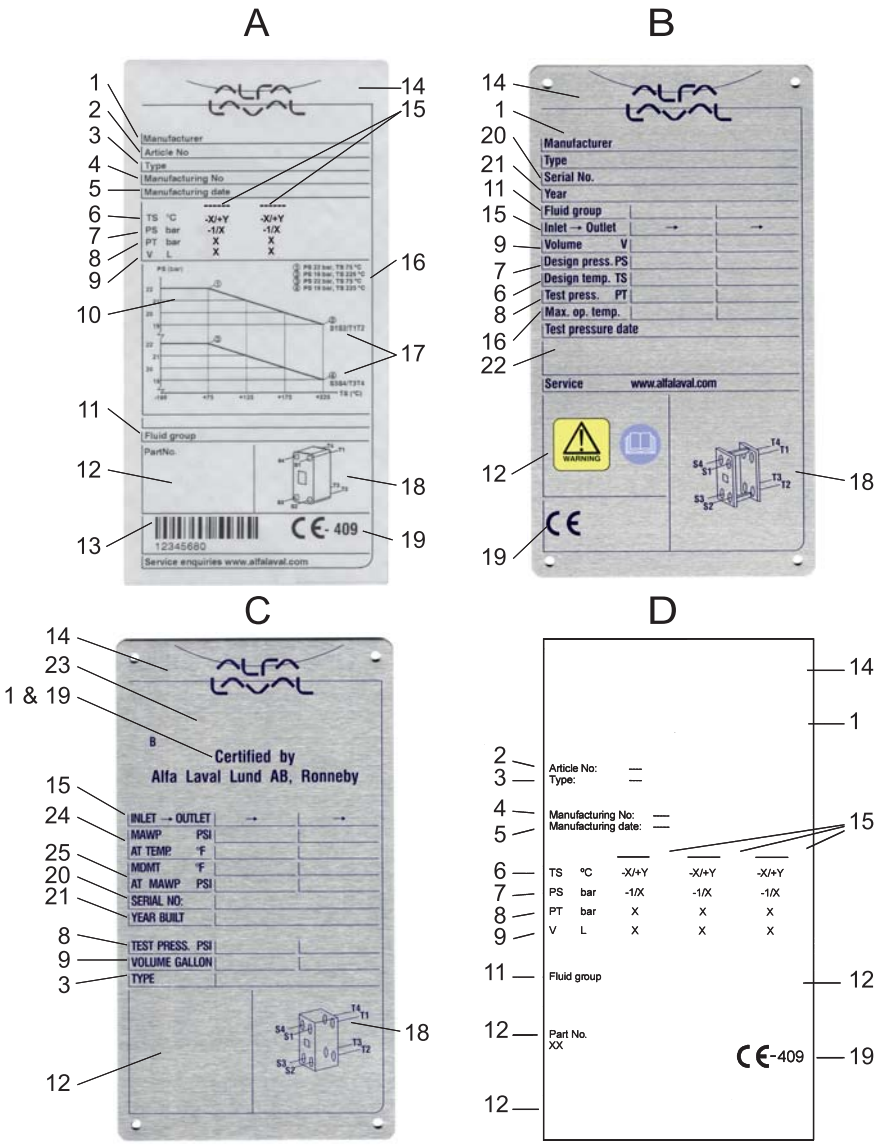
1	Cover plate	Front and rear cover plates to protect the channel plates and increase the design pressure.
2	Bonded corrugated plates	For media flow in alternate channels.
3	Bonded seal	Keeping the media within the unit.

Name plates

> ***Warning!***
> For each unit, the mechanical design pressures and temperatures are marked on the name plate. These must not be exceeded.

On the name plate, the type of unit, manufacturing number and manufacturing year can be found. Pressure vessel details in accordance with the applicable pressure vessel code are also stated. The name plate is fixed to the frame plate (most common) or the pressure plate.

Four name plates exist depending on the type of pressure vessel approval.



Name plate types
A. PED Standard
B. PED Stainless steel, optional
C. ASME
D. PED Customer designed, optional

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Descriptions of name plate fields

1. Manufacturer's name
2. Article number
3. Type
4. Manufacturing number
5. Date of manufacture
6. Max. allowed operating temperatures
7. Max. allowed operating pressures
8. Test pressure
9. Volume of each space
10. Operating area
11. Fluid group
12. Information unique to the customer
13. Bar code information
14. Space for logotype
15. Locations of connections for each fluid
16. Allowed operating temperatures and pressures
17. Description of each space
18. Possible locations of connections (Sketch on name plate showing possible locations of connections depending on heat exchanger execution).
19. Space for mark of approval
    CE-409 BHE Manufacturing, Ronneby, Sweden
    CE-036 Alfa Laval (Jiangyin) Manufacturing Co., Ltd, Jiangyin City, PRC
    CE-0948 Alfa Laval S.p.A. Alonte, Italy
20. Serial number
21. Manufacturing year
22. Date of test pressure
23. Space for National Board stamp and serial number
24. Max. allowed working pressures at temperature
25. Max. allowed medium temperature at max. allowed working pressure

Alfa Fusion technology

Fusion-bonded plate heat exchangers represent a new class of plate heat exchangers made of 100 % stainless steel.

AlfaNova comprises a number of thin corrugated stainless steel plates. The process uses a stainless steel filler as activator to bond the plates together in a high temperature furnace. At contact points between the corrugated plates the filler reacts with the plate surface. The filler has a very good capability to wet surfaces and fill crevices.

It has almost full interaction with the plates and a fusion zone is created. This zone is in consequence also of stainless steel and has similar properties to the plates in terms of corrosion resistance and durability.

AlfaFusion technology enables the production of reliable heat plate exchangers with higher mechanical and termal resistance than those of conventional technology.

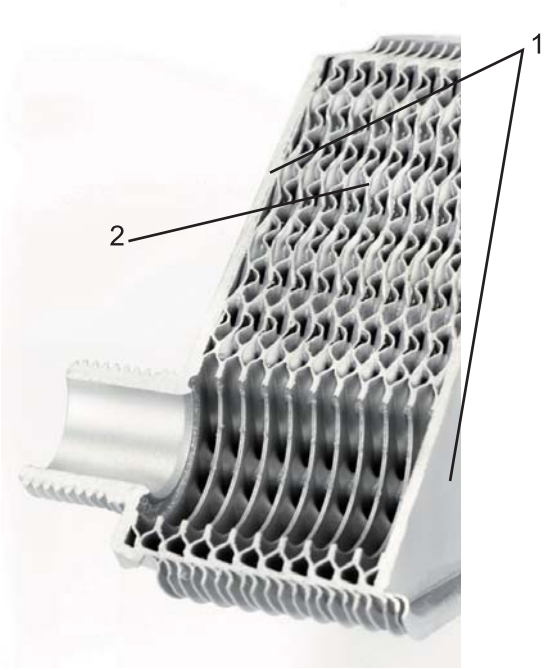

Figure 3. Cover plate (1). Corrugated plates (2) bonded together with stainless steel filler forming channels between the plats.

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Installation

Requirements

Warning!
The heat exchanger must be installed and operated in such a manner that no risk of injury to personnel and damage to property will be incurred.

Note!
Unless otherwise specified, product data for normal refrigerants, i.e. HFC and HCFC, are applicable to refrigeration applications. The manufacturer must be specifically consulted before the heat exchanger is used for flammable, toxic or dangerous liquids (e.g. hydrocarbons). The use must follow the relevant safety rules for handling such liquids. For further information, please refer to the supplier's website.

Foundation
Install on a flat foundation giving enough support to the unit.

Protection against pipe forces
Fit the pipes so that no tension is transferred to the heat exchanger.

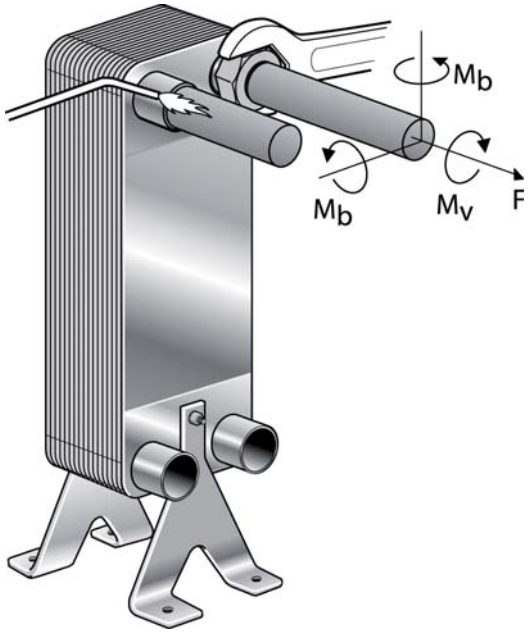

Figure 4. Pipe forces.

Maximum recommended load components during mounting						
Outer diam. mm (inch)	**F (N)**	**F (lb)**	**Mv (Nm)**	**Mv (lb *ft)**	**Mb (Nm)**	**Mb (lb *ft)**
20-25 (0.8-0.9”)	± 170	± 38	± 50	± 36	± 20	± 14
25-30 (1.0- 1.2”)	± 350	± 78	± 100	± 73	± 20	± 14
30-40 (1.2-1.6”)	± 560	± 125	± 160	± 118	± 20	± 14
40-45 (1.6-1.7”)	± 700	± 157	± 300	± 221	± 20	± 14
45-55 (1.7-2.1”)	± 800	± 179	± 350	± 258	± 40	± 29
55-65 (2.1-2.5”)	± 1000	± 224	± 500	± 368	± 40	± 29

Installation in general

Warning!
Safety valves should be installed according to pressure vessel regulations.

Note!
Before connecting any piping, make sure all foreign objects have been flushed out of the system.

The installation must be provided with equipment that protects the heat exchanger against pressures and temperatures outside the approved minimum and maximum values shown on the name plate.

For best possible heat transfer performance, the heat exchanger should be connected so that the media flow through the heat exchanger in opposite directions (in counter-flow). Take into account the risk of fire during the installation work, i.e. bear in mind the distance to flammable substances.

Installation as evaporator

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

Note!
In evaporator applications and in applications in which a phase change of the media occurs, the heat exchanger should be installed vertically.

For refrigeration applications – Figure A shows the installation of an evaporator, for which the connections may be either on the front or on the rear. Figure B shows a condenser.

- Use an anti-freeze thermostat and flow monitor to ensure a constant water flow before, during and after the compressor has been running.
- Avoid “pump-down”, i.e. emptying the evaporator by running the compressor after shut-down until a preset refrigerant pressure is reached. The temperature could then drop below the brine freezing point, which could damage the evaporator.
- Use a flow switch and a low-pressure switch.

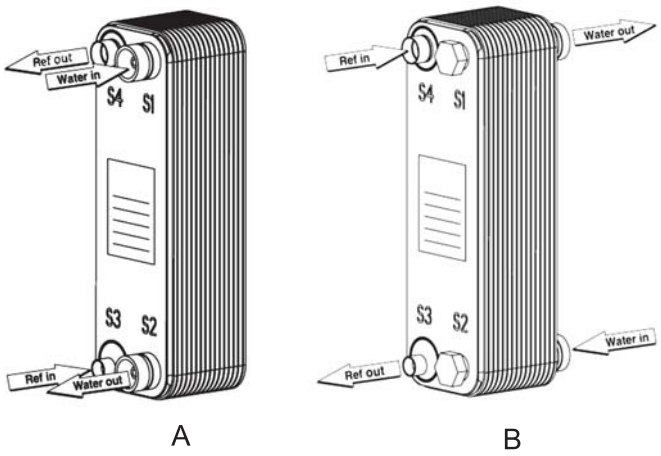

Figure 5. Installation as evaporator (A) and condensor (B).

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Installation, welding aspects

For installation of AlfaNova equipped with welding connections, the TIG or MIG welding method must be used for installation of the heat exchanger to minimise heat impact of the heat exchanger.

Note!
Protect the heat exchanger by using a heat-sink (welding paste or tape) around the connection before welding operation

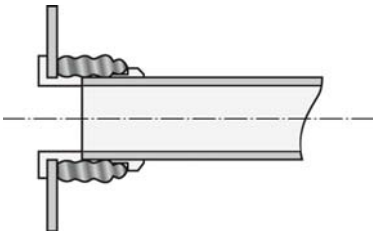


Figure 6. Protection against overheating.

Lifting

Warning!
Never lift by the connections or the studs around them. Straps should be used when lifting. Place straps according to figure below.

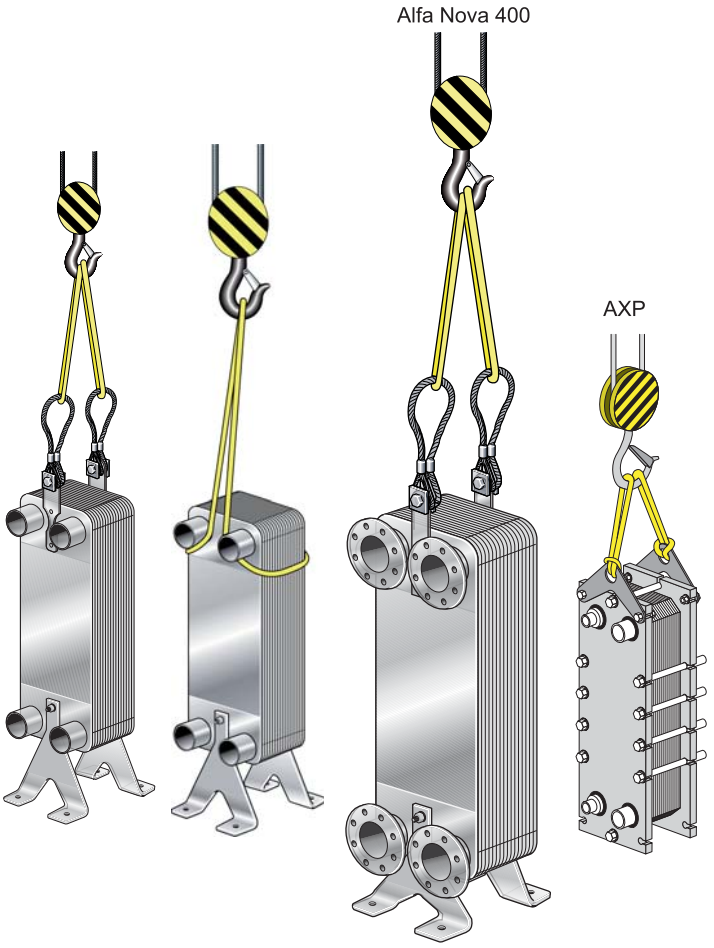


Figure 7. Lifting

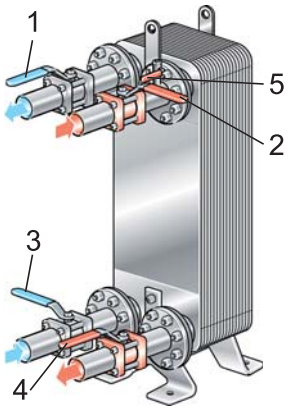
Operation

Start-up

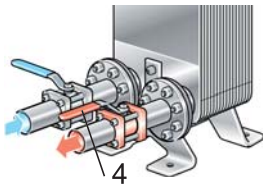
Note!
If several pumps are included in the system, make sure you know which one should be activated first.

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, causing liquids to travel along a pipe as a wave at the speed of sound. This can cause considerable damage to the equipment.

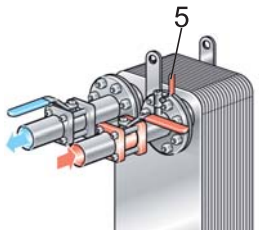
Step 1
Check that the inlet valve(2) is closed between the pump and the unit controlling the system flowrate.
Inlet valve (2, 3) for both fluids should be closed, the outlet valves (1, 4) opened and the vent valve (5) closed.



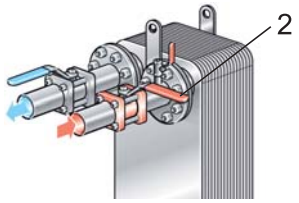
Step 2
If there is a outlet valve (4), make sure that it is fully open



Step 3
Open the vent valve (5) and start the pump.



Step 4
Open the inlet valve (2) slowly.



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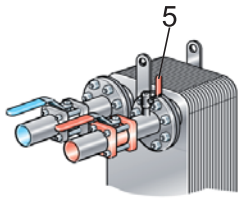
Step 5
When all air is expelled, close the vent valve (5).



Step 6
Repeat steps 1–5 for the second media.

Unit in 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.

During operation, check that:

- media temperatures and pressures are within the limits stated on the name plate
- no leakages appear due to faulty tightening of the connections.

Protection against freezing
Bear in mind the risk of freezing at low temperatures. 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 at operating conditions below 5 °C/41 °F and/or when the evaporating temperature is below 1 °C/34 °F.

Protection against clogging
Use a filter as protection against the possible occurrence of foreign particles. If you have any doubt concerning the maximum particle size, consult your nearest representative of the supplier or look under Product information on the supplier's web site.

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 swinging pressures/temperatures.

- 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.
- In automated installations, the stopping and starting of pumps and actuation of valves should be programmed so that the resulting amplitude and frequency of the pressure variation will be as low as possible.

Protection against corrosion
All components in contact with media are manufactured in stainless steel grade AISI 316. Media causing corrosion to AISI 316 must not be exposed to the heat exchanger.

Insulation
Heating and cooling insulations are available as accessories.

Shut-down

Note!
If several pumps are included in the system, make sure you know which one should be stopped first.

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 fusion plate heat exchanger is shut down for a longer period, it should be drained. Draining should also be done if the process is shut down and the ambient temperature is below the freezing temperature of the media.
   Depending on the media processed, it is also recommended to rinse and dry the heat exchanger and its connections.

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Maintenance

General guidelines regarding maintenance

Plate Sheet material
Stainless steel can corrode. Chlorine ions are hazardous.

Avoid cooling brines containing chloride salts as NaCl and, most harmful, $CaCl_2$.

Note!
Rinse well!

Note!
Under no circumstances should hydrochloric acid be used with stainless steel plates. Water of more than 300 ppm Cl ions may not be used for preparation of cleaning solutions.

Chlorine as a growth inhibitor

Note!
Chlorine, commonly used as a growth inhibitor in cooling water systems, reduces the corrosion resistance of stainless steels.
Chlorine weakens the protection layer of these steels making them more susceptible to corrosion attacks than they otherwise should be. It is a matter of time of exposure and concentration.

In every case where chlorination of the AlfaNova heat exchanger cannot be avoided, your local representative must be consulted.

Cleaning-In-Place

The Cleaning-In-Place (CIP) equipment permits cleaning of the plate heat exchanger.

CIP performs:

- cleaning of fouling and descaling of lime deposits
- passivation of cleaned surfaces to reduce susceptibility to corrosion
- neutralisation of cleaning liquids before draining.

Follow the instructions of the CIP equipment.

The following CIP models can be used: CIP200L, CIP400L and CIP800L.

Cleaning liquids

AlfaCaus
A strong alkaline liquid, for removing paint, fat, oil and biological deposits.

AlfaPhos
An acid cleaning liquid for removing metallic oxides, rust, lime and other inorganic scale. Includes an inhibitor for passivation.

AlfaNeutra
A strong alkaline liquid for neutralisation of AlfaPhos before drainage.

Kalklöser P
An acidic cleaning powder with a corrosion inhibitor particularly effective for removing of calcium carbonate and other inorganic scale.

Neutra P
An alkaline powder for neutralisation of used Kalklöser P prior to disposal.

AlfaAdd
A neutral cleaning strengthener to be used with AlfaPhos, AlfaCaus and Kalklöser P. Provides better cleaning results on oily, fatty surfaces and where biological growth occurs. AlfaAdd also reduces any foaming.

Alpacon Descalant
An acidic, water based, non-hazardous cleaning agent designed for removal of scale, magnetite, algae, humus, mussels, shellfish, lime and rust. Containing BIOGEN ACTIVE, a biological mixture made from renewable materials, as an active ingredient.

Alpacon Degreaser
A neutral degreaser to be used with Alpacon Descalant. Effectively removes oil, fat or grease layers, but also reduces foaming. Containing BIOGEN ACTIVE, a biological mixture made from renewable materials, as an active ingredient.

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Fault tracing

Pressure drop problems

The pressure drop has increased..

Action	
1.Check that all valves are open including non-return valves. - Measure the pressure just before and just after the heat exchanger, and the flow rate. For viscous media a membrane manometer with a diameter of at least 30 mm should be used - Measure or estimate the flow rate if possible. A bucket and a watch showing seconds may be sufficient for small flow rates. For larger flow rates, some type of flowmeter is required.	
Correction	
YES	-
NO	-

Action	
2.Compare the pressure drop observed with the one specified for the actual flow rate (see data printout). Is the pressure drop higher than specified?	
Correction	
YES	Check the temperature program, see step 3
NO	If the pressure drop corresponds to the specifications, there is no need for action. If the pressure drop is lower than specified, the pump capacity is probably too small or the observation may be wrong. See pump instruction manual.

Action	
3.Check the thermometer readings. Do the readings correspond to those specified?	
Correction	
YES	The heat transfer surface is probably clean enough, but the inlet to the heat exchanger may be clogged by some objects. Check the port area.
NO	Heat transfer is obviously dropping below specifications, because of deposits on the heat transfer surface, which at the same time also increases the pressure drop, since the passage becomes narrower. If a Cleaning-In-Place (CIP) system is available, follow the instructions and use it to wash out the deposits.

Heat transfer problems

The heat transfer capacity is dropping.

Action	
1.Measure temperatures at inlets and outlets. Also measure flow rates on both media, if possible. At least on one of the media, both temperatures and the flow rate must be measured. Check to see if the transferred amount of heat energy corresponds to the specifications. If great precision is important, it will be necessary to use laboratory thermometers with an accuracy of 0.1 °C, and also to use the best equipment available for flow measurement. Has the heat transfer capacity of the unit dropped below specified values?	
Correction	
YES	Clean the heat transfer surface. Use the Cleaning-In-Place (CIP) system.
NO	-