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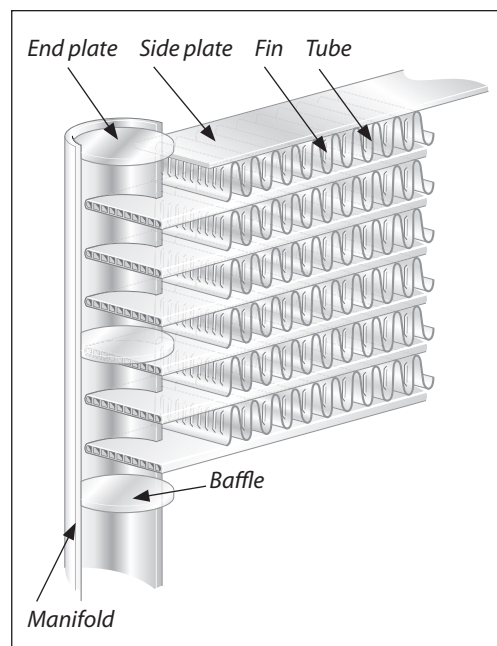
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**MicroChannel  
Heat Exchanger –  
Construction**

The figure on the right represents the basic structure of a MicroChannel heat exchanger. The actual design depends on the specified application.

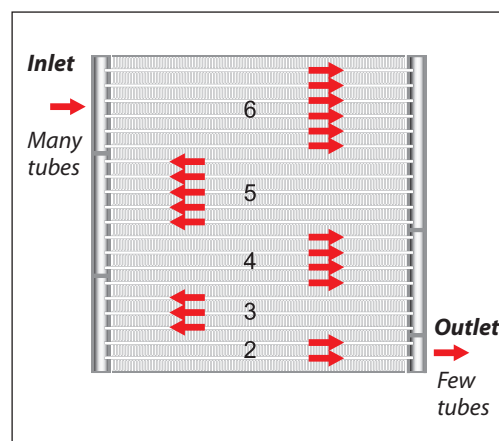


*Flow arrangement*

The MicroChannel condenser is often designed with multiple passes (parallel flow) with fewer tubes in each successive pass.

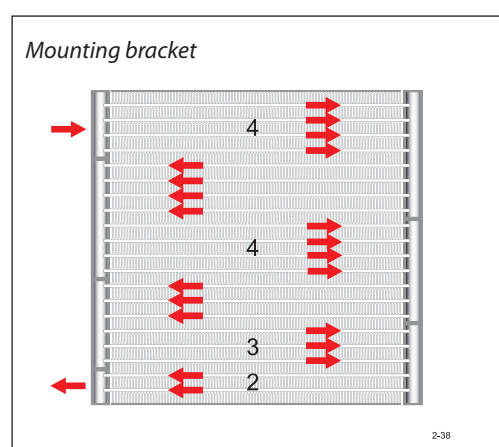
Accidentally connecting the outlet tube to the outlet header of the MCHE will result in excessively high refrigerant-side pressure loss and poor heat exchanger performance.

The inlet and outlet tubes are designed only for connection and to support their own weight. Unfortunately they locate where handles would be, and often look like handles. **Never lift an MCHE by the inlet and outlet tubes.**



*Mounting*

- The MicroChannel heat exchanger must be mounted with at least some flexible brackets, so movement is possible without applying unnecessary stress/tension to the heat exchanger or its connections.
- It is preferable for the mounting brackets of the MCHE to touch only rubber or plastic grommets, washers, bumpers, etc. Direct contact with metal fasteners and/or frames can result in galvanic corrosion unless appropriate steps are taken to prevent it, e.g. careful alloy selection, paints/coatings, etc.
- To meet customer-specific requirements, different mounting types are available.



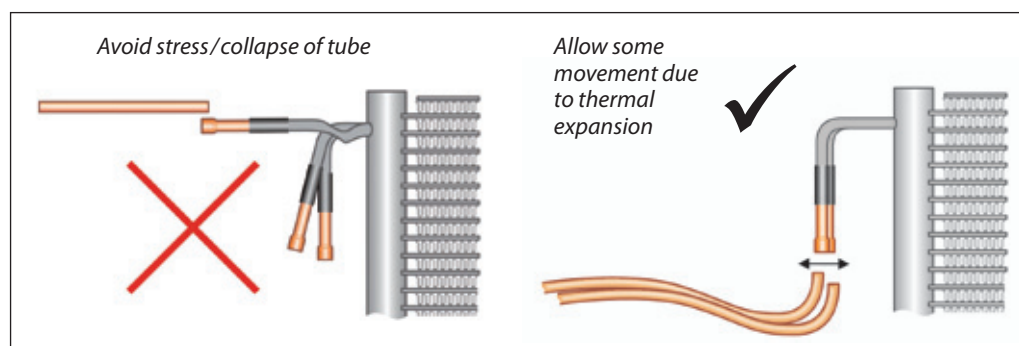
## Fitters' Notes

## Heat Exchangers

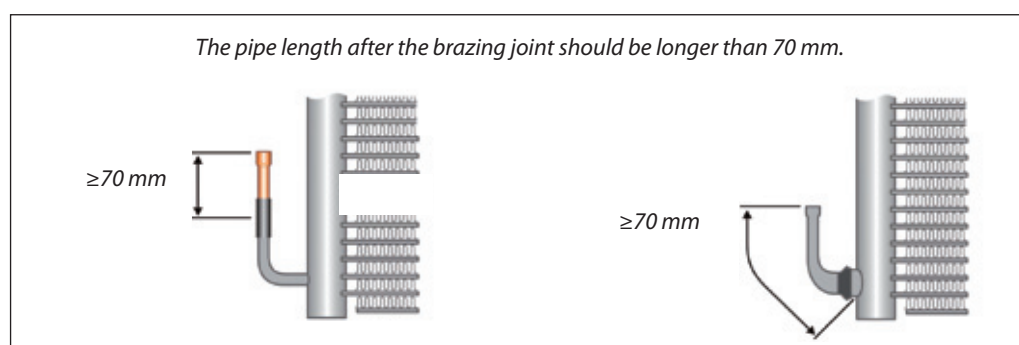
### MicroChannel Heat Exchanger – Construction

#### *Inlet/outlet connections*

- Inlet/outlet connections should be designed so the stress from thermal expansion will not be transferred to the tubing.
- Inlet/outlet connections should also be supported/designed so brazed joints are not exposed to stress/tension.
- To avoid damaging or collapsing the thin-walled aluminium inlet/outlet tubes, mating tubes should be pre-bent/prepared so no bending/forcing is needed during installation.
- When copper and aluminium tubes are joined together, galvanic corrosion of the aluminium can result. To prevent this the joint is protected with paint, resin or a plastic heat shrink tube.



To protect the Cu-Al brazing and shrink tube, the tube length after the joint on inlet/outlet pipes should be longer than 70 mm. When brazing the coil into your system, additional protection can be obtained by dry nitrogen purging and/or wrapping the copper stub tube with a wet cloth. The aluminium inlet/outlet tube on the MCHE must also be at least 70 mm long to protect the tube-header braze joint.



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**Fitters' Notes**

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**Heat Exchangers**

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**MicroChannel Heat Exchanger – Cleaning Procedure**

Compared with fin & tube heat exchangers, MicroChannel coils tend to accumulate more dirt on the surface and less dirt inside, which can make them easier to clean.

*Step 1. Remove surface debris*

Remove surface dirt, leaves, fibres, etc., with a vacuum cleaner (preferably with a brush or other soft attachment rather than a metal tube), compressed air blown from the inside out, and/or a soft bristle (not wire!) brush. Do not impact or scrape the coil with the vacuum tube, air nozzle, etc.

*Step 2. Rinse*

Do not use any chemicals (including those advertised as coil cleaners) to wash MicroChannel heat exchangers. They can cause corrosion. **Rinse only.**

Hose the MCHE off gently, preferably from the inside out and top to bottom, running the water through every fin passage until it comes out clean. MicroChannel fins are stronger than those of traditional fin & tube coils, but must still be handled with care. Do not bang the hose into the coil. We recommend putting your thumb over the end of the hose rather than using a nozzle end because the resulting spray is gentler and impact damage is less likely.

*Step 3: Optional blow dry*

MicroChannel heat exchangers, because of their fin geometry, tend to retain water more than traditional fin & tube coils. Depending on the specific design and installation of your coil, it may be beneficial to blow or vacuum out the rinse water from your unit to speed drying and prevent pooling.

*Warning!*

While it is possible to carefully clean with a pressure washer, **it is also possible to totally destroy a coil with a pressure washer. We therefore do not recommend their use.**

**Micro Plate Heat Exchanger – MPHE Instructions**

*General information*

Store dry at 17 °C (62 °F) to 50 °C (122 °F). The performance of Danfoss MPHEs is based on their installation, maintenance and operating conditions being in accordance with the manual. Danfoss cannot assume any liability for MPHEs that do not meet these criteria. Mount MPHEs vertically (see figs. right).

*Condensers*

Connect the refrigerant (gas) to the upper left connection, Q4 (Dual circuit: upper left, Q4, and right, Q6), and the condensate to the lower left connection, Q3 (Dual circuit: lower left, Q3, and lower right, Q5). Connect the water/brine circuit inlet to the lower right connection, Q2, and the outlet to the upper right connection, Q1 (Dual circuit: inlet lower middle, Q2, and outlet upper middle, Q1).

*Evaporators*

Connect the refrigerant (liquid) to the lower left connection Q3 (Dual circuit: lower left Q3 and lower right Q5) and the refrigerant (gas) outlet to the upper left connection Q4 (Dual circuit: upper left Q4 and upper right Q6). Connect the water/brine circuit inlet to the upper right connection, Q1, and the outlet to the lower right connection, Q2 (Dual circuit: inlet upper middle, Q1, and outlet lower middle, Q2).

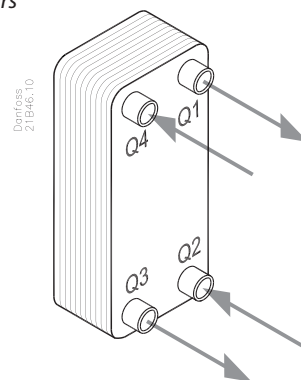
*Strainer*

If any of the media contain particles of 1 mm or larger, we recommend that a strainer (16–20 mesh) be installed before the MPHE.

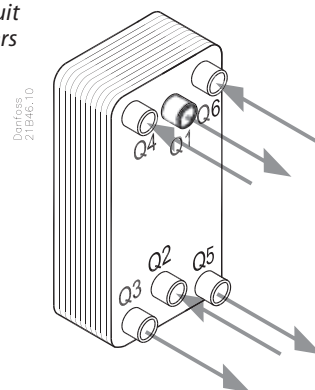
**IMPORTANT:**

MPHEs have sharp edges. Their surfaces can be very hot or cold. Media they contain may be at high pressure. For product information, refer to the product label.

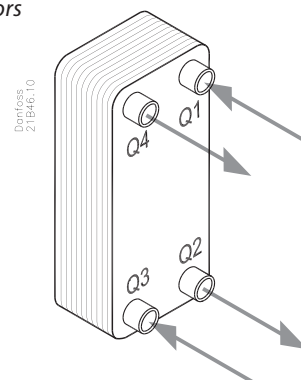
*Condensers*



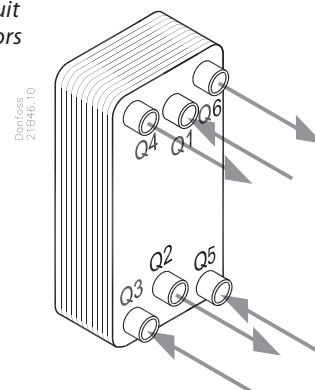
*Dual Circuit Condensers*



*Evaporators*



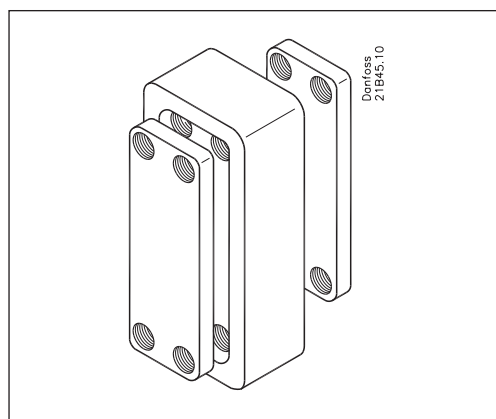
*Dual Circuit Evaporators*



**Micro Plate Heat Exchanger – MPHE Instructions**

*Insulation*

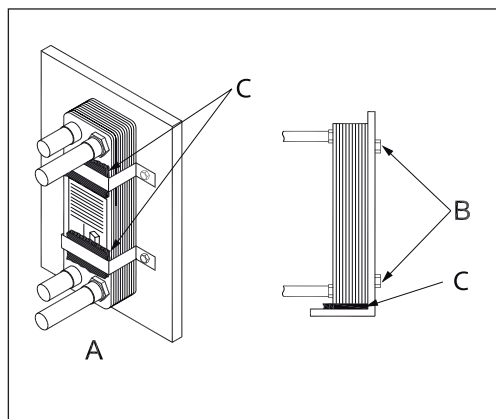
It is recommended that the product be insulated during operation. Use expanded cellular rubber insulation to create a vapour barrier and prevent heat losses.



*Mechanical mounting*

- A** Bracket mounting  
(for versions without mounting bolts or screws)
- B** Mounting with bolts  
(for versions with bolts)
- C** Rubber pads.

Stud Bolt	M6	1/4"	M8	M10	M12
Max. Torque	10	12	15	18	22

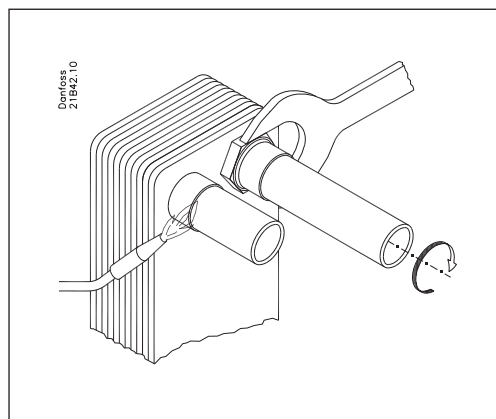


*Connecting pipes*

Model	22	30	55/62	118	117	212
Torque	350	350	400	1000	1000	1000
Max. Temp.	<<<<<<<<<< 800 °C / 1472 °F >>>>>>>>>					

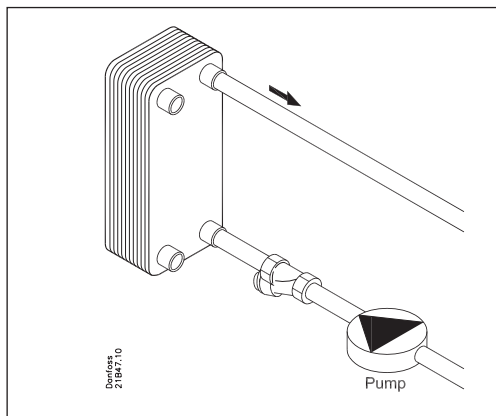
*Soldering procedure*

Degrease and polish the connection surface. Use nitrogen gas inside the MPHE to avoid oxidation during soldering. Apply flux with a brush. Insert the copper pipe into the connection, and braze with min. 45 % silver solder.



*Maintenance – Back flow cleaning*

Use a strainer or filter. Use a 5% solution of a weak acid such as phosphoric or citric acid. Reverse the normal flow direction, and increase the flow rate to 1.5 times normal.



**MicroChannel Heat Exchanger – MCHE Instructions**

*Storage/handling*

Store in a dry, clean environment, 0 °C (32 °F) to 50 °C (122 °F). Keep in packaging until installation. Keep vertical during storage and transportation. Do not stack flat on top of each other. The fins are easily bent, leading to irreparable damage. The tube walls are vulnerable, and can be punctured by sharp objects. Never lift or carry MCHes by their inlet/outlet tubes. Never hit or drop MCHes on their edges.

*Preparation and Installation*

The Danfoss MCHE condenser is designed to have the airflow and refrigerant in crossflow configuration. Arrange the two flows correctly.

Ensure that the air flow is distributed evenly across the entire face area in accordance with the technical specification to attain the specified capacity. This can be achieved by housing the air flow and making sure there are no short-cuts between the fan intake and outlet. Seal the wide gaps on both sides of the face area with sealing tape (see fig. 2).

When brazing the lines to the copper connections, use a wet rag at the base of the copper connection to minimise heating of the copper/aluminium transition (see fig. 3).

Never bend or stress the aluminium tube or the brazed joints. Aluminium MCHes expand and contract more than other heat exchangers.

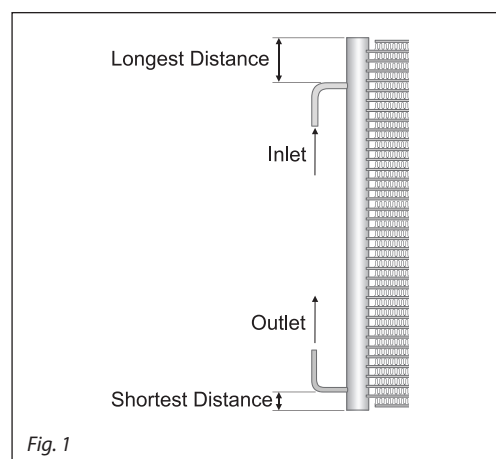


Fig. 1

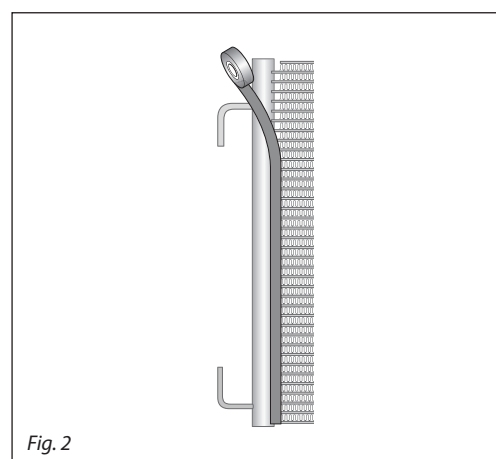


Fig. 2

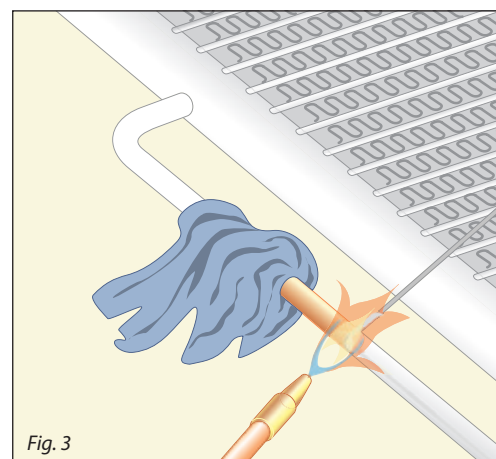


Fig. 3

**MicroChannel Heat Exchanger – MCHE Instructions**

Thermal expansion causes MCHEs to expand/contract in two dimensions (see fig. 4). Installation support brackets must be designed to allow this movement.

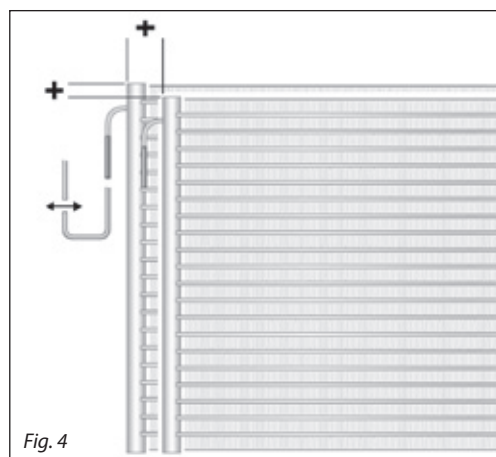


Fig. 4

Remember to insert plastic/rubber/foam between the aluminium coil and dissimilar metals (see fig. 5).

*Refrigerant charge*

Danfoss MCHE condensers require a significantly smaller refrigerant charge than round tube condensers. Over-charging will result in higher head pressure and loss of system capacity. Charge in accordance with the OEM's instructions. If these are not available, follow the instructions below.

Charge as follows:

1. Under full- or near full-load operating conditions, put approximately 1/3rd the nominal charge (by mass of refrigerant) in the system. Allow the system to stabilise, and check for gas bubbles in the liquid line sight glass.
2. Add small amounts of refrigerant successively, allowing the system to stabilise each time and checking for bubbles as before.
3. Once there are few or no gas bubbles entering the expansion valve, the charge is most likely correct.
4. If the system is operating with a head pressure higher than that specified, remove refrigerant from the system.

*Corrosion*

To prevent galvanic corrosion, avoid contact between the aluminium MCHE and dissimilar metals by separating them with plastic, rubber or foam tape (see fig. 5).

Also take care never to expose the MCHE to dissimilar metal chips, dust or filings from adjacent handling or manufacturing.

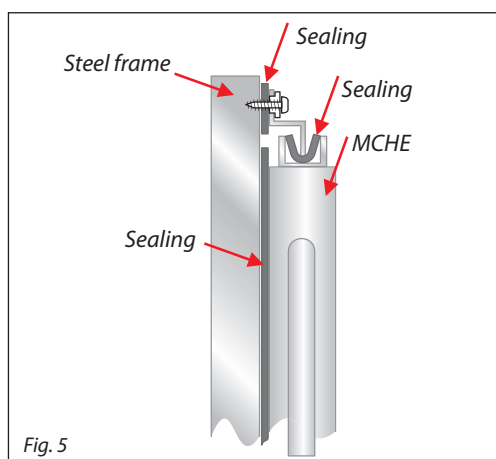


Fig. 5



**Troubleshooting  
Refrigerant Systems Using  
Plate Heat Exchangers**

**Symptoms**

- High condensing pressure
- Low condensing pressure
- Low evaporating pressure

*Possible causes of high condensing pressure*

- Condenser water flow too low
- Condenser water inlet temperature too high
- Refrigerant overcharge
- Condenser internal volume is small compared with evaporator volume
- Oil in condenser
- Non-condensable gases in refrigerant circuit
- Air in condenser water side
- Dirt in water side – surface fouling or blocked water channels
- Overload from evaporator side
- Temperature differences in condenser side too big

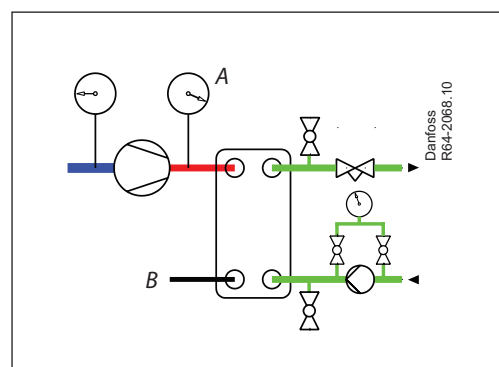
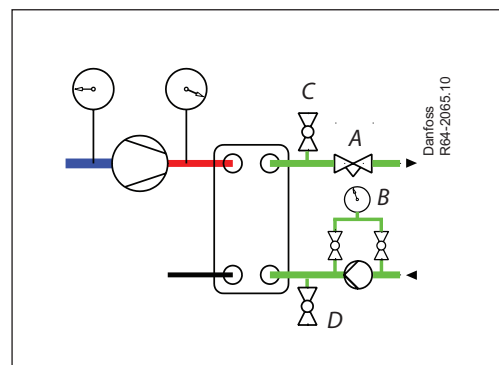
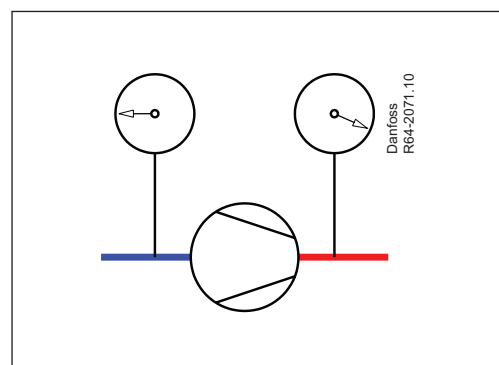
*How to detect: Water (or brine) flow too low*

- Measure the flow using manual regulating valve (A)
- Measure the pressure difference across the pump (B) and check the flow from the pump manual or selection program
- Measure the condenser pressure loss from the drain (D) and venting (C) connections and check the flow from the selection program
- Measure the compressor operating conditions and calculate the condenser capacity  $Q_c$ . Measure the water inlet and outlet temperature difference  $\Delta T$ . Calculate the water mass flow  $m$ .

$$m = \frac{Q_c \text{ [kJ/s]}}{\Delta T \text{ [K]} \times 4.2 \text{ kJ/kg K}} = \text{[kg/s]}$$

*How to detect: Refrigerant overcharge*

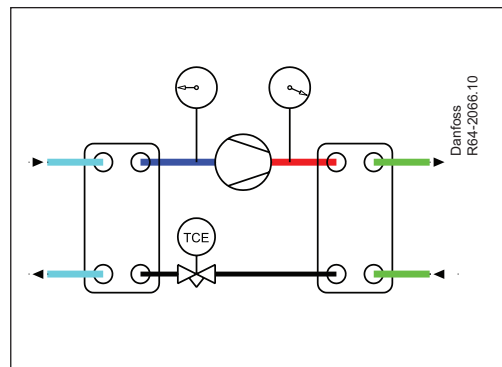
- Overcharge will reduce the internal surface area used for condensing. The smaller area increases not only the temperature difference between the condensing temperature and the refrigerant media but also the condensing pressure.
- Measure the condensing pressure (A) and establish the corresponding saturated liquid temperature
- Measure the liquid temperature at the condenser outlet (B)
- Calculate the subcooling (B-A)
- Excessive subcooling will indicate overcharge.



**Troubleshooting  
Refrigerant Systems Using  
Plate Heat Exchangers**

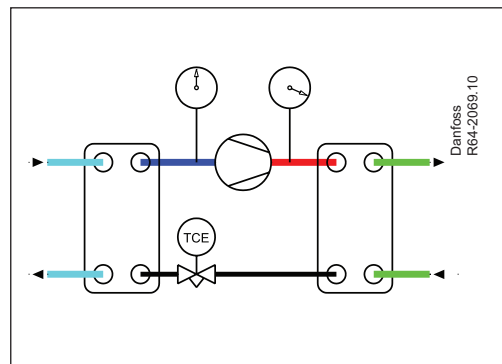
*How to detect: Condenser volume is too small*

- Specific to chillers and heat pumps without a liquid receiver having relatively high internal evaporator volume
- In nominal operating conditions the condensing pressure and subcooling may be normal
- In low-load conditions and low evaporating temperatures more refrigerant will accumulate in the condenser, increasing the condensing temperature and subcooling as in the case of overcharge
- Check the evaporator and condenser internal volumes
- Consider installing a liquid receiver



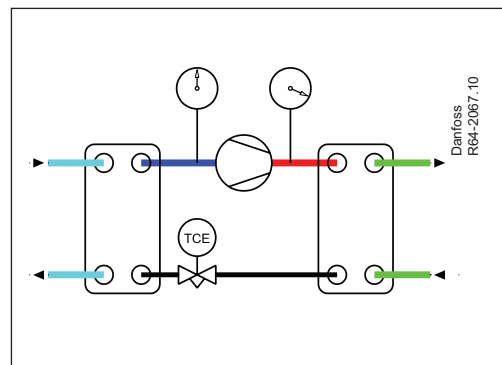
*How to detect: Oil in the condenser*

- Specific to chillers and heat pumps without a liquid receiver
- Low suction gas superheat and short running times increase the amount of oil leaving the compressor
- The compressor oil charge may be bigger than the condenser internal volume
- Oil collecting in the condenser reduces the surface area available for condensing. This will increase the condensing temperature
- Check the oil level of the compressor if possible. Check the compressor running times and suction gas superheat



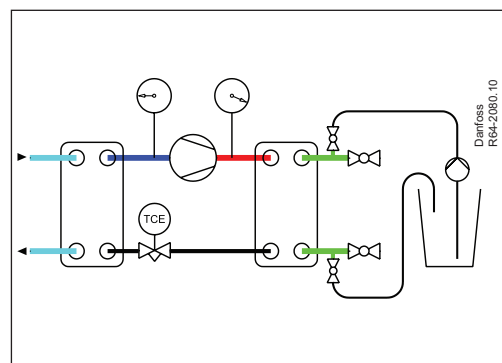
*How to detect: Non-condensable gases*

- Non-condensable gases have the same effect as overcharge. The condensing pressure will rise and there will be excessive subcooling.
- The high-pressure manometer may sometimes vibrate due to non-condensable gases
- Non-condensable gases will collect in the top part of the condenser, making it the best place to purge the system



*How to detect: Dirt in the water side of the condenser*

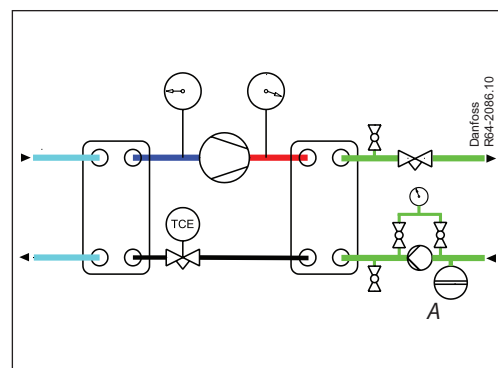
- Impurities in the water or brine side may cause fouling and even block some water channels. This will increase the condensing pressure
- The condenser may be cleaned by pumping water in the reverse direction compared with normal operation. Cleaning agents may also be used
- It is recommended that filters be used in front of plate heat exchangers



**Troubleshooting  
Refrigerant Systems Using  
Plate Heat Exchangers**

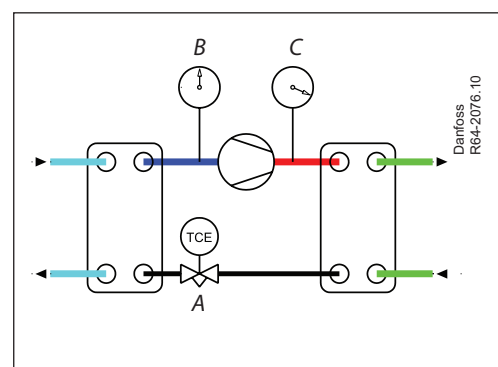
*How to detect: Air in the water side of the condenser*

- Air in the water side of the condenser impairs heat transfer
- Air in the circulation pump will reduce the water or brine flow
- Besides increasing the condensing temperature, the air can cause a distinctive noise that will help to identify the cause of the problem
- Check that the expansion tank (A) is connected to the suction side of the circulation pump and the pressure inside the tank is correct



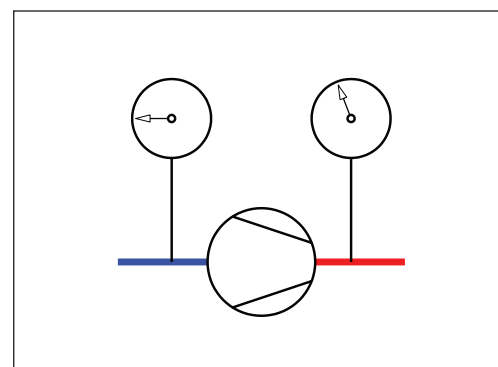
*How to detect: High load from suction side*

- On a hot day with high humidity, the refrigerant load from the air conditioning system may exceed the refrigerant capacity of the water chiller
- If the expansion valve (A) does not have a MOP function, the suction pressure (B) will be high. The refrigerant capacity will increase causing a high load on the condenser and thus a high condensing temperature (C)



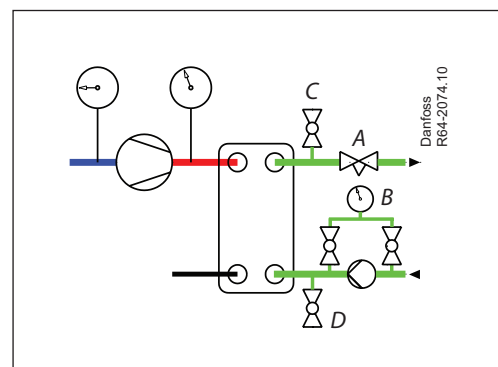
*Possible causes of low condensing pressure*

- Condenser water flow too high
- Water inlet temperature too low
- Defective compressor valves



*How to detect: Water (or brine) flow too high*

- Measure the flow using manual regulating valve (A)
- Measure the pressure difference across the pump (B) and check the flow from the pump manual or selection program
- Measure the condenser pressure loss from the drain (D) and venting (C) connections and check the flow from the selection program
- Measure the compressor operating conditions and calculate the condenser capacity  $Q_c$ . Measure the water inlet and outlet temperature difference  $\Delta T$ . Calculate the water mass flow  $m$ .

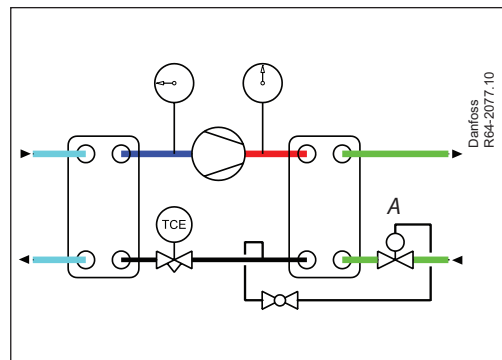


$$m = \frac{Q_c \text{ [kJ/s]}}{\Delta T \text{ [K]} \times 4.2 \text{ kJ/kg K}} = \text{[kg/s]}$$

**Troubleshooting  
Refrigerant Systems Using  
Plate Heat Exchangers**

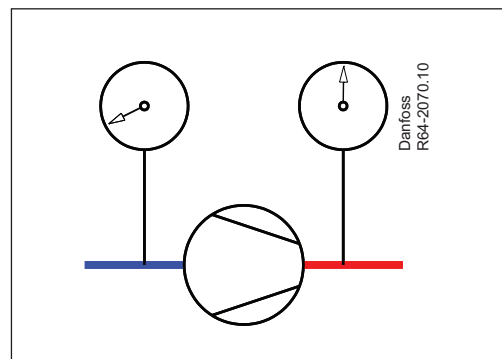
*How to correct: Condensing pressure too low*

- One way to solve the problem is to install a pressure-actuated water valve (A) to the water or brine inlet pipe
- The valve will also protect the heat exchanger from the pressure shocks that may occur in industrial water systems when valves are closed and opened rapidly



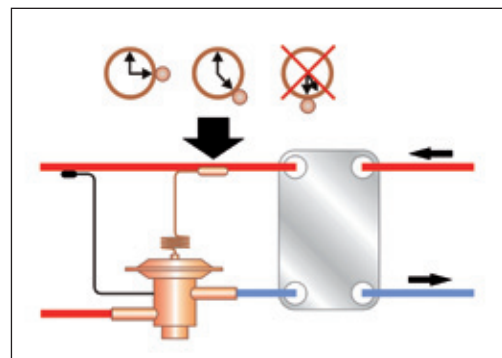
*Possible causes of low evaporating pressure*

- Expansion valve is wrongly installed
- Expansion valve is wrongly adjusted
- Expansion valve is wrongly sized
- Insufficient subcooling
- Water or brine flow too low
- Partial freezing
- Air in water side
- Dirt in water side – surface fouling or blocked water channels
- Uneven refrigerant distribution



*How to detect: Expansion valve is wrongly installed*

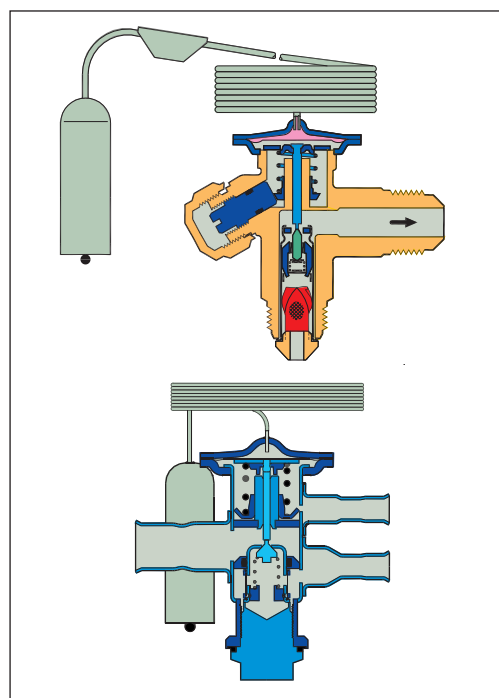
- The pipe between the expansion valve and heat exchanger should be straight.
- A bend will act as a centrifugal separator. On the outer side of the bend there will be more liquid than vapour compared with the inside of the bend, causing bad refrigerant distribution inside the evaporator
- This will result in lower evaporating pressure and capacity
- Thermostatic expansion valves in particular are sensitive to the correct bulb mounting



**Troubleshooting  
Refrigerant Systems Using  
Plate Heat Exchangers**

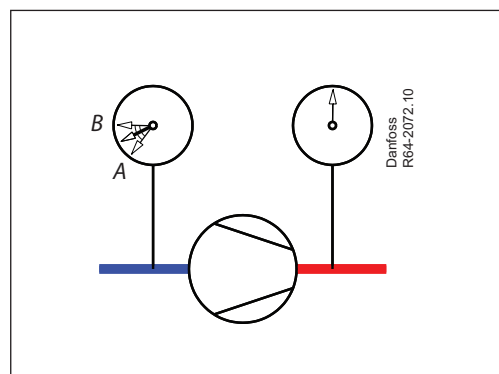
*How to detect: TEV installed upside down*

- If an expansion valve with internal pressure equalizing is installed upside down, dirt and oil may collect above the diaphragm. This can increase the superheat and make the operation of the valve slower
- In expansion valves with external pressure equalizing there is a risk that oil will collect in the equalizing pipe, impairing valve operation
- In valves with MOP there is a risk of refrigerant evaporating from the diaphragm, which can cause charge migration



*How to detect: Expansion valve is wrongly adjusted*

- Quite often the expansion valve is simply installed without adjustment. This may impair system efficiency and compressor service life
- High superheat will result in lower evaporating pressure (A) and thus lower capacity and system COP
- Low superheat will result in higher evaporating pressure (B). There is a risk of wet suction gas reducing compressor service life. The system refrigerant capacity and COP may also be lower when part of the refrigerant evaporates in the compressor and not in the evaporator



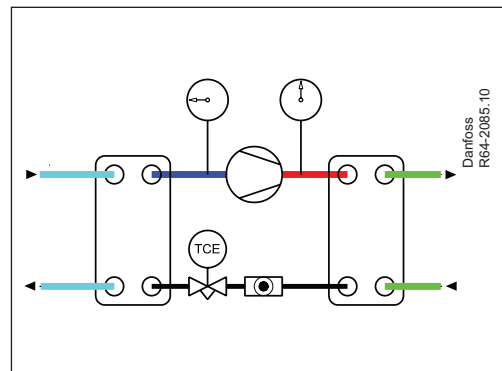
*How to detect: Expansion valve is wrongly sized*

- If the orifice in the expansion valve is too small, the evaporating temperature will be low, reducing the refrigerant capacity and system COP
- If the orifice is too big it is impossible to achieve stable superheat. Hunting will shorten the expansion valve service life, and wet suction gas may result in compressor failure

**Troubleshooting  
Refrigerant Systems Using  
Plate Heat Exchangers**

*How to detect: Insufficient subcooling*

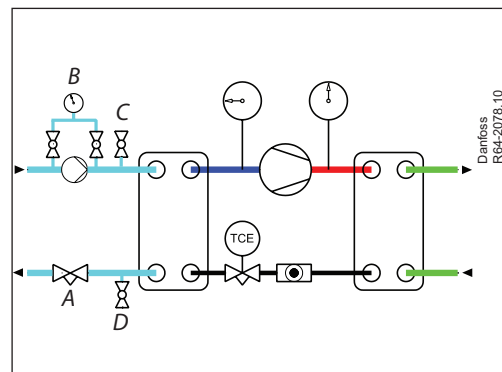
- Insufficient subcooling, blocked filter drier, tight bend in liquid line, small solenoid valve, etc., may cause flash gas in the liquid line that reduces expansion valve capacity
- Flash gas often causes audible hunting that is also visible in the suction pressure manometer
- The bubbles can be observed from the sight glass if it is installed just before the expansion valve
- It is also possible to use an electronic sight glass such as TIFF-4000A to determine the state of the refrigerant



*How to detect: Water (or brine) flow too low*

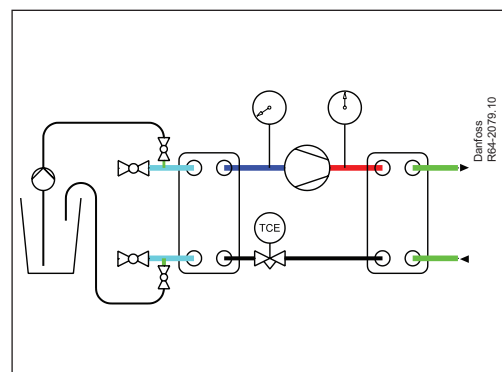
- Measure the evaporator water flow using manual regulating valve (A)
- Measure the pressure difference across the pump (B) and check the flow from the pump manual or selection program
- Measure the evaporator pressure loss from drain (D) and venting (C) connections and check the flow from the selection program
- Measure the compressor operating conditions and calculate the refrigerant capacity  $Q_o$ . Measure the water inlet and outlet temperature difference  $\Delta T$ . Calculate the water mass flow  $m$ .

$$m = \frac{Q_o \text{ [kJ/s]}}{\Delta T \text{ [K]} \times 4.2 \text{ kJ/kg K}} = \text{[kg/s]}$$



*How to detect: Dirt in the evaporator*

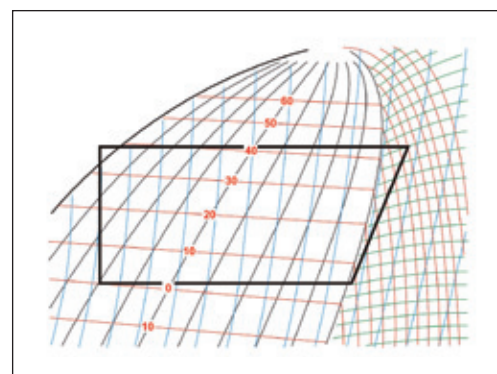
- Impurities on the water side may cause fouling and even block some water channels.
- Fouling will reduce the evaporating pressure and thus system capacity
- Blocked water channels are very harmful to TEV operation, because refrigerant droplets may flow through the evaporator
- The evaporator may be cleaned by pumping water in the reverse direction compared with normal operation. Cleaning agents may also be used.
- It is recommended that filters be used in front of the plate heat exchangers



**Troubleshooting  
Refrigerant Systems Using  
Plate Heat Exchangers**

*How to detect: Partial freezing*

- There is a risk of freezing when R407C and other refrigerants with a high temperature glide are used
- Although the evaporating temperature is above 0 °C the temperature in the evaporator inlet may be below 0 °C
- Even partial freezing will reduce the refrigerant capacity and increase the risk of evaporator breakdown
- The risk can be evaluated by drawing the cycle as a log p, h-diagram
- In brine systems measure the freezing point using good quality instruments or simply put a sample in the freezer and note its melting/freezing points



*How to detect: Uneven liquid distribution*

- Although the evaporator water flow and temperatures are according to the selection program the evaporating temperature is lower and superheat higher than it should be
- The reason may be uneven liquid distribution inside the evaporator
- Carefully remove the insulation from the evaporator's side. Measure the surface temperature at many points with a fast-reacting thermometer
- Temperature variations across the horizontal plane will indicate uneven liquid (or water) distribution inside the evaporator

