

installation, operating and maintenance manual

Gasketed and semi-welded Plate heat exchangers



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Introduction

This installation manual is a guide for installation, commissioning, operation, and maintenance of gasketed and semi-welded plate heat exchangers manufactured and supplied by Danfoss. It is meant for those who are responsible for the installation, operation, and maintenance of the heat exchangers. It is recommended that you read this manual carefully before commencing any work with the heat exchanger.

This installation manual is applicable for gasketed, and semi-welded plate heat exchangers manufactured and supplied by Danfoss.

Danfoss cannot be held responsible or liable for damage because of incorrect installation, use and/or maintenance of Danfoss gasketed and semi-welded heat exchangers or damage caused by as not complying with the instructions in this installation manual.

Please note that our plate type heat exchangers are specially designed and built for the optimal design conditions (pressures, temperatures, capacities, type of fluids etc.) provided by the customer during the calculation process - as stated on the nameplate.

Sudden pressure peaks or pressure surges which can occur during start-up or shutdown of the system can severely damage the heat exchanger and should be prevented. Danfoss cannot be held responsible for any damage because of any operation deviating from the original design criteria.



Drawings and figures featured in this document serves as examples and for illustrative purposes only



Always comply to local regulations and legislation when handling the plate heat exchanger.



Only qualified personnel should handle the heat exchanger during lifting, transportation, installation, commissioning, and maintenance.

Safety alert notices

The following must always be observed when installing or servicing plate heat exchangers:

- Comply with national/local safety regulations
- Ensure that the heat exchanger is free from pressure and completely drained and flushed with clean water where possible.
- Ensure that the heat exchanger is cooled down to ambient temperature between 10 - 40 °C (50 - 104 °F)

Warning symbols refer to safety alert notices. Warning/safety notices should be observed carefully to prevent:

Personal injury caused by:



- Wrong transport/lifting
- Burning/freezing because of touching parts with extreme temperatures.
- Burning/freezing/poisoning because of uncontrolled release of pressurized media
- Contact with chemicals
- Touching sharp edges of e.g., plates or cassettes
- Draining or overflowing tanks

Equipment damage caused by:



- Wrong transport/lifting
- Liquid hammering
- External forces
- Corrosion
- Chemical reaction
- Erosion
- Material fatigue
- Thermal and/or mechanical shock
- Freezing
- Blocking of the heat exchanger due to particles
- Operation outside the design criteria

Identification of the heat exchanger

Nameplate

All plate heat exchangers supplied by Danfoss are provided with a name plate positioned on the front (head) of the heat exchanger.

Additional nameplates can be found elsewhere if specified by the client and ordered as an option.

On the name plate main technical details of the heat exchanger are specified. Before installation, please make sure that the intended process is compliant with the name plate data.

Please note that other nameplates than shown in this operation manual (e.g., customized nameplates, SONDEX® nameplates as well as Danfoss nameplates) may occur.



Never exceed any of the stated values on the nameplate, at any time!



Do not make changes to the nameplate or repaint it, at any time.



Avoid aggressive cleaning detergents for cleaning the heat exchanger when a foil sticker/label is used.



Do not remove the nameplate.



Nameplate for single plate heat exchangers (Metal/Stainless steel)

From DN65 and up. S-, SF-, SW- (except industrial refrigeration), SWC- and SEC-types

Month/year of production	09-2022	
Certification/approval type e.g. CE, NoBo, ASME, DNV-GL etc.	CE 1727	
HEX ID - Calculation number	32-220510115016	
Tag. number - a number that is assigned to identify e.g. a project equipment etc.	Unit no. 1	
Type designation	Plate heat exchanger type	S86-IS16
Serial number	Serial no.	DKA11322350001
Assembly (A) measure nominal	A-measure nom. (min./max.)	744.2 (725.7 / 762.6) mm
Minimum / maximum design temperature	Min. / Max. design temperature	15.0 / 100.0 °C
Maximum differential pressure	Max. differential pressure	12.0 bar
Inlet - outlet connections	Inlet > Outlet	F1 > F4 / F3 > F2
Design pressure	Design pressure	12.0 / 6.0 bar (g)
Test pressure	Test pressure	17.2 / 17.2 bar (g)
Total internal volume	Volume	332.1 / 329.4 L
Fluid type, per side	Fluid	Water / Water

Do not exceed above values at any time.
Please read instruction manual before installation, operation and maintenance.

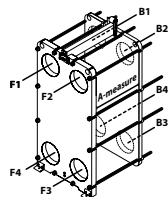


Fig. 1

Nameplate for single plate heat exchangers (Foil sticker)

Up to DN50. S- and SF-types


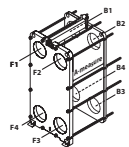
Month/year of production	Tag No.	 MADE IN DENMARK	
Certification/approval type e.g. CE, NoBo, ASME etc.	Plate heat exchanger type	Month and year	MM-YYYY
Tag. number - a number that is assigned to identify e.g project equipment etc.	Serial No.	Certification/Approval type	This product fulfils PED requirements for SEP / Art. 4, Sec. 3
Type designation	A-measure nom. (min./max.)	Min. / Max. design temperature	Max. differential pressure
Serial number	71 (70 / 72) mm	2,0 / 120,0 °C	16,0 bar
Assembly (A) measure nominal	Inlet > Outlet	Side 1 / Side 2	
Min. and max. design temperature	Design pressure	F1 - F4 / F3 - F2	
Maximum differential pressure	Test pressure	16,0 / 16,0 bar (g)	
Inlet - outlet connections	Test pressure	20,0 / 20,0 bar (g)	
Design pressure	Volume	2,8 / 2,6 L	
Test pressure	Fluid	Fresh water / Fresh water	
Total internal volume	 <p>Do not exceed above values at any time. Please read instruction manual before installation, operation and maintenance.</p>		
Fluid type, per side	<p>Manufactured by Danfoss A/S, 6430 Nordborg, Denmark www.heatexchangers.danfoss.com</p> <p>SONDEX®</p>		

Fig. 2

Nameplate for IRF semi-welded plate heat exchangers (Metal/Stainless steel)

Semi-Welded-types for industrial refrigeration


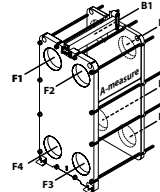
Month/year of production	Plate heat exchanger type	Month and year	MM-YYYY
Certification/approval type e.g. CE, NoBo, ASME etc.	Serial No.	Marking	CE 1727
Type designation	A-measure Nominal*		
Serial number	246 mm		
Assembly (A) measure nominal (Tolerance -1,5%)	Max. differential pressure	Min. working temperature	Max. working temperature
Maximum differential pressure	17,0 Bar	-15,0 °C	110,0 °C
Minimum and maximum working temperature	Inlet > outlet	Ref. side / Brine side	
Inlet - outlet connections	Max. working pressure	F4 - F1 / F3 - F2	
Design pressure	Max. test pressure	16,0 / 10,0 Bar	
Test pressure	Volume	22,9 / 14,3 Bar	
Total internal volume	Fluid	16,6 / 15,2 Ltr.	
Fluid type, per side	<p>Ammonia / Prop. Glycol 30%</p>		
 <p>* A-measure min.: A-measure Nominal - 1.5%</p> <p>Do not exceed above values at any time. Please read instruction manual before installation, operation and maintenance.</p> <p>Manufactured by Danfoss A/S, 6430 Nordborg, Denmark</p>			

Fig. 3

(*)Danfoss Quality approval confirms PHE has passed leak test procedure

Technical documentation - data sheets and drawings

Each heat exchanger comes with a data sheet and a dimension drawing unless other is specified as per customer order.




Please note that other data sheets and drawings than shown in the following examples may occur.

Example of a data sheet for a gasketed heat exchanger:

GHEX

ENGINEERING TOMORROW



Danfoss HEXSelector 1.0.17

#6-21180-44-1

Customer	A	Date	6.10.2021
Project	Montes del Plata 3039 - HU Cooler Improv Engineer		Heikki Saaros
HEX Type	S44A-IG16-80-TLA	Contact Person	
		E-mail	
Units Connected	1 (Parallel)		

Calculated Parameters		Unit	Side 1	Side 2
Flow Type				CounterCurrent
Heat Load		kW	100,37	
Inlet Temperature		°C	59,4	31,0
Outlet Temperature		°C	35,0	39,7
Mass Flow Rate		kg/s	2,12	2,76
Volumetric Flow Rate		L/min	145,00	166,67
Total Pressure Drop		kPa	82,11	13,80
Pressure Drop in Port		kPa	0,29	0,39
Surface Margin		%	2,58	
LMTD		K	9,8	
HTC (Available/Required)		W/m²·K	319 / 311	
Port Velocity		m/s	0,73	0,84
Shear Stress		Pa	62,83	10,30

Properties of Fluid		Unit	Side 1	Side 2
Fluid			Oil ISO VG 150	Water
Liquid Viscosity		mPa·s	86,9600	0,7181
Liquid Density		kg/m³	879,0000	994,6086
Liquid Heat Capacity		kJ/kg·K	1,9380	4,1758
Liquid Thermal Conductivity		W/m·K	0,1346	0,6206

Specifications		Unit	Side 1	Side 2
HEX Type			S44A-IG16-80-TLA	
Number of Plates			80	
Grouping			1x40 + 0x0 / 1x39 + 0x0	
Plate Thickness		mm	0,4	
Plate Material			AISI316L	
Effective Area		m²	32,84	
Gasket Material			NBRH (HangOn)	
Frame	Type		IG	
	Length	mm	639	
	Maximum Number of Plates		99	
Volume		l	60,0	58,5
Weight, empty/operating		kg	499 / 610	
Paint Category			Category C2L	
Paint Color			BLUE RAL 5010	
Connection	Inlet		F1: DN 65 Flange rubberlind HT PN10/PN16	F3: DN 65 Flange rubberlind HT PN10/PN16
	Outlet		F4: DN 65 Flange rubberlind HT PN10/PN16	F2: DN 65 Flange rubberlind HT PN10/PN16
Certification/Approval Type			PED 2014/68/EU, Art. 4.3	
Minimum Design Temperature		°C	0,0	
Maximum Design Temperature		°C	90,0	
Maximum Differential Pressure		bar	16,0	
Maximum Test Pressure		bar	20,0	
Maximum Design Pressure		bar	16,0	16,0

1358.0.1.0.14-FR1GA1AP0

Fig. 4

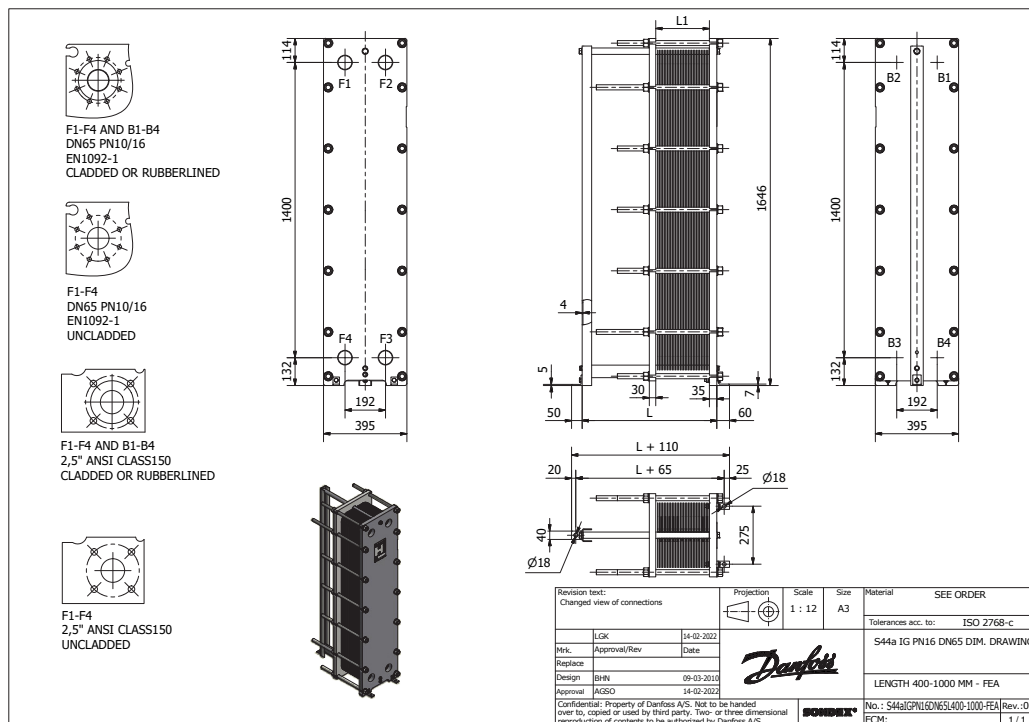


Fig. 5

In drawings and data sheets, the designation F1, F2, F3, F4 refers to connections on the head. B1, B2, B3, B4 refer to connections on the follower.

Type designation for a gasketed heat exchanger
(Stated on the data sheet)

Example:

S21A -IG10-47-TMTL27

Percentage of thermal plate pattern composition

In this example, 27% of the plates are thermal long

Thermal plate pattern composition (most common plate patterns*1)

TL = Thermal long (high Theta)

TK/TS = Thermal short (low Theta)

TM = Thermal mix (pairs TL+TK)

Number of plates (including end plate)

Frame PN class

Nominal design pressure 6, 10, 16, 25, 40 (63) bar is available

Frame design

ST/T = Basic frame design. Only connections on head, only blue color, no lock bush on follower.

G = Simple frame design without roller on the carrying bar. Connection(s) on follower possible. No lock bush on follower.

S = Advanced frame design with roller on the carrying bar. Connection(s) on follower possible. Lock bush on follower (single sided disassembly possible)

Frame application type

I = Industrial frame (painted)

F = Food/sanitary frame (glass blasted stainless steel)

D = Danfoss design code (DDC), frame design for e.g., PED Art. 4.3 (Sound Engineering Practice) (painted)

Gasket type

If blank = Sonderlock,

A = Hang on type A

B = Hang on type B

If other letters are stated, it is related to the plate design i.e. AE and AD etc.

Plate model

Heat exchanger type

S = Standard plate

SF = Freeflow plate

SW = Semi-welded

SEC = Evaporator

SWC = Condenser

A = AHRI certified type,

D = D-plate technology with D-Lock™ gasket system

*1 Other plate patterns may occur

Design/components

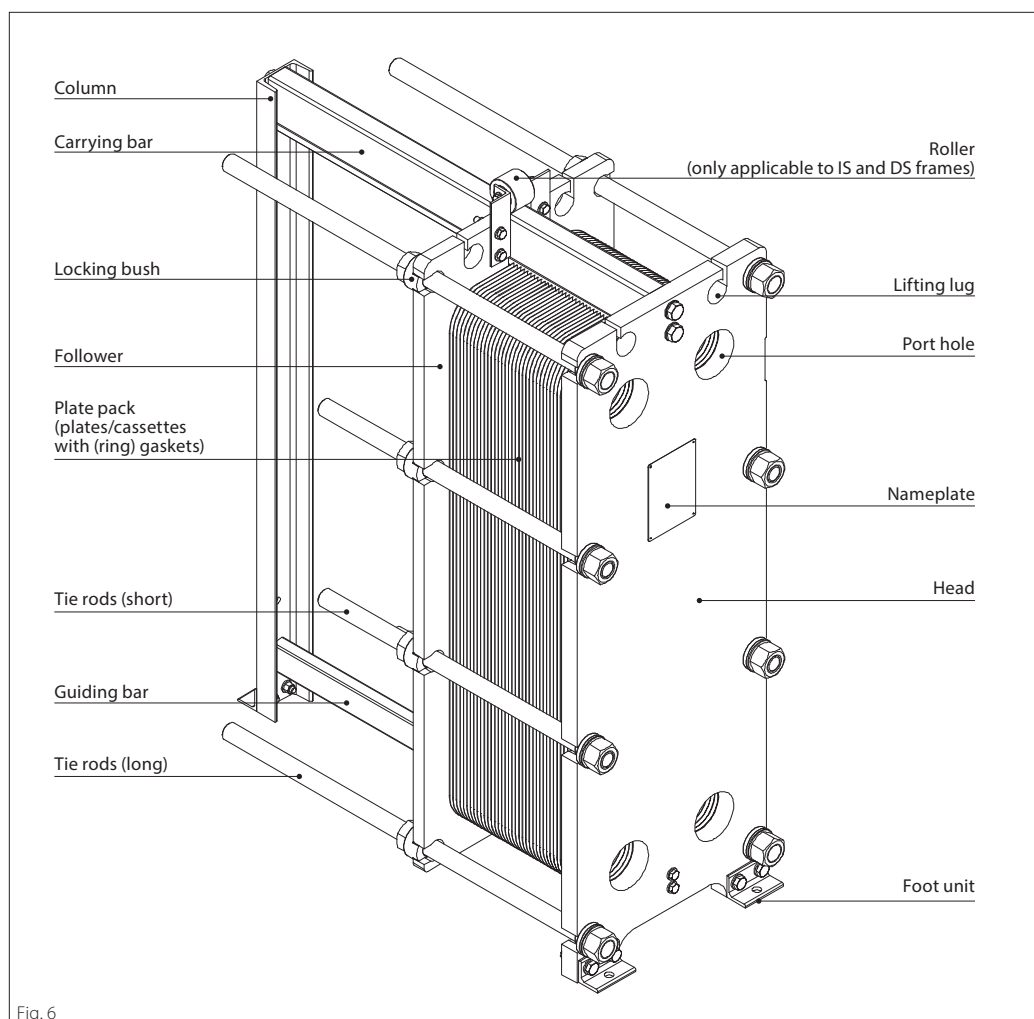


Fig. 6

Frame

The heat exchanger frame consists of a frame plate (head), a pressure plate (follower), a carrying bar, a guiding bar, and a column. The tie rods are used to press the plate pack together. The size and number of tie rods depend on the type of heat exchanger and the pressure rating.

The (ring) gasket material is carefully selected to match the combination of temperature and chemical resistance requirements (e.g., NH₃ and compressor oil on the welded side).

Single Plates

Single plate pack consists of single plates fitted with a flow gasket on each plate to seal the plate pack. The number of plates, size and other criteria depend on the thermal output required. The number of plates determines the total heat transfer area (surface).

Semi-welded plates (plate cassettes)

A plate cassette consists of two single flow plates welded together, creating a sealed flow channel. The cassettes are fitted with two individual gaskets, a ring gasket, and a flow gasket, to seal the plate pack preventing the intermixing of media. This gasket design allows the use of different gasket materials for the ring and flow gaskets respectively for best fit to the actual media and temperature conditions.

Gaskets

The following gasket types are used in Danfoss plate heat exchangers:

- SonderLock gaskets
- Hang-on gaskets (type A, B, AD, AE, A2 and B2)
- D-Lock™ gaskets
- Glued gaskets for sanitary plate heat exchangers (Recommended glue/adhesive that is FDA compliant - DOWSIL™ 786 Silicone Sealant-M Clear, for non food application you can use 3M 1099)

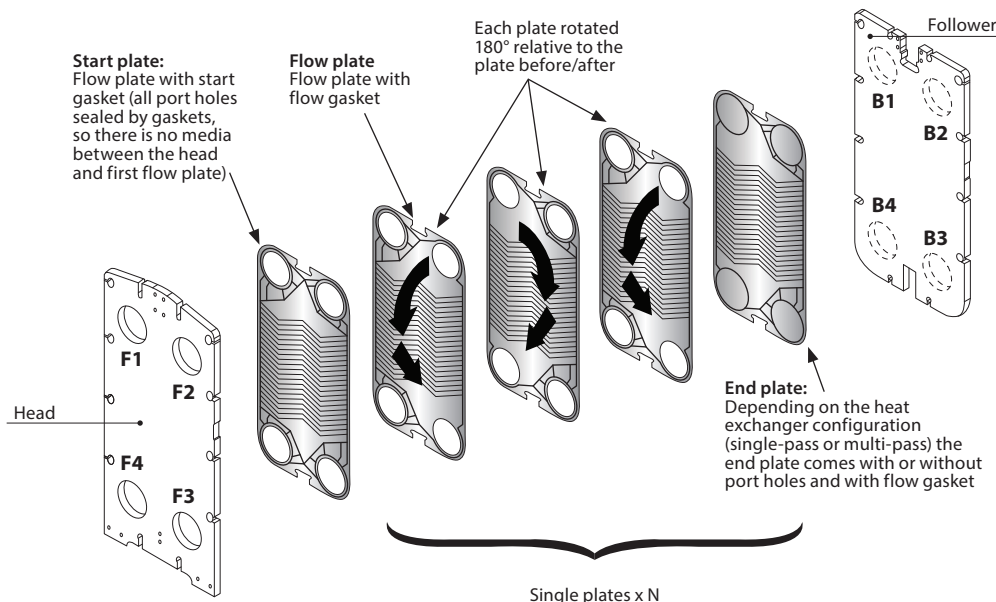
Right (R)/ Left (L) plates

Most of the plates are designed in such a way that they can be used both as right and left plates, by alternately turning them 180°. Semi-welded cassettes are not turned.

On a right plate the media flows from porthole F2 to F3 or reverse from porthole F3 to F2.

On a left plate the media flows from porthole F1 to F4 or reverse from porthole F4 to F1.

Single plates: Left and Right plates and flow.



Connections

(F= head/front, B=follower/back side):

F1, F2, F3 and F4: Connections on head

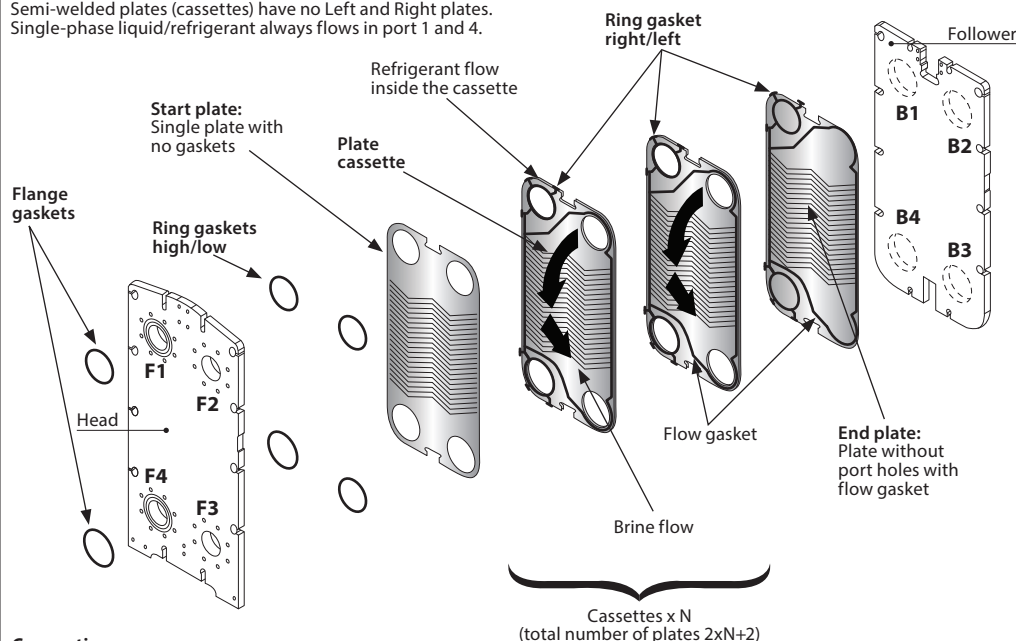
B1, B2, B3 and B4: Connections on follower (optional, depending on the configuration)

Please consult the nameplate for actual data regarding connections.

Fig. 7

Flow arrows shown are indicative only!

Semi-welded plates (cassettes) have no Left and Right plates. Single-phase liquid/refrigerant always flows in port 1 and 4.



Connections

(F= head/front, B=follower/back side):

F1, F4: Single-phase/refrigerant side

F2, F3: Two-phase/Brine side, *ring gasket

Please consult the nameplate for actual data regarding connections.

Fig. 8

Flow arrows shown are indicative only!

Accessories/optional components

Insulation jackets/covers

We offer insulation jackets for our range of plate heat exchangers. For heat insulation, we use mineral wool, and for applications with condensation risk on external surfaces of heat exchanger we offer closed cell PU foam.

Drip/condensation tray

A drip/condensation tray collects any remaining water after drainage (when the unit has been opened for inspection and maintenance), as well as the water that has condensed on the outside of the heat exchanger during operation. We offer two types of drip/condensation trays, either insulated or uninsulated. Both types come with a 0,8 mm electro galvanized sheet metal. The insulated version comes with a 60 mm of PU-foam insulation inside the drip/condensation tray. The insulated drip/condensation tray is equipped with holes (and reinforcements) for connecting, with the foot units of the plate heat exchanger. Depending on the length of the heat exchanger it is placed inside the drip/condensation tray and only the column is located outside the drip/condensation tray, or it is hanging underneath the heat exchanger.

Note: place the insulated drip tray before lifting the plate heat exchangers in place.

Safety cover

If the plate heat exchanger is being used with temperatures above 45°C or with aggressive fluids, we advise that you cover the plate heat exchanger with a screen plate to prevent the risk of human exposure to the surface and fluids.

Inline filter/filtration

If the fluid in the plate heat exchanger contains particles larger than the 1/3 of free channel between the plates, it is recommended to fit an inline filter. The inline filter is placed in the portholes in the plate pack (inserted from the follower side) on the inlet connections of the heat exchanger. The inline filter offers a last line of defence in case of failure in the main filter system or if foreign objects are introduced into the pipe system during maintenance. The filters are supplied in custom length, to suit the total length of the plate pack, and supplied in AISI316L or Titanium.

Instrumentation (for marine applications)

We offer inline instrumentation flanges fully fitted with:

- Thermometer
- A 1/ valve used as drainage valve or air bleed valve, depending on orientation
- Pressure gauge

Sectioning

In some applications it can be useful to add intermediate frames with special flow diverting corner pieces/blocks. Using these, it is possible to combine several plate heat exchangers into one, e.g., pasteurizers in the dairy industry. Intermediate frames are only available for IS and FS frames.

Connections

Depending on the heat exchanger application, various connection types are available e.g.,

- Standard flange, threaded holes on head
- Stud bolts on head
- Flange welded on pipe
- Threaded connection
- Dairy type connections: SMS, RJT, DS, DIN
- Elbow flange

Standard flange

The standard flange connection is the most used option for DN50 and bigger. The head has threaded holes suitable for DIN or ANSI flanges, depending on the requirements.

The port holes can be uncladded (porthole only covered by paint), cladded (AISI304/316/Titanium or Hastelloy), assembled with a gasket, or be equipped with a rubber liner which also acts as a gasket.

Stud bolts on head

The head can also be supplied with stud bolts fitted or shipped as loose parts.

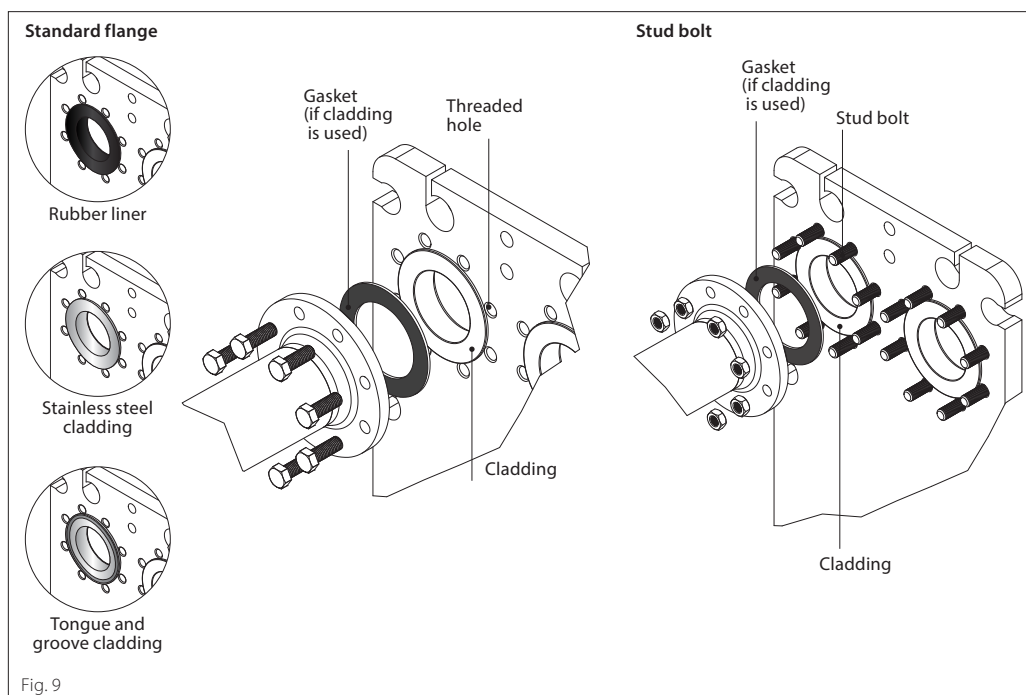


Fig. 9

Threaded connection

Threaded connections are available up to DN50/2"

Welded-on pipe

Flanges are welded onto pipe and head respectively (flange elbows are also possible).

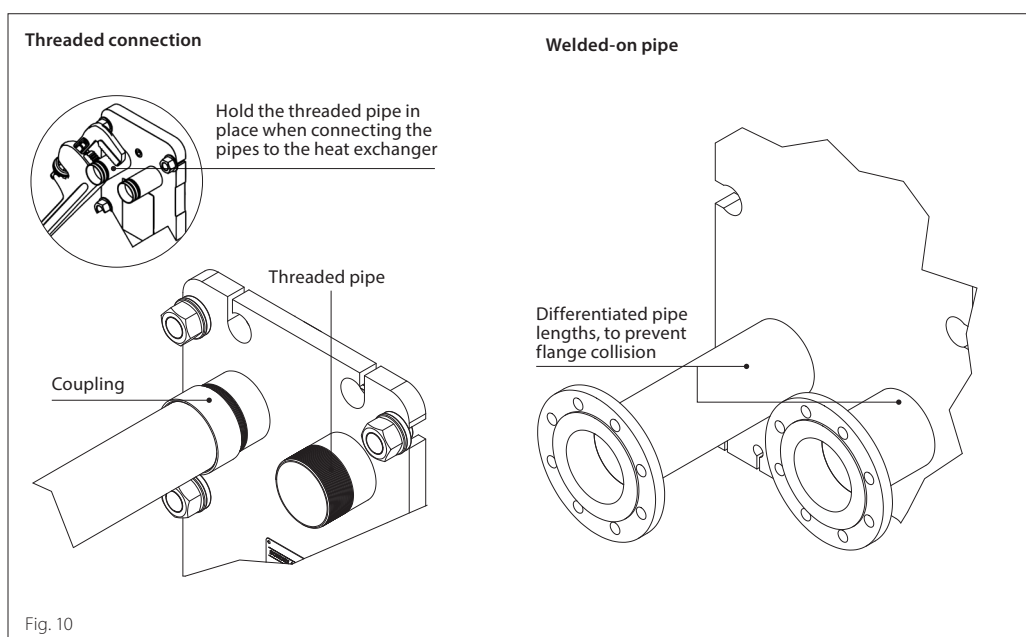
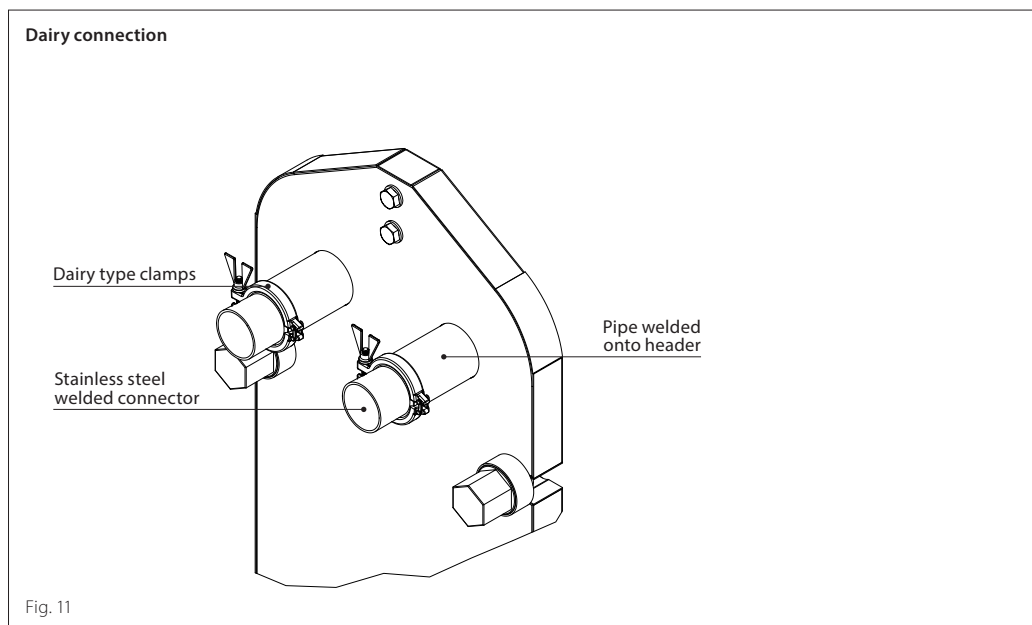


Fig. 10

Dairy connection

For dairy applications and other food applications with strict hygiene demands, a selection of different types of dairy type clamps/ stainless steel welded connectors are available.

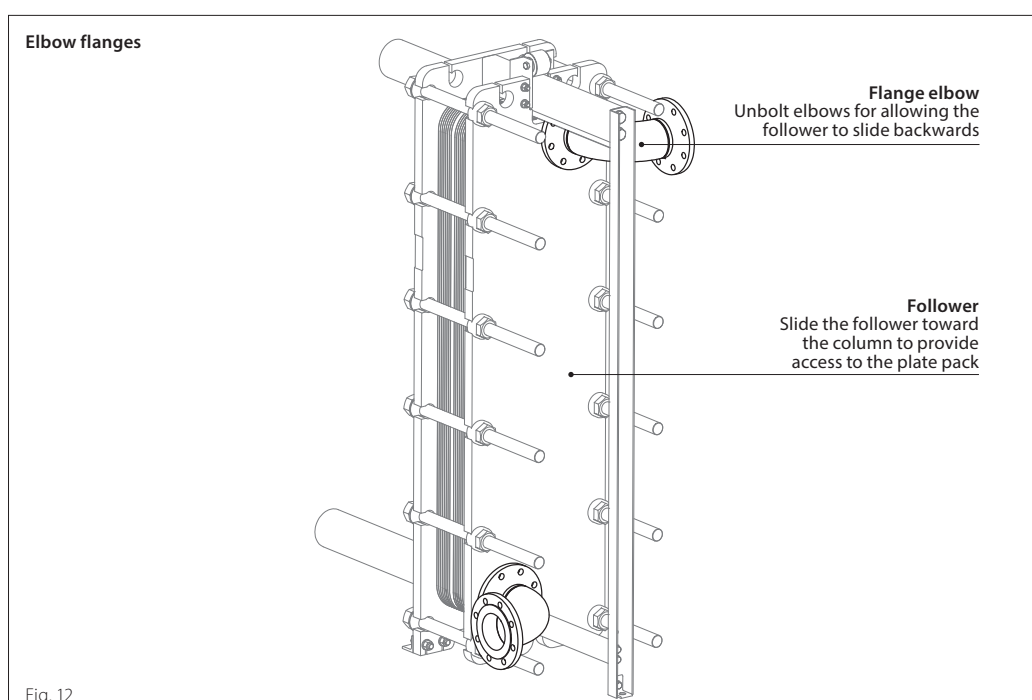


Elbow flange

If the heat exchanger has multiple passes (please refer to the multi-pass solution section), it will have 1-4 flange connections on both head and follower. This makes servicing a little more complicated, as the heat exchanger is locked between two sets of pipes.

To counter this, we suggest the use of flange type elbows, as the needed pipe dismantling can be reduced to a minimum in this manner.

Elbow connections should be designed in a way, that their removal will allow follower frame plate to slide across carrying bar (when plate pack is loosened for service needs) without obstacles.



Function

Single-pass solution

Single-pass heat exchangers (gasketed and Semi-welded units) allow the two fluids to pass each other only once, a single-pass heat exchanger has all connections on the head.

With all connections on the head, maintenance and cleaning of single-pass solutions is much easier, as opening the plate heat exchangers do not interfere with the pipe installation.

Single-pass solutions are available with co-current or counter-current flow depending on the specified duty.

Single-pass solution (single plate, counter-current)
with all connections (incl. flanges and pipes) on the head

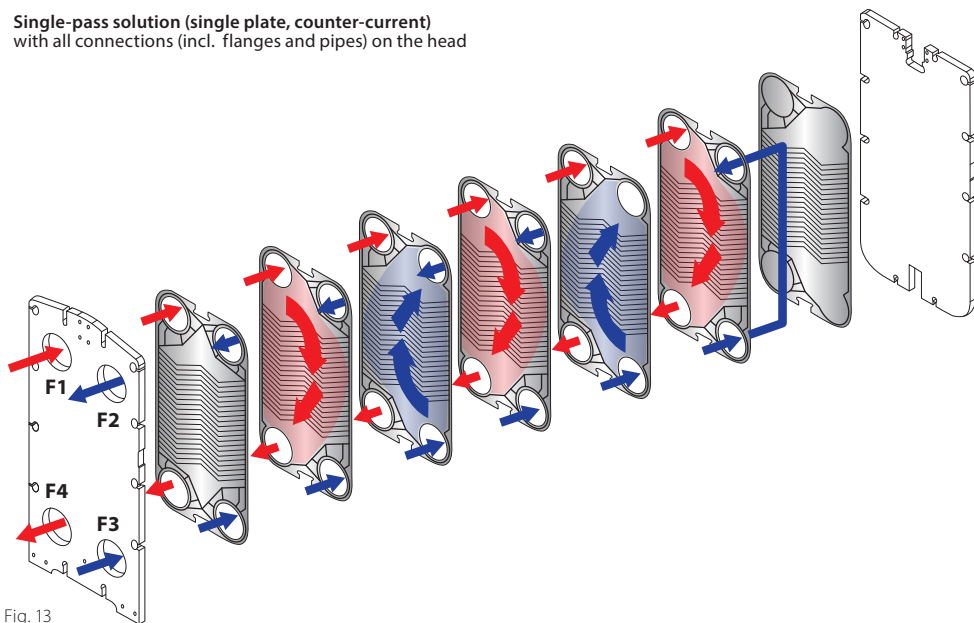


Fig. 13

Single-pass solution
Semi-welded plate acting as condenser, counter current, fig. 14a
Semi-welded plate acting as evaporator, co current, fig. 14b
with all connections (incl. flanges and pipes) on the head

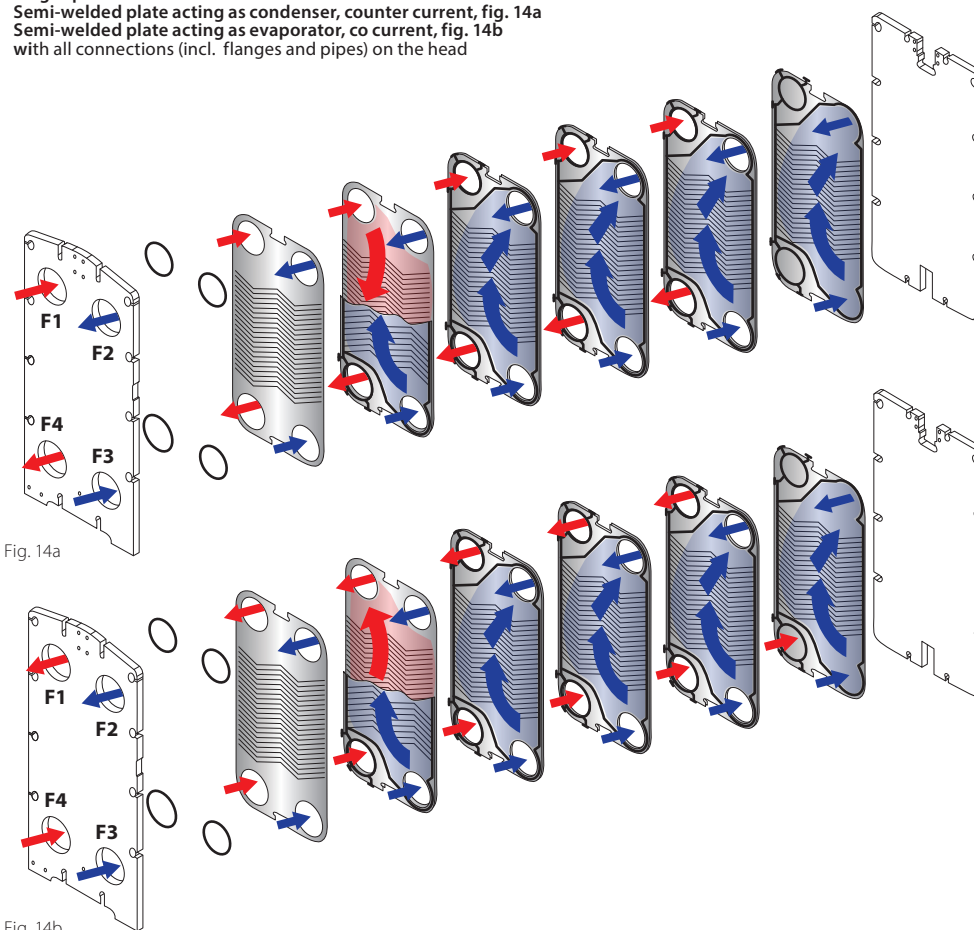


Fig. 14a

Fig. 14b

Multi-pass solution

Multi-pass heat exchangers allow the fluid to pass through the heat exchanger several times before exiting. The main purpose is to change the flow direction of one or both fluids and this is done by using combi-plates (e.g., plates with 1,

2 or 3 un-holed ports). A multi-pass solution has connections on the head and the follower.

Multi-pass solution
with connections (incl. flanges and pipes) on the head and the follower

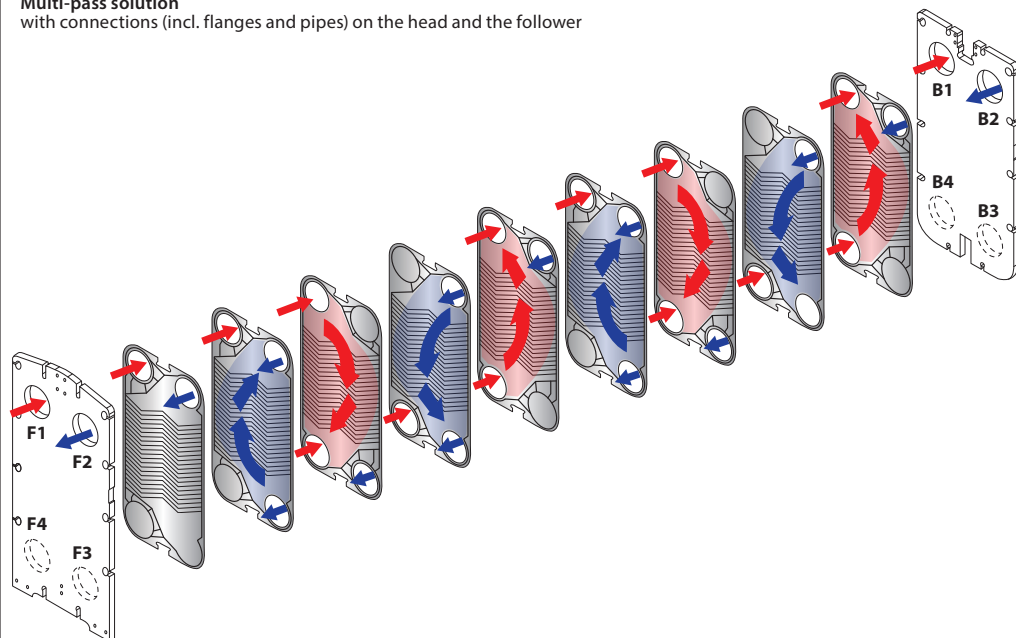


Fig. 15

Multi-section solution

Multi-section plate heat exchangers can be used for heating and cooling of two or more medias.

A multi-section solution can be considered as multiple (two or more) heat exchangers in one frame. The multi-section heat exchanger

is delivered with intermediate frames with corner blocks dividing the plate heat exchanger into various sections where e.g., pre-heating, pasteurization and cooling can take place all at once

Intermediate frames are only available for IS and FS frames.

Multi-section solution
with intermediate frames

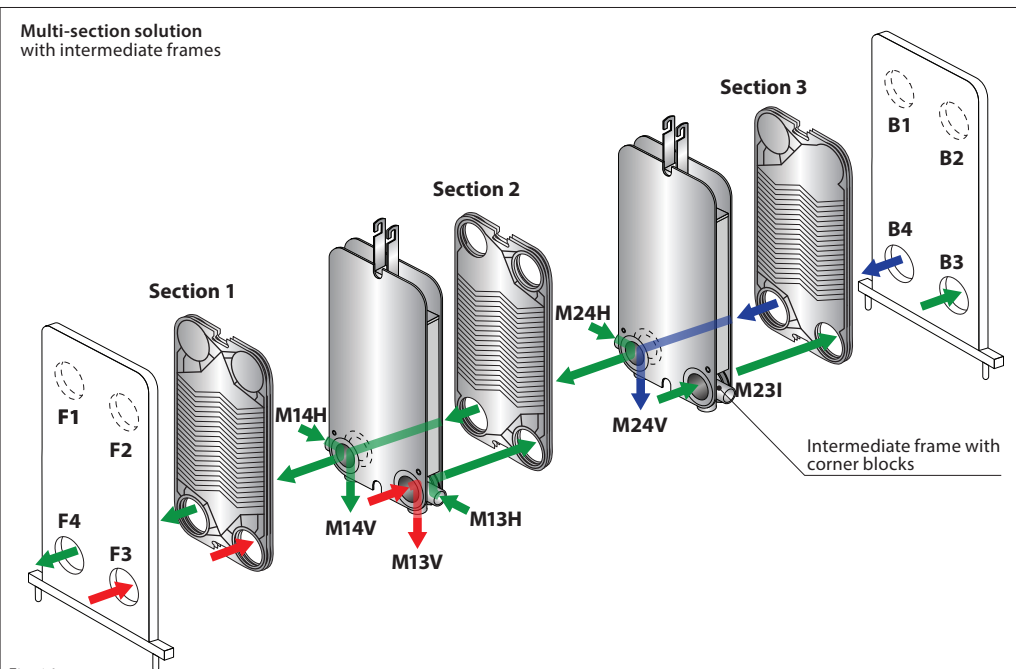


Fig. 16

Installation

Before installation

Prior to installation, check if the assembly measure (A measure) is in accordance with the name plate as the tie rods may have loosened during transportation. If the assembly measure does not comply to the nameplate the heat exchanger must be tightened, follow the "Closing the heat exchanger" section.

Foundation

Install the plate heat exchanger on a flat foundation providing enough support for the frame and sufficient space for service and maintenance.

Space requirement

Ensure enough space around and above the plate heat exchanger for maintenance purposes (e.g., replacement of plates and/or gaskets, tightening of the plate pack etc.) as well as the lifting equipment to be used.

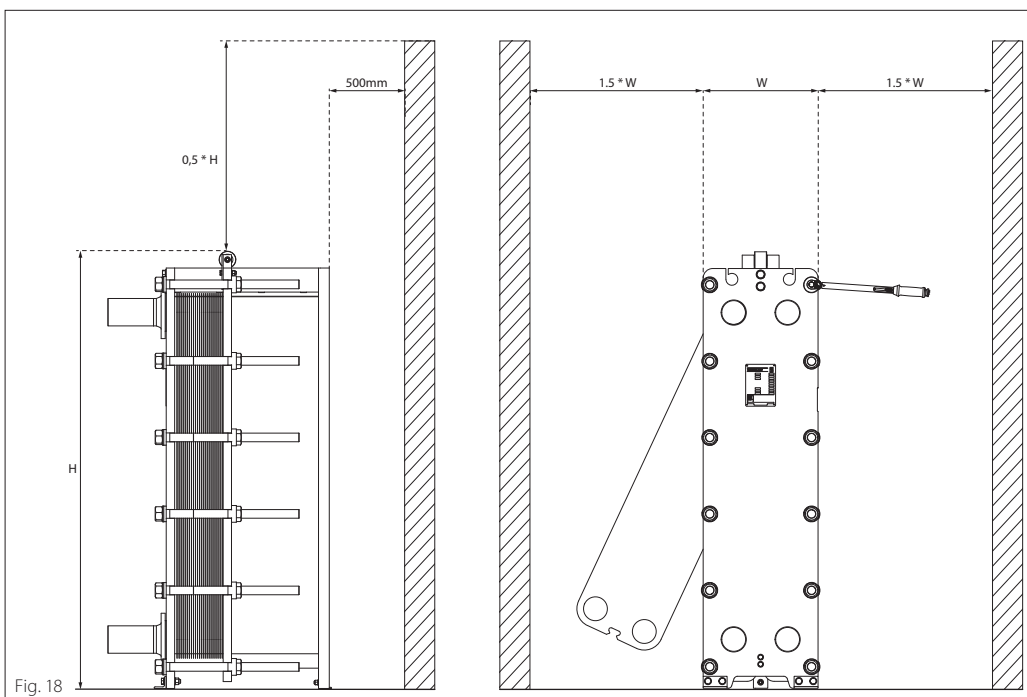
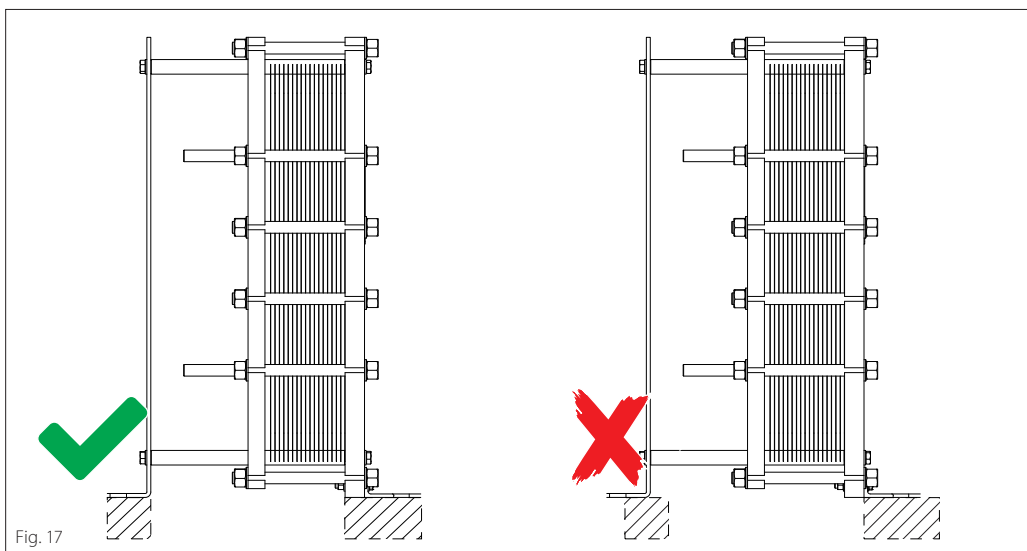
As a rule of thumb, free space around the unit should be $1.5 \times \text{Width}$ (where "W" equals the width of the header) on each side of the unit. Free height above the unit should be $0.5 \times \text{Height}$ (where "H" equals the height incl. the roller of the unit), see fig. 18.



All mount brackets as well as bottom of the header should be fully supported by foundation or support frame. Foundations and support frame should be able to carry load of heat exchanger when it is full of working medias (see fig. 17).



Place the insulated drip/condensation tray before putting the plate heat exchangers in installation place.



Short-term storage rules (less than 1 month)

Make sure heat exchanger is emptied/dried and has no (or achievable minimum) leftovers of working media inside.

Always avoid, storing the heat exchanger in areas with high ozone content (example around brushed electric motors or welding equipment), salt air and other corrosive atmospheres.

All connections must be closed to prevent water or mechanical particles/debris to enter the heat exchanger. Factory provided cover plugs can be used for that purpose.

To prevent damage to the gaskets, do not store organic solvents or acids near by the heat exchanger and avoid direct sunlight, intensive heat radiation or ultraviolet radiation. Preferably the plate heat exchanger should be stored inside in dry conditions at room temperatures round 15 – 20 °C (59 – 68 °F) and a humidity of max. 70%. Minimum and maximum storage temperatures should be inside of design range of heat exchanger (see the product label).

All connections should be covered to prevent any dirt or water to enter the plate heat exchanger.

The tie rods should be well coated with a suitable grease or similar lubricant.

Loosen the tie rods to supply air flow to the heat exchanger, so that any moisture does not damage the equipment and to extend the lifetime of the gaskets, as the rubber material may lose its elastic property when it is subjected to pressure for more than 6 months.

Long-term storage rules (more than 1 month)

Apply rules of short-term storage, plus:

To extend gasket service lifetime, it is recommended to relax the gaskets by loosening the tie rods by approximately 10% of the compressed plate pack dimensions.

Grease all tightening rods with thin layer of grease.

Place the plate heat exchanger in a protective box provided with a lining on the inside that will prevent against moisture penetration. The protective box should protect heat exchanger from atmospheric effects (rain, snow, strong wind) and mechanical damages.

Examine packing condition at least once a month.



For certain applications it's good practice to fill the HEX with e.g., nitrogen gas during transportation (max. 1 bar)

Before raising / lifting - warnings

The plate heat exchanger may fall or be damaged if the raising and lifting instructions are not followed or if improperly lifting equipment or procedures are used.



Always have authorized personnel to lift and move the plate heat exchangers and always observe the correct procedures when lifting and/or moving the equipment.



CAUTION:
Only use lifting equipment that is approved for the weight of the heat exchanger and is in full compliance with the specification and limitation of the equipment. The weight of the heat exchanger can be found on the datasheet.



Never lift the heat exchanger using any other method than described and never use the connections, studs, tie rods, the column, or intermediate frames (if fitted) for lifting.



CAUTION:
Never use steel cables/ropes, chains, hooks, or damaged lifting slings when lifting the plate heat exchanger.

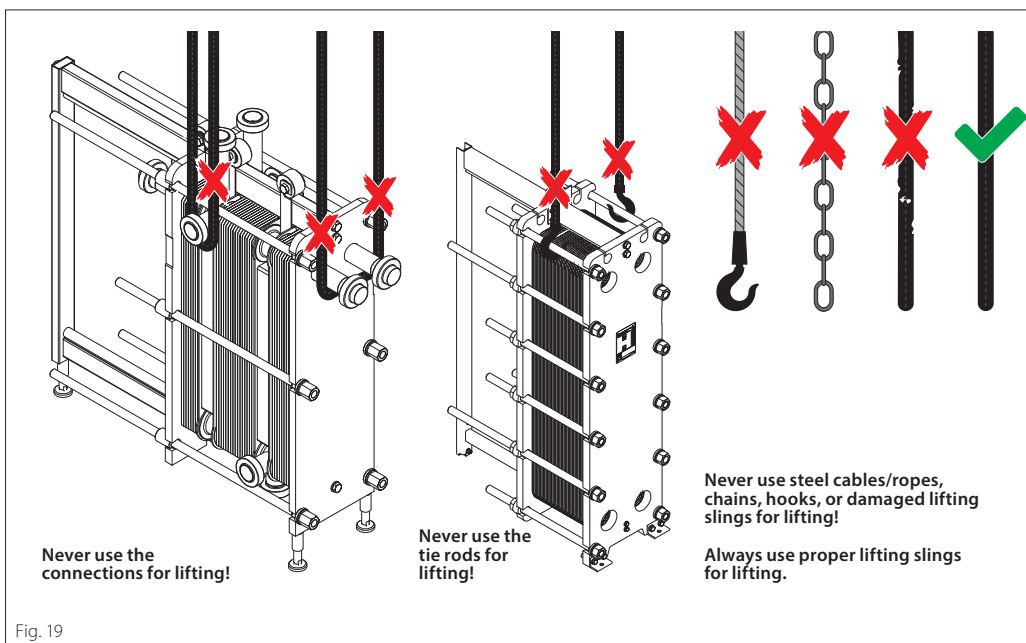


Fig. 19

Raising the unit from a lying position

The following description applies to all SONDEX® and Danfoss frame types (ST, IG, DG, FG, IS, DS) with a length up to 2500 mm. These units are usually delivered lying with the head/fixed cover facing down on a pallet. Depending on the type of connection mounted on the heat exchanger, the unit may be delivered in an upright position instead.

How to raise the unit:

- Remove all tightening elements from the plate heat exchanger and the pallet
- Place lifting slings under the head and slowly lift the heat exchanger horizontally off the pallet (1)
- Remove the pallet and place two timber beams on the floor and slowly lower the plate heat exchanger on to the timber beams (2)
- IG, DG, FG, IS, DS frames: place lifting slings around the upper tie rods, on each side of the column (3a)

- ST frames: place a lifting sling (a loop) around the carrying bar (3b)
- Slowly raise the unit from its lying position on the timber beams. Use the foot units as support when raising the plate heat exchanger. Pay attention to the unit's centre of gravity and not to damage the foot units (4)
- Remove the lifting slings and the timber beams.

Once the unit is in an upright position follow the procedure "Lifting the unit from an upright position".



The plate heat exchanger is delivered on a pallet and can be packed in a wooden box or wrapped in stretch film. The centre of gravity as well as measurements and weight are marked on the box or on the stretch film.

Raising IG, DG, FG, IS and DS frames from a lying position

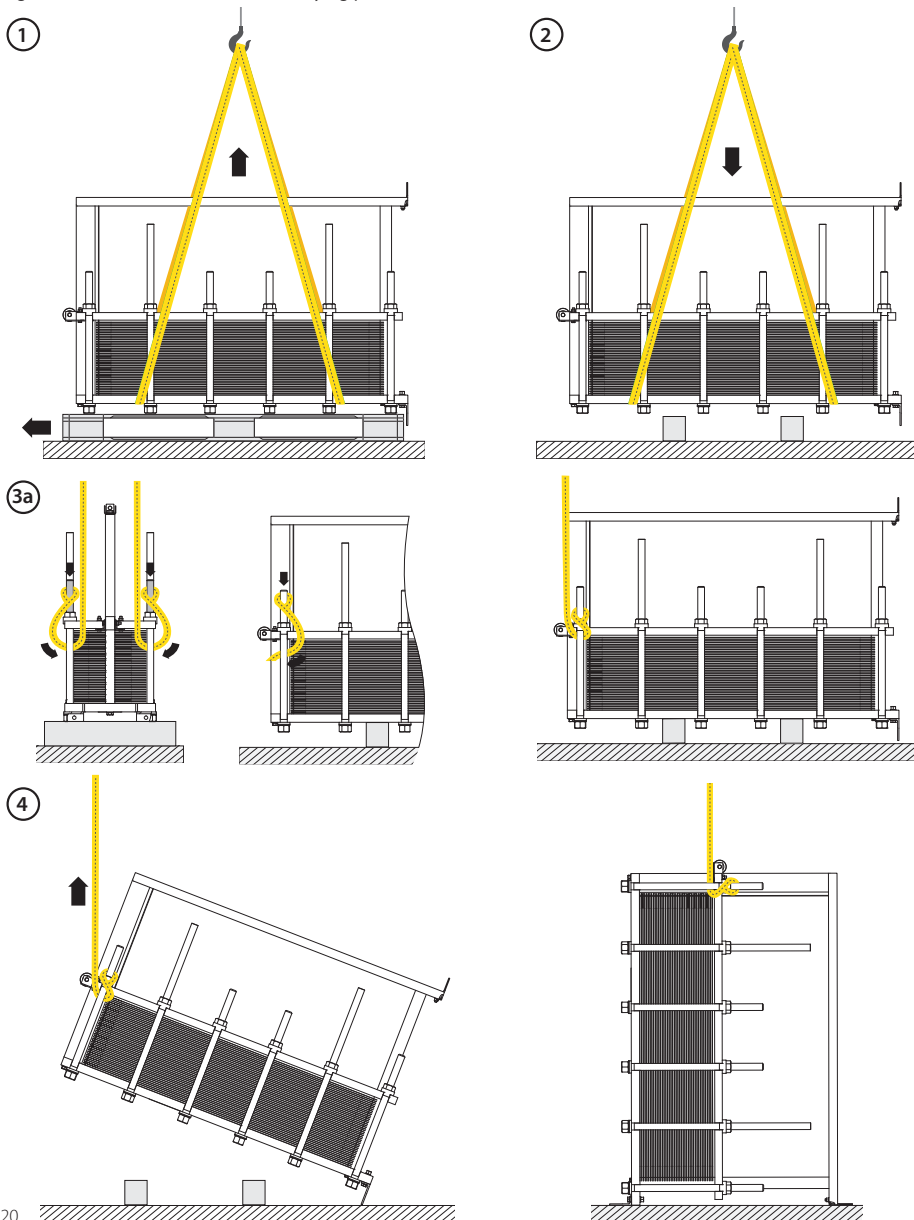
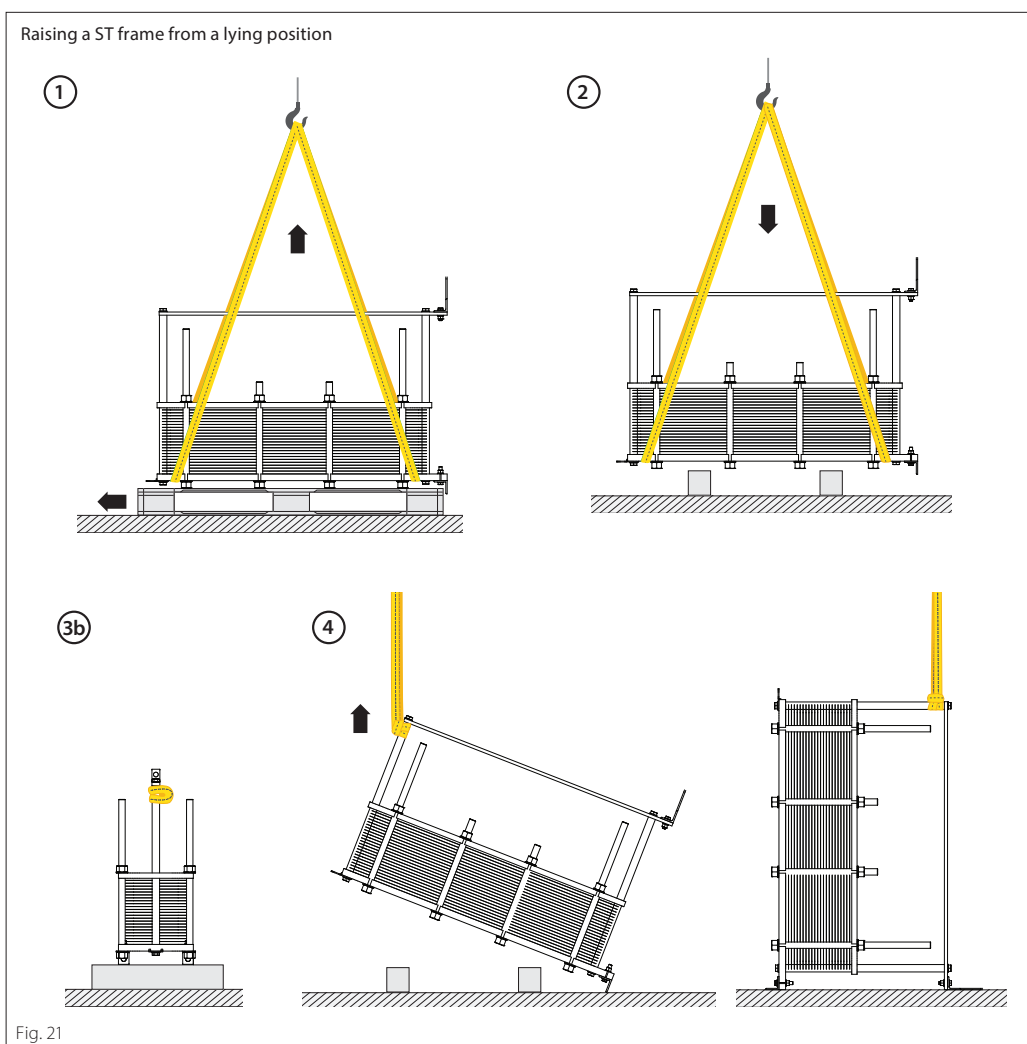


Fig. 20



CAUTION:
Always be careful when raising the unit to avoid sliding and damages to the equipment.



The frame type can be found on the data sheet or on the nameplate.

Lifting the unit from an upright position

The following description applies to all SONDEX® and Danfoss frame types with a length longer than 2500 mm. These units are usually delivered standing upright.

How to lift the unit:

Remove all tightening elements from the plate heat exchanger and the pallet

- Secure lifting shackles in the dedicated lifting lug on both the header and the follower (4 fixation points)
- Secure a lifting sling (4 fixation points) in each of the lifting shackles and carefully lift and move the unit to its final position
- Slowly lower the unit and mount the heat exchanger securely to the floor, using the foot units
- Remove the lifting slings and the shackles.



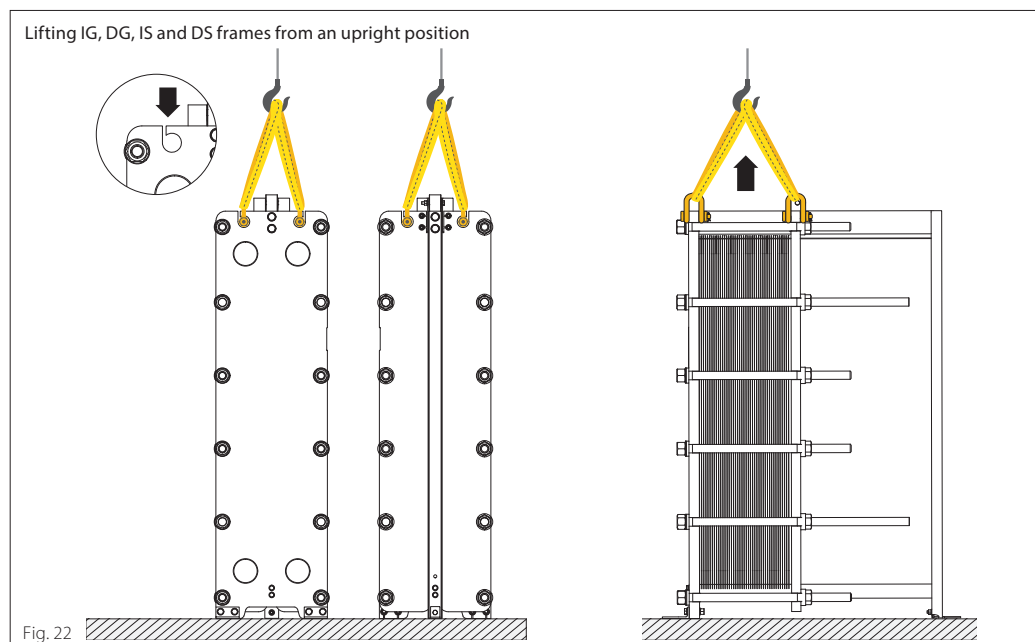
CAUTION:

Always be careful when lifting the unit to avoid damages to the plate heat exchanger.



CAUTION:

Ensure the Centre of Gravity is well checked to prevent unexpected tilting.



Transportation

Usually, the heat exchanger will be supplied horizontally on a pallet, this applies to all SONDEX® and Danfoss frame types (ST, IG, DG, IS, DS) with a length up to 2500 mm

The back side of the head will then be secured to the pallet. This allows the unit to be transported by means of a forklift truck.



WARNING:
Make sure to fully support the pallet with the forklift forks during transportation.

Avoid tilting the pallet.



WARNING:
The centre of gravity is not package centre-lined on the pallet.

Ignoring this warning might result in tilting forklift truck and material damage.

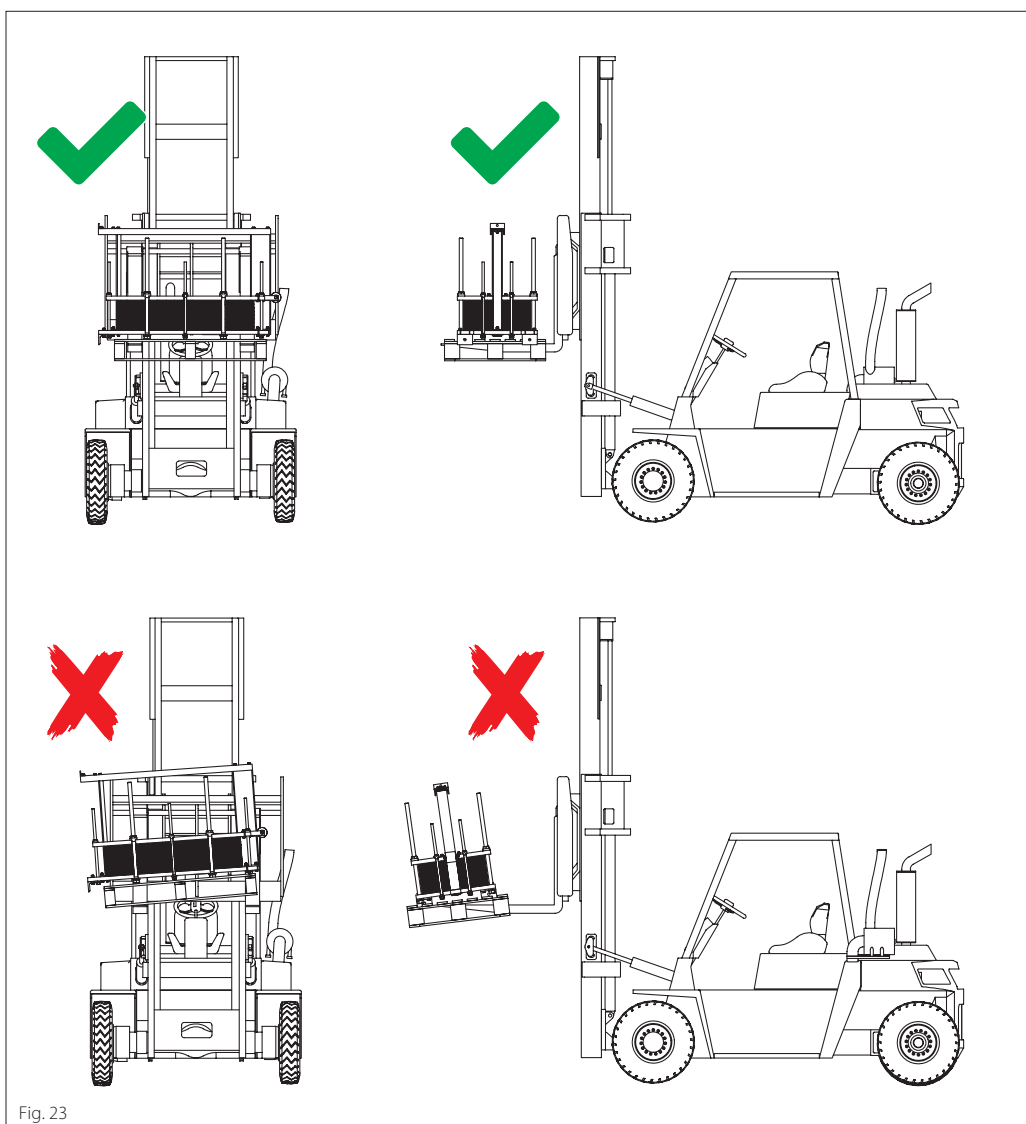


Fig. 23

Installing the pipe connections

Most plate heat exchangers are intended for counter-current flow directions, but some specific applications require co-current flow. Refer to the nameplate for information about flow direction (inlet > outlet).

Danfoss plate type heat exchangers are provided with various connection types depending on size, application, and design criteria, please refer to the data sheet/drawing for your specific connection type.

Single plate heat exchangers are fitted with threaded pipe connections or studded flanges ready for counter/blind flanges.

Semi-welded heat exchangers for industrial refrigeration are fitted with factory installed welding flanges. The refrigerant side is hermetically closed by blind plates and might be pressurized with nitrogen.

Before connecting any piping to the plate heat exchanger make sure to clean and flush the piping system thoroughly for any foreign objects.

When connecting the piping system to the plate heat exchanger make sure that the piping system does not subject the plate heat exchanger to stress or strain. Connections are designed to withstand suitable forces and moments induced by the piping. Please refer to the tables (fig. 25 and 26) indicating a suitable initial estimate of primary loadings for connections either in standard or severe service.

Make sure that the piping system, connected to the plate heat exchanger, is secured against pressure peaks/surges and temperature shocks!

When doing any welding for flange/valve/pipe make sure that earthing is made next to the welding. Never use the heat exchanger for earthing as heat plates gaskets etc. might be severely damaged.

Ensure during installation and setting-adjustments, that the (process) temperature will never exceed the temperature limits indicated on the name plate, to prevent gasket damage.

When fitting threaded pipe to the threaded plate heat exchanger connection make sure that the connection does not rotate during tightening as this might damage internal ring gaskets. A secure counter-hold is needed (fig. 10).

For studded (blind) flange connection, insert the gaskets before bolting the blind flanges to the head or follower.

Tighten the bolts evenly - do not over-tighten as this might damage the bolts/threads.

Note:

- Identify actual flow inlets/outlets on the name plate before commencing piping work.
- Heavy piping should be supported. This will prevent heavy forces on the plate heat exchanger. If information about the max. nozzle load is required, please reach out to your local Danfoss sales rep.
- To be able to open/close and dismantle the plate heat exchanger, shut off valves should be installed in all connections.
- Depending on your application, blind flanges or plastic caps must be removed prior to start working on the piping system.
- Nitrogen pressurized refrigerant side must be depressurized through the small valve in the blind plate before removing the flanges.
- Always install flexible connections on the follower to prevent vibrations on the plate heat exchanger. The flexible connections also help prevent expansion of the pipes, which could be caused by temperature influence.
- Flexible connections must be fitted perpendicular to the header/follower.
- Install vents on side 1 and side 2 of the upper connections of the plate heat exchanger, at a minimum of a half inch. For additional information refer to the "Shut down - for a short period of time" section.
- The vents should be fitted on the highest point in the direction of the media flow.
- The installation must be fitted with safety valves according to current pressure vessel regulations.

Standard-service nozzle loading										
Nom. size	PN6		PN10		PN16		PN25		PN40	
	F (N)	M (N*m)	F (N)	M (N*m)	F (N)	M (N*m)	F (N)	M (N*m)	F (N)	M (N*m)
DN25	154	0	162	0	173	1	190	1	219	2
DN40	271	72	284	73	304	74	335	75	385	78
DN50	354	147	372	148	398	150	437	153	503	157
DN80	623	444	653	448	700	455	769	465	884	481
DN100	814	687	854	695	914	707	1005	725	1155	755
DN150	1324	1416	1389	1440	1487	1476	1634	1530	1880	1620
DN200	1870	2288	1962	2340	2101	2419	2308	2536	2655	2732
DN250	2444	3285	2565	3380	2746	3523	3017	3738	3470	4096
DN300	3042	4395	3192	4551	3417	4785	3755	5136	4318	5722
DN350	3660	5612	3840	5849	4111	6204	4518	6736	5196	7624
DN400	4296	6932	4508	7272	4826	7781	5303	8545	6099	9817
DN450	4948	8353	5192	8820	5558	9519	6108	10569	7024	12318
DN500	5614	9873	5892	10493	6308	11423	6931	12818	7971	15143

Fig. 24

Standard-service nozzle loading										
Nom. size	PN6		PN10		PN16		PN25		PN40	
	F (lbf)	M (lbf*ft)	F (lbf)	M (lbf*ft)	F (lbf)	M (lbf*ft)	F (lbf)	M (lbf*ft)	F (lbf)	M (lbf*ft)
DN25	35	0	36	0	39	1	43	1	49	1
DN40	61	53	64	54	68	54	75	55	87	57
DN50	80	108	84	109	89	111	98	113	113	116
DN80	140	327	147	331	157	335	173	343	199	355
DN100	183	507	192	513	206	521	226	535	260	557
DN150	298	1044	312	1062	334	1089	367	1128	423	1195
DN200	420	1688	441	1726	472	1784	519	1871	597	2015
DN250	549	2423	577	2493	617	2599	678	2757	780	3021
DN300	684	3242	718	3357	768	3529	844	3788	971	4220
DN350	823	4139	863	4314	924	4576	1016	4969	1168	5623
DN400	966	5113	1013	5363	1085	5739	1192	6302	1371	7241
DN450	1112	6161	1167	6505	1250	7021	1373	7795	1579	9085
DN500	1262	7282	1325	7739	1418	8425	1558	9454	1792	11169

Fig. 25

Standard-service nozzle loading										
Inch	PSI 100		PSI 150		PSI 250		PSI 300		PSI 400	
	F (N)	M (N*m)	F (N)	M (N*m)	F (N)	M (N*m)	F (N)	M (N*m)	F (N)	M (N*m)
1	156	0	162	0	176	1	182	1	195	1
2	274	72	286	73	309	74	320	74	343	76
3	358	147	373	148	403	150	418	151	449	153
4	630	445	656	449	709	456	736	460	789	467
6	823	689	857	696	927	709	961	716	1031	730
8	1339	1421	1395	1442	1508	1483	1564	1504	1677	1545
10	1890	2300	1970	2345	2129	2435	2209	2480	2368	2570
12	2471	3306	2575	3388	2783	3553	2887	3635	3095	3800
14	3075	4430	3205	4564	3463	4834	3593	4968	3852	5237
16	3700	5665	3856	5869	4167	6277	4323	6481	4634	6889
18	4343	7008	4526	7301	4891	7886	5074	8178	5440	8763
20	5002	8458	5213	8860	5634	9664	5845	10066	6266	10870
22	5676	10012	5915	10546	6393	11615	6632	12149	7110	13218

Fig. 26

Standard-service nozzle loading										
Inch	PSI 100		PSI 150		PSI 250		PSI 300		PSI 400	
	F (lbf)	M (lb*ft)	F (lbf)	M (lb*ft)	F (lbf)	M (lb*ft)	F (lbf)	M (lb*ft)	F (lbf)	M (lb*ft)
1	35	0	37	0	39	1	41	1	44	1
2	62	53	64	54	69	54	72	55	77	56
3	81	108	84	109	91	111	94	112	101	113
4	142	328	147	331	159	336	165	339	177	345
6	185	508	193	513	208	523	216	528	232	539
8	301	1048	314	1063	339	1094	352	1109	377	1140
10	425	1696	443	1730	479	1796	497	1829	532	1896
12	555	2439	579	2499	626	2620	649	2681	696	2802
14	691	3267	720	3367	779	3565	808	3664	866	3863
16	832	4178	867	4329	937	4630	972	4780	1042	5081
18	976	5169	1017	5385	1100	5816	1141	6032	1223	6464
20	1125	6238	1172	6535	1267	7128	1314	7424	1409	8017
22	1276	7384	1330	7778	1437	8567	1491	8961	1598	9749

Fig. 27

Tightening sequence

To obtain a leak-free flange connection the bolt tension must be tightened correctly according to the described tightening sequence..

Second pass

Tighten the bolts to a maximum of 60% of the final torque value.

First pass

Lightly tighten the bolts, to 30% of the final torque value.

Third pass

Tighten the bolts to the final torque value.

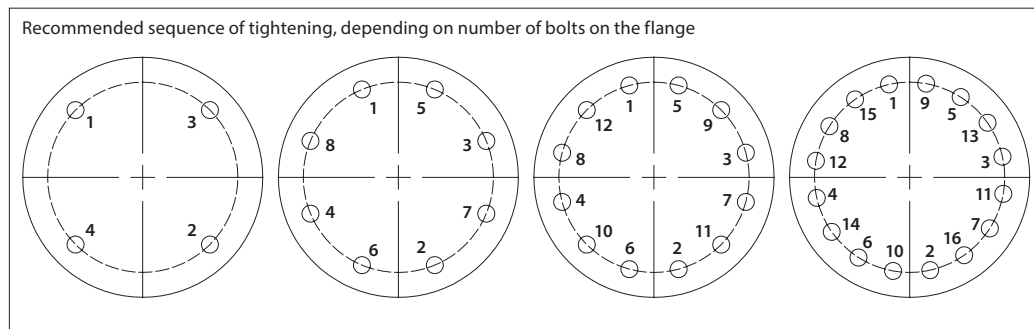


Fig. 28

Flanges with gasket grooves (Narrow ring gaskets) Carbon Steel Bolts Class 8.8									
Nom. size	PN16			PN25			PN40		
	Qty.	Size	Torque [Nm]	Qty.	Size	Torque [Nm]	Qty.	Size	Torque [Nm]
DN65	8	M16	65	8	M16	60	8	M16	55
DN65	4	M16	135	-	-	-	-	-	-
DN80	8	M16	75	8	M16	70	8	M16	60
DN80	4	M16	140	-	-	-	-	-	-
DN100	8	M16	130	8	M20	150	8	M20	130
DN150	8	M20	230	8	M24	250	8	M24	230
DN200	12	M20	200	12	M24	220	12	M27	230
DN250	12	M24	295	12	M27	310	12	M30	320
DN300	12	M24	345	16	M27	275	16	M30	290
DN350	16	M24	385	16	M30	455	16	M33	465
DN400	16	M27	490	16	M33	565	16	M36	590
DN500	20	M30	545	20	M33	570	20	M39	655
DN600	20	M33	715	20	M36	760	20	M45	920

Fig. 29

Flanges Flat Face (Wide gaskets) Carbon Steel Bolts Class 8.8									
Nom. size	PN16			PN25			PN40		
	Qty.	Size	Torque [Nm]	Qty.	Size	Torque [Nm]	Qty.	Size	Torque [Nm]
DN50	4	M16	165	4	M16	170	4	M16	175
DN65	8	M16	145	8	M16	150	8	M16	155
DN65	4	M16	109	-	-	-	-	-	-
DN80	8	M16	155	8	M16	160	8	M16	165
DN80	4	M16	205	-	-	-	-	-	-
DN100	8	M16	160	8	M20	285	8	M20	295
DN150	8	M20	300	8	M24	495	8	M24	510
DN200	12	M20	300	12	M24	500	12	M27	730
DN250	12	M24	490	12	M27	740	12	M30	1030
DN300	12	M24	545	16	M27	745	16	M30	1055
DN350	16	M24	595	16	M30	1075	16	M33	1485
DN400	16	M27	830	16	M33	1440	16	M36	2015
DN500	20	M30	1130	20	M33	1490	20	M39	2310
DN600	20	M33	1590	20	M36	1960	20	M45	3635

Fig. 30

Flanges Flat Face (Wide gaskets) Carbon Steel Bolts SA 193						
ANSI B16.5	150 psig			300 psig		
	Qty.	Size	Torque [Nm]	Qty.	Size	Torque [Nm]
2"	4	5/8	170	8	5/8	131
2.5"	4	5/8	188	8	3/4	155
4"	8	5/8	285	8	3/4	295
6"	8	3/4	495	12	3/4	383
8"	8	3/4	625	12	7/8	730
12"	12	7/8	931	16	9/8	1055

Fig. 31



For threaded connections, use a pipe wrench to hold the nozzles in place when connecting the pipes, as the pipes may rotate and potentially damage the internal gasket.



Always remember to lubricate the threads with suitable grease or similar lubricant, before tightening the torques.

Operation

Commissioning

Commissioning, control during operation, maintenance and repair of the installation should be done by authorized, trained, and properly instructed staff.

Before commissioning check if all connections are fitted and tightened correctly and that the A-measure is correct according to the nameplate Measure AF1, AF2, AF3, AF4 dimension according to fig. 35.

Check the pressures and the temperatures of the

media and make sure they are within the limits of the values specified on the name plate.



The plate heat exchanger must not be subject to thermal or mechanical shock as this could lead to premature gasket failure.



Commissioning of heat exchangers containing refrigerants must always comply to local regulations and legislation.

Start-up process - Single plate heat exchanger

For plate heat exchangers with liquid on both sides (liquid/liquid flow), the flow with an operating temperature closest to the ambient temperature is to start first.

Assumed is, that no back pressure is present and check valves in piping will prevent backflushing effect when the plate heat exchanger return valves are opened. Also assumed is that bleed valves can safely be opened (no extreme pressure, vapours, gasses, or temperatures), that could harm environment or operators.

Local precautions to be taken to make such a safe operation.

Side 1 (cold) / Flow 1

Delta T to ambient temperature lowest.

- Ensure that valve 10 is closed
- Open return valve on cold side (1)
- Open air bleed valve on cold side (2)
- Start pump on cold side (3)
- Gradually open supply valve on cold side (4) and close air bleed valve (2) when no further air is present in the system

Side 2 (warm) / Flow 2

Delta T to ambient temperature highest.

- Ensure that valve 9 is closed
- Open return valve on warm side (5)
- Open air bleed valve on warm side (6)
- Start pump on warm side (7)
- Gradually open supply valve on warm side (8) and close air bleed valve (6) when no further air is in the system

Inspect for leakages

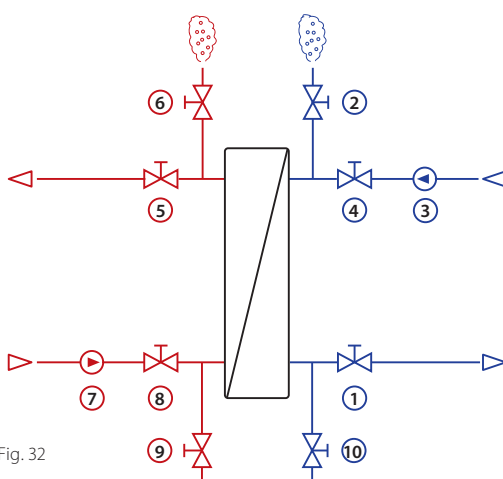


Fig. 32



Water hammering occurs when a fluid media is abruptly stopped or forced to abruptly change direction, and the same would happen if live steam injection is used. This creates a pressure spike moving upstream in the system with a velocity of 1500 meters per second (i.e., faster than a bullet). Water hammer may cause considerable damage to the equipment and cause refrigerant leakage to the surroundings.



WARNING:
If a wedge is inserted between the follower and the carrying bar, remove it before commissioning. The wedge is inserted to ensure that no displacements occur when the exchanger is lifted or during transportation.

Guidelines for Hot water exchangers

For lifetime of gaskets for exchangers running with temperature 150°C to 180 °C we have following recommendations:

- The heat exchanger is used in continuous operation
- No large fluctuations in temperature and pressure as rubber seals are very sensitive to large fluctuations
- At start up, heating 5 °C/min
- If the plate heat exchanger runs at the maximum operating temperature of the gaskets, the lifetime will be around 1 year
- The lifetime of the gaskets will be longer at a lower temperature, in general it is said that for every 10°C the temperature is raised or lowered, the lifetime doubles in a negative or positive direction.
- The service interval for hot water heat exchanger:
Operating temperature 160 – 180 °C = Every one year
Operating temperature 120 – 150 °C = Every two year
- Recommending a second loop with a heat exchanger for stand-still operations working at a circuit temperature around 80 – 90 degrees.

Shut down - for a short period of time (<12 hours)

If the plate heat exchanger must be shut down for a short period up to 12 hours, then the following procedure should be followed:

Side 2 (warm) /Flow 2

- Close supply valve on side 2 (warm) (1)
- Stop pump on side 2 (warm) (2)
- Close return valve on side 2 (warm) (3)

Side 1 (cold) /Flow 1

Maintain flow on side 1 (cold) until the heat exchanger temperature is <40°C or close to the ambient working temperature, then

- Close supply valve side 1 (cold) (4)
- Stop pump on side 1 (cold) (5)
- Close return valve on side 1 (cold) (6)

Close any other connected valves, and check that device is fully depressurized and drained, and ready for e.g., disassembly.

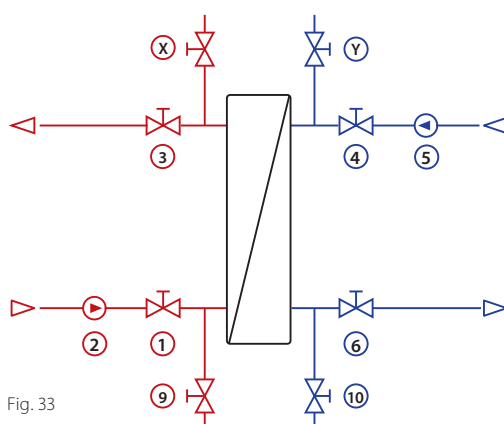


Fig. 33

Shut down - for a long duration (> 12 hours)

Ensure after the heat exchanger has been closed in, that drain valves 9 and 10 are opened and that bleed valves X and Y are opened to facilitate drainage, see fig. 34.

For long duration (>1 month); prior to close in the heat exchanger it must be flushed with clean liquid (application depending) and the heat exchanger, should be stored in no freezing conditions.

If the unit is to be shut down for an extended period (more than a few hours) then the following procedure should be followed:

- Follow the *shut down - for a short period of time* procedure
- Drain the plate heat exchanger completely
- Rinse/flush the plate heat exchanger and let it dry
- All connections should be covered to prevent any dirt or water/moisture to enter the plate heat exchanger.
- Lubricate threads on the tie rods

If you are shutting down the plate heat exchanger for more than one month:

- Loosen tie rods according to the instruction in "opening the plate heat exchanger" section until the length of the plate pack reaches: A-measure nominal +10%
- Cover the plate pack with black plastic to exclude any sunlight
- See the "Storage" section for additional information about storage of the plate heat exchanger for a longer period.



It is recommended to attach a warning notice to the plate heat exchanger to remind personnel that the tie rods need adjustment before the unit can be put back into service

Opening the plate heat exchanger



CAUTION:
Ensure unit is depressurized and drained and flushed of hot and/or aggressive fluid before unit is opened to prevent personal injury.

Before disassembly clean the threads and give them a light coat of suitable grease or similar lubricant.

Use appropriate tools for the disassembly.

When opening and disassembling the plate heat exchangers observe the following:

- Mark the plate package before opening. This can be done by a diagonal line or by numbering each individual plate in sequence
- Measure and note the actual assembly measure (Reference name plate for validation).
- Shut down the heat exchanger as described in section "Shut down"
- Make sure the heat exchanger cools down to the ambient temperature $1 < T < 40^{\circ}\text{C}$ (104°F)
- The heat exchanger should be totally drained on both sides before opening.

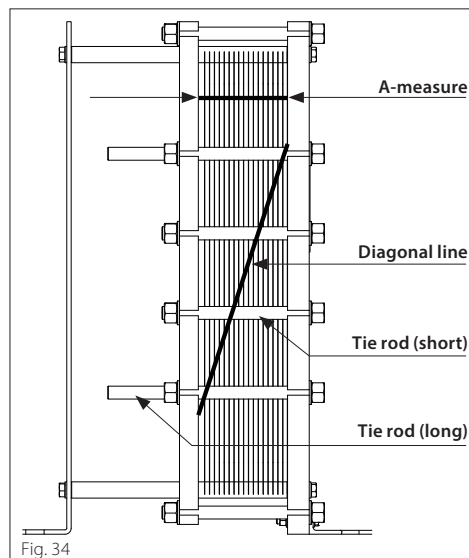


Fig. 34

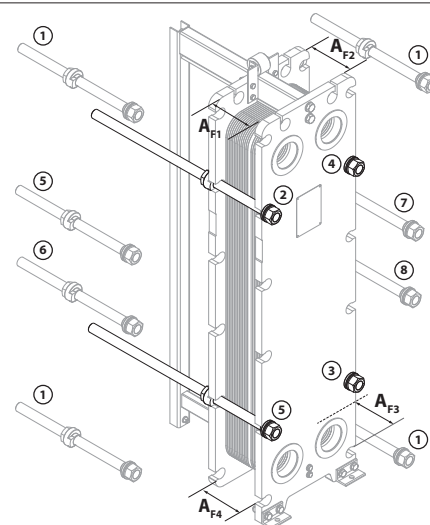


Fig. 35

1. Measure (or read from the label) the A-measure.
2. Loosen the tie rods should be done slowly (with small nut travel distance along the tie rod) when you are close to nominal A-measure. The further away from the nominal A-measure you go, bigger nut travel distances can be used.
3. Lose the tie rods in max nut travel distance of 3 mm until you reach the A-measure = A nominal (measured/from label) + 5%. At this point you can totally loosen and take away pairs of tie rods from top and bottom (indicated as 1 in fig. 35).
4. Lose all remaining tie rods with max. travel distance of a nut 6 mm until you reach the A-measure = A nominal + 10%. At this point you can loosen (with max travel 50 mm at once) all remaining short tie rods, if the heat exchanger height is less than 1500 mm. If the height is bigger, keep the short tie rods in place until A-measure = A nominal + 15%.
5. Start losing the long tie rods in sequence 2, 3, 4, 5 with maximum nut travel distance of 25 mm until all bars and nuts are loose.
6. When the follower is no longer under compression from the plate pack, it can be slid backwards, and the individual plates/cassettes can be inspected and/or removed. For followers with a roller (IS or DS-frames) we recommend making sure they can't accidentally move along the carrying bar during service. You can strap them to the column.



While opening the plate heat exchanger extra caution must be paid to prevent the plates sliding off the carrying bar



CAUTION:
In case of incorrect disassembly, asymmetric load on tie rods might happen. Example: tie rod 1 are removed and tie rods 2, 4, 3 are totally loose, then most of the tightening load will be on tie rod 5. There is a risk that the thread will not be able to withstand such load and the nut might "shoot" forward as the thread will be cut off. DO NOT stand directly in front of the tie rods, due to possible nut trajectory and risk of personal injury, when assembling or disassembling the unit.



CAUTION:
Do not loosen one or all tie bolts fully at once. Loosen the tie bolts slowly, little by little in the sequence shown in fig. 35. If a hydraulic tool is used to loosen the tie bolts, the tool must be set on lowest speed.



CAUTION:
The plates/cassettes have sharp edges! Always use personal protective equipment when handling plates/cassettes to prevent injuries on hand/arms.

Plate/cassette replacement



If a plate/cassette must be renewed because of serious damage, it is recommended to replace the plates/cassettes as well as the plates/cassettes next to this plate/cassette.

- Plates/Cassettes must be replaced if damaged or not cleanable
- When ordering new plates/cassettes all data from the nameplate is required
- New plates/cassettes can be supplied with complete gaskets ready for immediate installation.



CAUTION:
The plates/cassettes have sharp edges! Always use personal protective equipment (gloves as a minimum requirement) when handling plates/cassettes to prevent injuries on hand/arms.

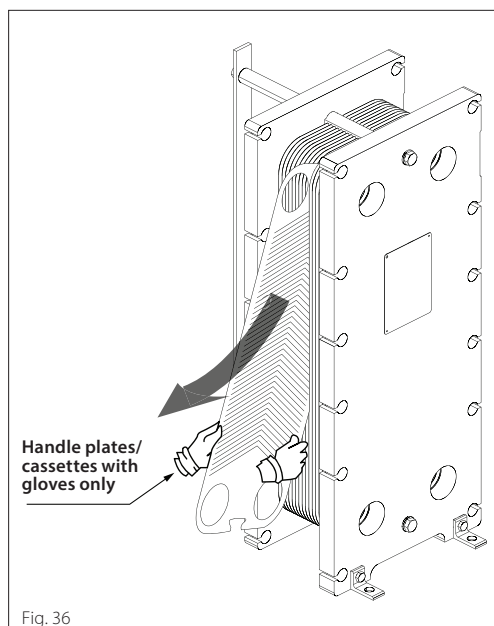


Fig. 36

Gasket replacement

Glue free gaskets i.e., SonderLock, Hang-on, D-Lock™ gaskets - these gaskets are mounted without the use of any glue.

They are attached to the plate by pushing the gasket fully down into the gasket groove or fastened by special devices i.e., SonderLock pins, Hang-on clamps or D-Lock™. Make sure that the gasket groove and gasket are clean.

Glue type gaskets

The surfaces must be clean and free from oil. Recommended glue/adhesive DOWSIL™ 786 Silicone Sealant-M Clear or 3M 1099. Follow the instructions of the manufacturer.

Semi-welded gaskets

The 2 types of gaskets in Semi-welded heat exchangers - ring gaskets for refrigerant side and field gasket for liquid side - can be replaced independently (see fig. 8).



CAUTION:
When using commercial solvents and adhesives, follow the manufactures recommendations carefully. Most of these solvents are hazardous.



CAUTION:
Always follow local regulations and legislation regarding recycling and scrapping of any of the components.

D-plates

When ordering D-plate the hanging insert is already mounted on the plate.

For any further information please reach out to your local Danfoss representative or your local Danfoss company.

Fitting the diagonal reinforcement

The diagonal reinforcement is made from an advanced glass-fibre reinforced polymer, able to withstand a wide range of chemicals, acids and alkalis fluids and it withstands temperatures from a range of -20°C to +180°C.

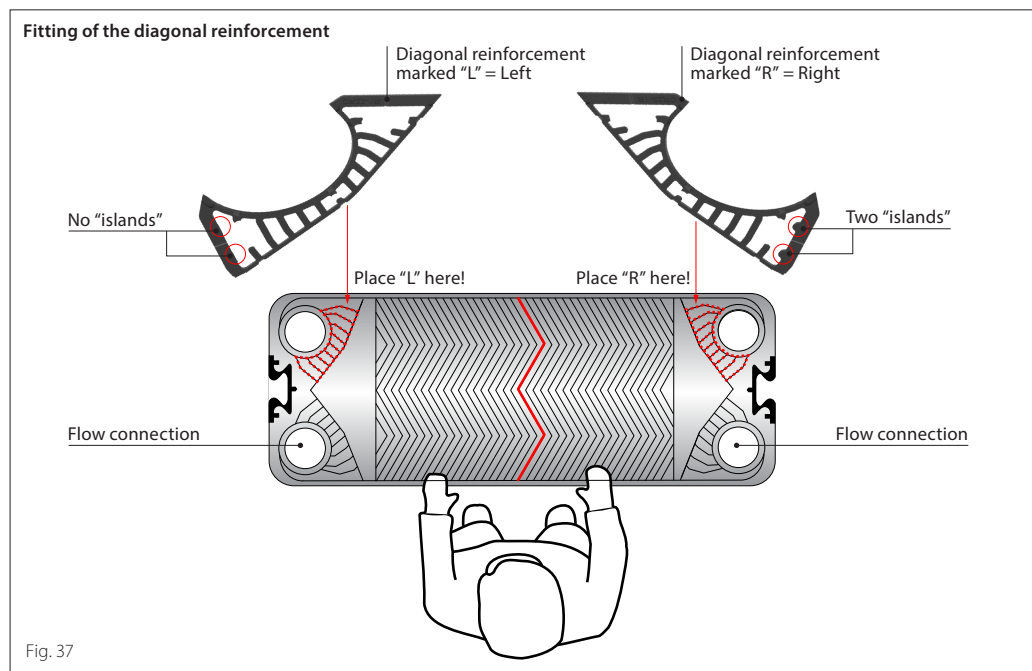


Flow connections = the port hole without the diagonal reinforcements.



Left / Right definition = when facing flow connections as illustrated below in fig. 38

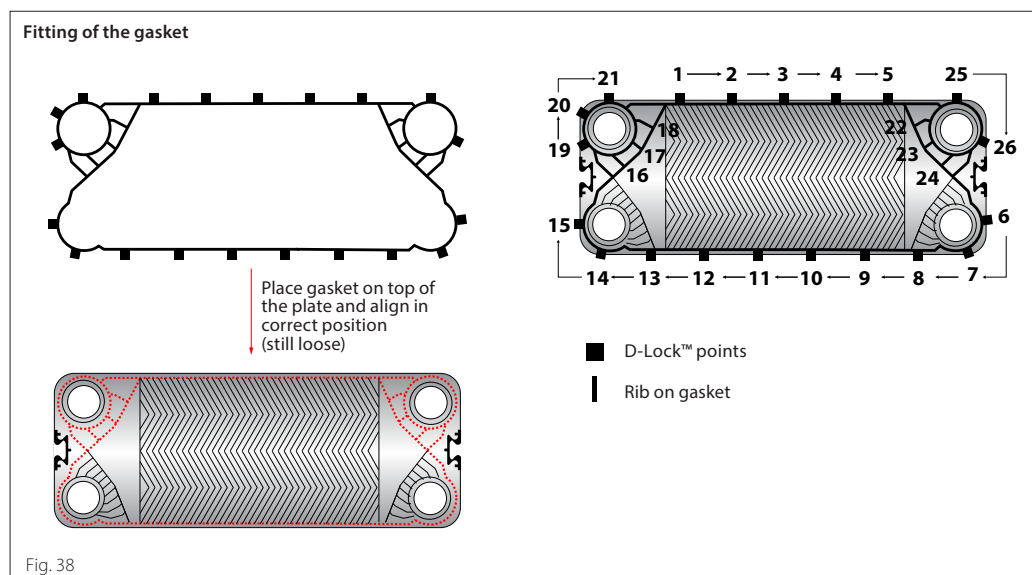
The diagonal reinforcement is not considered a service part during normal gasket replacement but can be easily replaced if lost during servicing.



Fitting the gasket

The patented D-Lock™ gasket system is easy to attach. It snaps the gasket into the D-Lock™ sockets and keeps the gasket firmly in place.

Place the gasket on top of the plate and the reinforcements and click the D-lock™ in place by following the number sequence 1 to 26 as illustrated below.



Fitting of start plate

The D-plate series usually comes with a dedicated start plate, however if the start plate is missing it can easily be made from an ordinary flow plate.

To ensure that the start plate lies completely flat against the head, the plates corner locks must be removed – this can be done with an angle grinder, fitted with a standard cutting disc of 1.0 to 1.5 mm thickness.

Fitting of a start plate

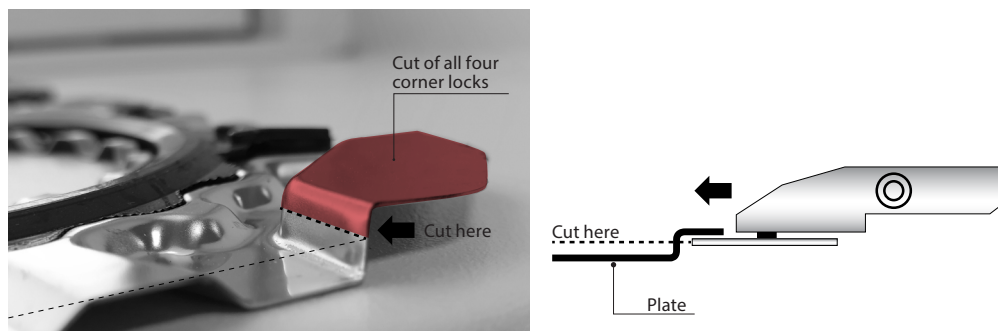


Fig. 39

Closing the heat exchanger

Before closing the heat exchanger clean the threads and give them a light coat of suitable grease or similar lubricant, if not already done.

Use appropriate tools e.g., a ratchet spanner for the disassembly.

When assembling and closing the heat exchanger observe the following:

- Check that all gaskets are correctly attached on the plates/cassettes
- Check that plates/cassettes are hanging correctly on the carrying bar
- Press the plate pack together by pushing the follower towards the head.
- Make sure the plates/cassettes are in the correct position according to the marked diagonal line or the sequential numbering
- Check the plate/cassettes honeycomb profile for uniformity (see fig. 41)
- Identify the A-measure noted prior to opening the heat exchanger (confirm with nameplate)
- Ensure there is no flow to any part of the unit
- Clean the tie rods and grease the threads, if not already done

- Put long tie rods in corresponding positions. Start tightening them with small increments (always keeping diagonal sequence of tightening 1,2,3,4) until you reach A-measure = A-measure nominal +10%.
- Put all short tie rods (except top no. 7 and 5 and bottom no. 8 and 6) in positions. Proceed tightening with maximum travel of nut 6 mm, following diagonal sequence until you reach A-measure = A-measure nominal +5%. For heat exchangers with height equal or bigger than 1500 mm, tighten the short tie rods as soon as you have possibility to do it, and use them for tightening the plate pack together with the long tie rods.
- Add remaining short tie rods to top and bottom positions, proceed tightening with maximum travel of nut 3 mm, following diagonal sequence until you reach A-measure = A-measure nominal.
- Prepare for operation. Follow instructions in section "Start-up process"
- If the heat exchanger does not seal immediately the tie rods can gradually be tightened to A-measure minimum. Please refer to the A-measure stated on the nameplate.

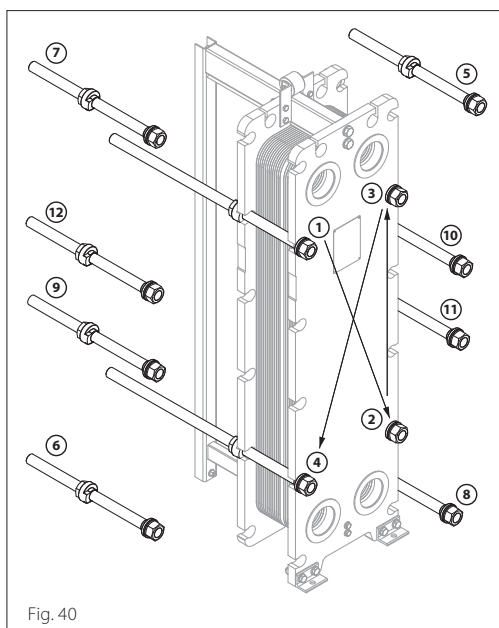


Fig. 40



Maximum allowable deviation of parallelism between header and follower of the frame is 5 mm.

That means after tightening the frame to required plate pack dimension, difference of A-measure in different corners of plate pack, along tie rods 1, 2, 3, 4 should not deviate more than 5 mm.

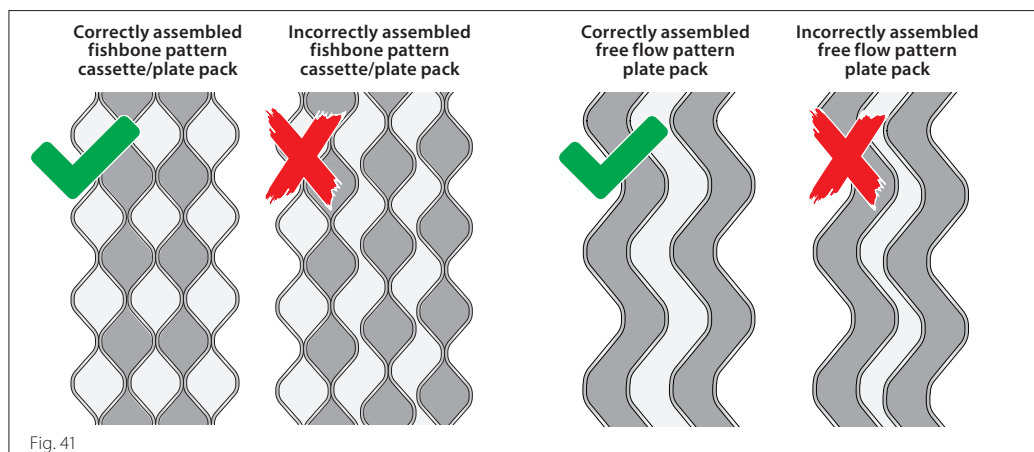


Fig. 41

Maintenance

CIP cleaning

Clean-in-Place, CIP cleaning, allows cleaning the plate heat exchanger without opening it and is done by circulating cleaning agents in the heat exchanger.



Refrigeration units:
CIP cleaning of the refrigerant circuit is not allowed. CIP cleaning can be done only on the brine circuit.

The use of CIP cleaning is relevant for soluble fouling only. Prior to CIP cleaning ensure that all materials in the entire circulation system are resistant to the cleaning agent/CIP liquid used.

Check maximum allowable working temperature on the nameplate mounted on the head of the plate heat exchanger before performing CIP cleaning. Maximum working temperature should not be exceeded at any time. Consult Danfoss if in doubt.

If the solution requires recirculation, select a flow that is as high as possible (but not higher than stated on the data sheet to prevent over-pressure), and no less than the service or operation flows.

Follow the instructions from the supplier of the cleaning agent. For re-circulated cleaning, we recommend that fluid is circulated in the plate heat exchanger for no less than 30 minutes and no longer than 4 hours.

Rinsing

After using any type of cleaning agent, always rinse the plate heat exchanger thoroughly with fresh water. After CIP cleaning, circulate fresh water for at least 10 minutes.



We advise to ask for a confirmation from the supplier of the cleaning agent that it will not damage the materials and other process components in the heat exchanger.

Cleaning agents' guidance

Oil and grease can be removed with a water emulsifying oil solvent.

Organic and grease cover can be removed with sodium hydroxide (NaOH) maximum concentration 1.5% - max. temp. 85 °C (185 °F). Mixture for 1.5% concentration = 5 l 30% NaOH per 100 l water.

Stone and limestone can be removed with nitric acid (HNO₃), max. concentration 1.5%, max. temp. 65 °C (Mixture for 1.5% concentration = 2.4 l HNO₃ 62% per 100 l water).

Do not exceed the max. concentration or max. temperature as nitric acid is very corrosive toward carbons steel frame parts and tie rods.

Nitric acid has a build-up effect on the passivation film of stainless steel.



CAUTION:
Nitric acid and Sodium Hydroxide may cause injury to exposed skin, eyes, and mucous membranes. Use of protective eyewear and gloves is strongly recommended.

Cleaning a flow plate

Use a brush with stiff bristles (non-metallic) and use water hose or low-pressure lance. It is recommended to lay the heat plate on a flat surface when cleaning to avoid the risk of bending the plate.

Use suitable cleaning solutions, depending on the type of fouling and plate/gasket material.

Welded cassettes are only cleanable on the brine side and all precautions must be taken to avoid any water or cleaning agent entering inside the cassettes. Single plates may be immersed into a solvent bath to dissolve hard fouling.

We strongly recommend that gaskets are always removed prior to cleaning as there is otherwise a risk that acidic cleaning agents can be trapped behind/around the gasket. When the water in the cleaning agent evaporates, the acid concentration increases, with risk of corrosion consequently.



CAUTION:
Some cleaning agents may cause injury to exposed skin, eyes, and mucous membranes.

Never allow any water or cleaning agent to enter the welded side of the cassettes.



Never use abrasive materials (wire brushes, emery cloth, sand/glass paper, angle grinders or similar) when cleaning a heat exchanger plate. This will damage the surface and the passivation film of the plates and may cause faster fouling, or in worst case penetrate the thin material.

Never use Hydrochloride for stainless steel plates.

Never use Hydrofluoric for titanium plates.



Always wear suitable protection when working with acidic or caustic solutions. Always wear gloves when handling plates.



Before fitting chemical cleaned plates, they must be thoroughly rinsed with fresh water.

Regular service of the plate heat exchanger

Service sequence – once a year as a minimum

- Check temperatures and flows against commissioning data
- Check general condition and look for any signs of leakage
- Wipe clean, all painted parts and check surfaces for signs of damage – “touch up” if necessary

- Check bolts and bars for rust and clean. Coat threaded parts with molybdenum grease or a corrosion inhibitor (ensure that no grease, etc. falls onto the plate gaskets).

Years after commissioning	Clean fluids/normal conditions				Dirty fluids/severe conditions			
2	-				PHE audit	Leak detection	CIP and manual cleaning	Replace ring gaskets
3	PHE audit	Leak detection	CIP cleaning	-				
5	PHE audit	Replace ring- and flow gaskets	Leak detection	CIP and manual cleaning	PHE audit	Replace ring- and flow gaskets	Leak detection	CIP and manual cleaning
6								
7	PHE audit	Leak detection	CIP cleaning	-	PHE audit	Leak detection	CIP & manual cleaning	Replace ring gaskets
8								
10	Replace ring- and flow gaskets	Leak detection	CIP and manual cleaning	-	PHE audit	Replace ring- and flow gaskets	Leak detection	CIP & manual cleaning
12								
13	PHE audit	Leak detection	CIP cleaning	-	PHE audit	Leak detection	CIP & manual cleaning	Replace ring gaskets
15								

PHE audit: Visual inspection of operating conditions, leaks, corrosion, and general condition

CIP: Clean in place (See section “clean in place”)

Manual cleaning: Plate pack disassembly/plate cleaning Replace gaskets: Plate pack disassembly/replace gaskets

At extreme fluids/conditions audits should be performed more frequent

Trouble-shooting

Most common problems with a plate heat exchanger, can be solved by own trained personnel. Below table lists a summary of possible problems together with relevant possible causes and solutions.

To maintain a continuous proper function of the plate heat exchanger, it is essential to keep the operating pressure and temperature within the ranges stated on the nameplate.

Exceeding these values, even as short-lasting peaks, may damage the unit or could be the cause of problems/issues.

To avoid costly repairs, it is recommended to have the installation and maintenance carried out by properly trained personnel.

Problem	Possible cause	Possible solution
Leakage	Connection sealing damaged	Check the rubber liners (if fitted)
		Check the flange gasket (if fitted)
		Check the ring gasket at first plate
		Fit the pipes tension-free
	Mixing of primary and secondary circuit	Check the plates for holes and/or cracks
		Check the diagonal part of the field gasket and ring gasket
	Plate package sealing damaged	Check the assembly distance "A"
		Check the condition of the gaskets
The operating conditions deviate from the specification	Check the proper position of the gaskets	
Insufficient capacity	Air in the system	Adjust the operating conditions
		Vent the piping system
	The operating conditions deviate from the specification	Check the pipe work for possible air traps
		Adjust the operating conditions
		The heat exchanger is fouled internally
Too high pressure drop	The connections have been interchanged	Redo the pipe work
	Flow larger than the design flow	Adjust the flow
	Channels in plates blocked	Flush / clean
	Incorrect measurement	Check the pressure indicator
	Fluid deviating from the specification	Check the chemical composition
	Air in the system	Vent the piping system
		Check the pipe work for possible air traps

For nearly all leakage problems it will be necessary to dismantle the unit before any attempts to rectify the fault can be made. Mark the area(s) where the leakage seems located with a felt tip marker or similar before disassembling the plate heat exchanger. Follow the instructions in section "Opening the plate heat exchanger".

"Cold leakage" is caused by a sudden change in temperature. The sealing properties of certain elastomers are temporarily reduced when the temperature changes suddenly. No action is required as the gaskets most often re-seal after the temperature has stabilized.

Gasket failures

Gasket failures are generally a result of

- Material aging/degradation
- Excessive exposure to ozone
- High or low operating temperature - outside specified material limits
- Exposure to pressure surges
- Attack by chemicals from cleaning, refrigerants, or oils
- Physical damage from incorrect assembly work
- Misaligned plates (check the hanging system at the top of the plate for distortion)

Decrease in performance

Decrease in performance is generally a result of

- Plate surfaces require cleaning or de-scaling
- Pumps or associated controls failing
- Plate channels blocked
- Liquid flows not as specified
- Associated chiller / cooling tower / boiler under sized or dirty
- Cooling fluid temperature to the plate heat exchanger is higher than the design temperature
- Heating fluid temperature to the plate heat exchanger is lower than the design temperature
- Refrigerant trap broken or jammed – unit becomes filled with condensate
- Plate package has been assembled incorrectly
- Plate heat exchanger is running with co-current flow, instead of counter current. (Check direction of pump flows)
- Air trap has developed in the plate package or piping work

After sales service

Ordering parts

When ordering spare parts, it is important to provide correct data for:

- Plate heat exchanger type and serial number.
On the nameplate a unique serial number is stated, this will be needed to ensure correct spare part selection as well as trouble shooting advise
- Required parts

Also indicate if there have been any design changes of the plate heat exchanger since commissioning date.

When ordering separate plates, it is important that the correct plate code index (the plate code index describes which port holes are open e.g., 1234 means that all portholes are open, 0000 means that all port holes are blinded (end plate)) and type of plate is stated e.g., plate material, plate thickness, thermal plate pattern TS/TL etc. Also, gasket material and liner type is required for correct spare part delivery or on-site service.

When ordering separate gaskets, it is important to indicate the correct gasket material.

When ordering tie rods, the existing bolts should be measured to get spare bolts with the same dimensions.

Modifications to the heat exchanger

Please note that a plate heat exchanger is specific designed and built for the operating parameters (pressures, temperatures, capacity, and type of fluids) initially provided by the customer.

If the plate heat exchanger needs to operate at a different capacity this can be achieved by adding or removing plates/cassettes.

Modification of the plate heat exchanger to match other parameters may also be considered. Consult Danfoss for redesign and/or approval of any change to operating parameters. After approval by Danfoss a new name plate will be issued.

You may only commission a plate heat exchanger under modified conditions after written approval by Danfoss



Always use genuine parts - Danfoss cannot guarantee performance or product lifetime, etc., when using parts from other product brands.



For any questions regarding spare parts reach out to your local Danfoss representative or your local Danfoss (Service) company.

Scrapping

At end of use, the heat exchanger should be dismantled, and its components sorted, recycled, and scraped, according to local regulations and legislation.

For any further information please reach out to your local Danfoss representative or your local Danfoss company.



Always follow local regulations and legislation regarding recycling and scrapping.



Danfoss A/S

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