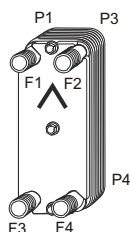


INSTALLATION AND MAINTENANCE MANUAL FOR MINEX

GENERAL INFORMATION

Minex heat exchangers are somewhat of a hybrid between classic gasketed plate heat exchangers (PHE) and compact brazed heat exchangers (BPHE). The major difference compared to a BPHE is that instead of brazed joints holding the plate package together, there are tightening bolts and frames. In order to seal off the circuits from each other there are, gaskets between the plates. However, Minex is small like a BPHE, so it doesn't need the typical support frame.



The front plate of SWEP's Minex is marked with an arrow to indicate the front side of the Minex and the location of the inner and outer circuits/channels. With the arrow pointing up, the left side (Ports F1, F3) is the inner circuit and the right side (Ports F2, F4) is the outer circuit.

The outer circuit has a slightly lower pressure drop as it contains one more channel.

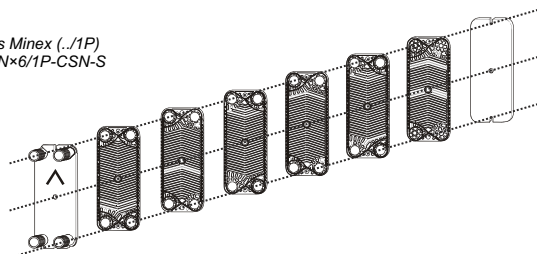
Ports F1/F2/F3/F4 are situated on the front of the heat exchanger. Note the order in which they appear. Ports P1/P2/P3/P4 are situated in the same order on the back.

MINEX CONSTRUCTION

In principle the Minex consists of a package of corrugated channel plates between a front and back frame. The channel plates are very similar to the channel plates of a regular brazed heat exchanger. Between the plates are elastomer gaskets which seal off the liquid from the atmosphere and create a flow channel. Every second channel plate is turned 180°, and a network of contact points builds up the well-supported plate package. In order to evenly distribute the fluids across the plate, Minex plates contain flow directors in the port areas.

A frame with tightening bolts keeps the plates in the correct position. Starting from the front side (F-side), the heat exchanger is constructed by a frame plate. As from 2001, the connections are of the so-called snap-in-place type, held in place by the frame. Together with the tightening bolts, washers and nuts, the pressure plate closes the plate package.

One Pass Minex (./1P)
e.g. M10N×6/1P-CSN-S



Please note the following;

- The chevrons of the first channel plate point downwards, i.e. the opposite of BPHEs (the front side of a Minex is the back side of a normal BPHE).
- M10 has three tightening bolts, one at each end, and the 3rd one is located in the middle of the plate package.

Material combinations

The standard channel plate and connection material is stainless steel of AISI 316 type (DIN 17441, Werkstoffnr 1.4401 or SS 142347-28). For demanding applications, titanium Grade 1 is an option. The frames are available in two different materials; corrosion-protected (galvanized) carbon steel and stainless steel. SWEP's standard gasket material is NBR, but EPDM is available as an option. The article number informs about the frame, plate and gasket material e.g. M10N×6/1P-CSN-S has frames made of galvanized carbon steel (C), plates made of stainless steel (S) and gaskets made of NBR (N).

Frame material e.g.: S, stainless steel;
C, galvanized carbon steel

Gasket material e.g.: N, NBR;
E, EPDM

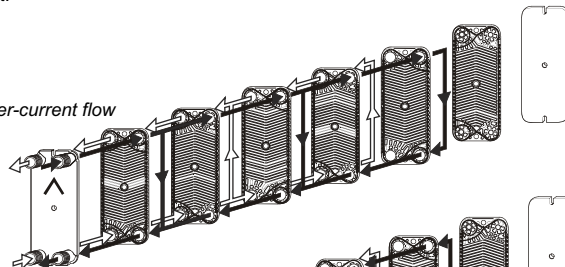
M10N×6/1P-XXX-S

Plate material e.g.: S, stainless steel;
T, titanium

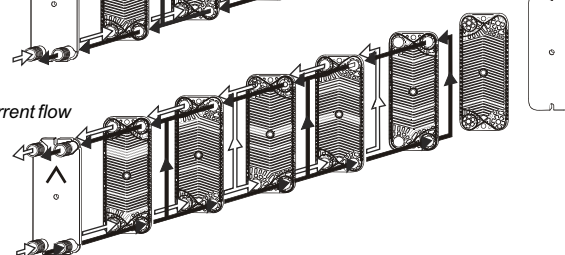
FLOW CONFIGURATIONS

The gasket and the gap between the two plates create a flow channel. Gaskets separate fluids in order to prevent mixing of the two fluids. The fluids can pass through the heat exchanger in different ways. All Minex models are of parallel-flow type and there are two different flow configurations: counter-current and co-current.

Counter-current flow



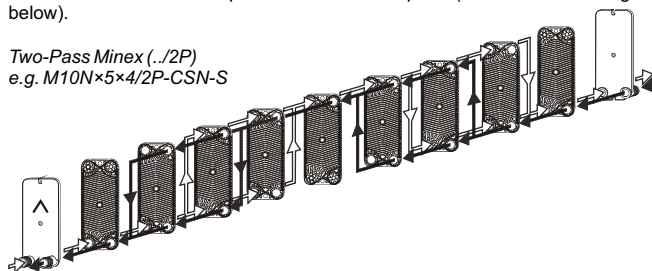
Co-current flow



Different versions available

In order to use the Minex for closer temperature approaches, it's possible to connect two plate packages in series, within one frame. This arrangement is called multi-pass. In multi-pass arrangements, there are two connections on each side of the frame. Multi-pass units have an additional flat rubber gasket between the last channel plate and end cover plate (not shown in the figure below).

Two-Pass Minex (./2P)
e.g. M10N×5×4/2P-CSN-S



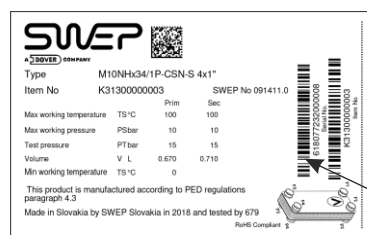
DESIGN CONDITIONS AND APPROVALS

The standard pressure rating for SWEP Minex, i.e. maximum operating pressure, is 12 bar (1.2 MPa, 174 psi) for the M10N units (high pressure alternative; TÜV-approved M10N units for 16 bar (1.6 MPa, 232 psi)). SWEP's standard maximum operating temperature is 110°C (230°F) for Minex units with NBR gaskets. Other gasket materials may have other temperature limits. For details, please check the label and other technical documentation.

SWEP Minex models are approved by a number of independent bodies, e.g.: TÜV, Germany; kiwa, the Netherlands, etc.

LABELLING SYSTEM AND OPERATING CONDITIONS

All Minex are equipped with an adhesive label, which includes vital information about the unit, e.g. type of heat exchanger (which indicates the basic Minex execution and material combination) and SWEP's item number. The label also includes the serial number, which is described below. The Operating Conditions; state the maximum operating temperature and pressure as per the respective approving organization. The label also provides information about the tightening measure (Total Plate Package Measurement).



Bar-code serial number

The Serial Number on the label provides this information:

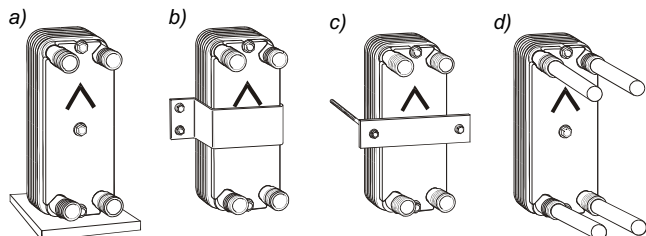
6 18 07 723 2 000008

Number in series
Number of circuits
Product code
Month 12, i.e. December
Year 00, i.e. 2000
Production Entity

MOUNTING

Pipes should be fitted so that thermal expansion does not affect the heat exchanger on the fittings. If there is a risk that the static pressure could exceed the design pressure, a safety valve must be installed. Never expose the unit to pulsations or excessive cyclic pressure or temperature changes. It is also important that no vibrations are transferred to the heat exchanger. If there is a risk, install vibration absorbers. Use a rubber-mounting strip or similar as a buffer between the Minex and the mounting clamp. The mounting direction has little or no effect on the performance of the Minex.

Several mounting suggestions for SWEP Minex are shown here.



- a) supported from the bottom
- b) sheet metal bracket (rubber insert between bracket and exchanger)
- c) crossbar and bolts (rubber insert between the crossbar and exchanger)
- d) for a smaller Minex, it is possible to mount the unit by simply suspending it from the pipes/connections

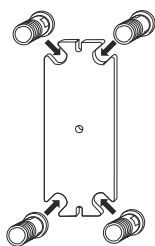
CONNECTIONS

Depending on the national/local standards and application, there are different options available for the connections. It is important to have the right international or local standard of connection, as they not always are compatible. The design of Minex connections differs somewhat compared to BPHE connections.

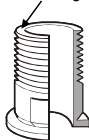
Snap-in-place connections

The Minex frame plate has specially designed slots in which the connections can be inserted. When the plate package is assembled, the connections are locked into position.

The locking of the connections to the frames is achieved without any welding or brazing of the connections. This in turn means that the material of the connections and the frames can be customized in accordance with the customer's preferences and demands, e.g. a corrosion-protected carbon steel frame combined with inexpensive stainless steel connections on one side and titanium connections on the other side.



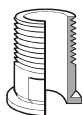
Sealing surface



All connections are equipped with a special plastic cap to protect the threaded connection and prevent dirt and dust from entering the Minex. This plastic cap should be removed with care, in order not to damage the thread, sealing surface or any other part of the connection. Use a screwdriver, pliers or knife.

Threaded connections

Examples of threaded connections: threaded female/male, ISO-G, NPT, ISO 7/1



Externally Threaded Connections (Male)



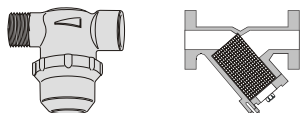
Internally Threaded Connections (Female) of Standard Type



Internally Threaded Connections (Female) with a Hexagonal Exterior

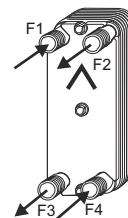
STRAINERS

If any of the media contain particles larger than 1 mm (0.04 inch), we recommend installing a strainer with a size of 16-20 mesh (number of openings per inch) before the exchanger. The particles could otherwise block the channels, causing bad performance, increased pressure drop and risk of corrosion. Some strainers can be ordered as accessories.



INSTALLATION OF MINEX IN SINGLE-PHASE APPLICATIONS

Normally, the circuit with the highest temperature and/or pressure should be connected on the left side of the heat exchanger when the arrow points upwards. For example, in a typical water-to-water application, the two fluids are connected in a counter-current flow, i.e. F1 for the hot water inlet, F3 for the outlet, F4 for the cold-water inlet and F2 for the outlet. This is because the right-hand side of the heat exchanger contains one channel more than the left-hand side, and the hot medium is thus surrounded by the cold medium to prevent heat loss.



Start-up

Make sure that the tightening measure (total plate package measurement) is correct according to the label on the heat exchanger. Close the pump discharge valves to the heat exchanger completely. The static pressure must be increased slowly until the operating pressure is reached, in order to not displace the gaskets. It is recommended that the inlet valves on both sides are opened simultaneously to avoid over-pressure on one side. It is also important to avoid hammering, as the elastomer gaskets may be displaced and thereby cause leakage.

Dismantling

The pressure on both sides should be decreased simultaneously and gradually when shutting down the unit. Remove the pipe work connected to the heat exchanger. The tightening bolts must be loosened with the frame and pressure plate as parallel as possible. This is most easily done with a hydraulic hand pump.

For M10:

Start to release the center nut and unscrew the bolt from the unit. NOTE! Do not punch the bolts through the plate package as this might damage the channel plates. Loosen the upper and lower tightening bolts max 2-3 mm (0.1 inch) at a time, in order to keep the plate package parallel.

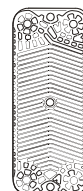
Since the gaskets are not glued, try to keep the plate package together. Keep the unit lying on the back, P-side, and remove one plate at the time. The start gaskets are made of two half-channel plate gaskets and should be removed carefully and saved. On the M10 you also have a center ring gasket on each plate, which seals off the center-tightening bolthole. There is only one way to place the gasket in the groove. The start plate gaskets therefore have to be adjusted (with a pair of scissors) to fit in to the gasket groove.



Start plate (4-hole) with gasket



Channel plate (4-hole) with gasket



End plate (0-hole) without gaskets

Assembly of plates

The plates should always be mounted with the gasket facing the front frame plate. Make sure the center ring gaskets are correctly located in the gasket groove in the middle of channel plate. In a single-pass unit, the start plate should always be mounted with the herringbone pattern pointing down, in the opposite direction of the arrow on the front of the frame. Make sure to alternate the channel plates so that every second plate has the arrow pointing up and on every second pointing down all through the plate package.

The bolts are short in order to decrease the outline dimensions. To be able to mount the nut on the bolt, we recommend using a screw clamp or similar tool to tighten the unit enough. After this tightening, the upper and lower bolt can easily be located in their holes. Take care that the plate package is not over-tightened as this might cause deformation of the plates and gaskets and thus affect the thermal performance. After dismantling and cleaning, always let the gaskets dry for 24 hours so they can revert to their original form before assembly. This procedure will prevent the risk of leakage and should not be ignored. The performance of the heat exchanger and the lifetime of the gaskets depend on the accuracy of the tightening. If leakage occurs when the plate pack is equal to the total plate package measurement, the gaskets should be replaced instead of further tightening.

Principle of assembly

There are a few differences such as number of plates, number of packages, placing of connections etc. when mounting different versions of Minex. The example below illustrates the assembly of a two-pass Minex.

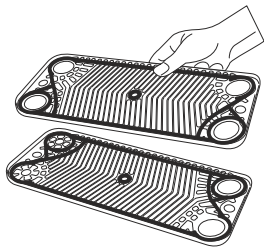


Figure 1. When assembling the Minex, start with the last channel plate. The chevrons of the plate should point downwards. Alternate the channel plates so that every second plate has the arrow pointing up and every second pointing down all through the plate package.

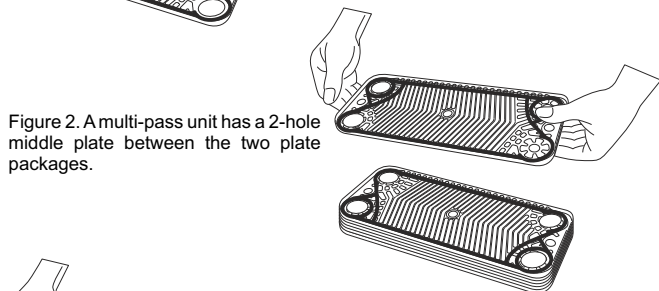


Figure 2. A multi-pass unit has a 2-hole middle plate between the two plate packages.

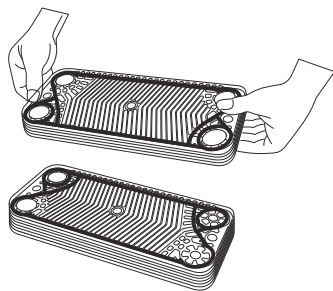


Figure 3. When mounting the second plate package, the chevron on the first plate should point upwards. Alternate the channel plates as described in figure 1. Put the second plate package on top of the 2-hole plate.

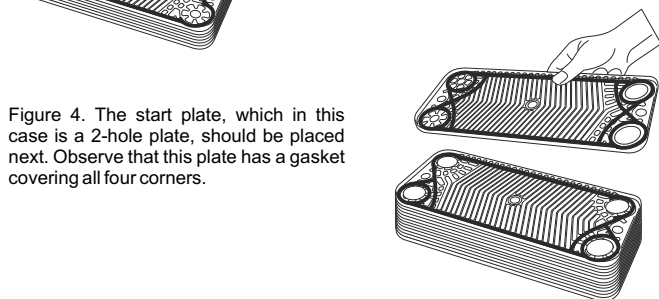


Figure 4. The start plate, which in this case is a 2-hole plate, should be placed next. Observe that this plate has a gasket covering all four corners.

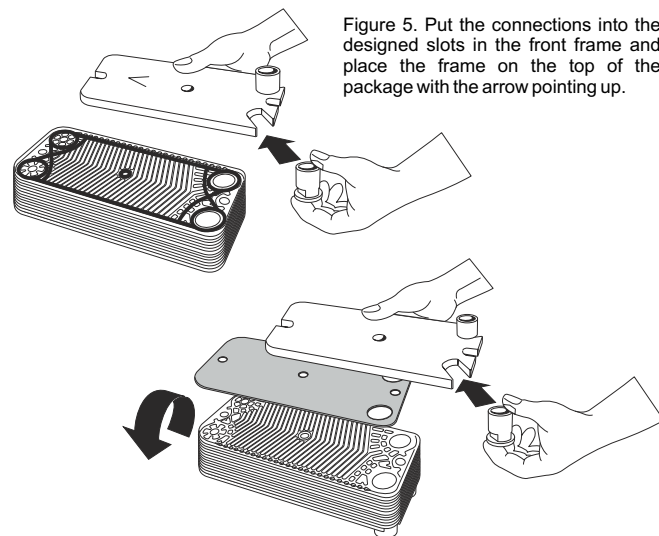
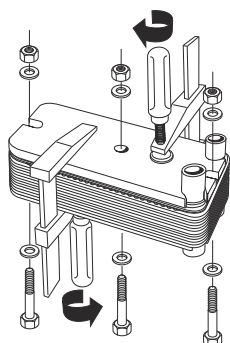


Figure 5. Put the connections into the designed slots in the front frame and place the frame on the top of the package with the arrow pointing up.

Figure 6. Turn the whole package upside-down and place the flat rubber gasket between the last channel plate and the end cover plate. Please note that the flat rubber gasket is used only for multi-pass units.

Figure 7. Put the two outer bolts and lock washers in place and use two screw clamps to tighten the unit in parallel. NOTE! If the bolt gets stuck, do not punch it through the plate package, as the channel plates can be damaged. The bolts must be screwed through the plate package. Finally, put the center bolt in place and do the final manual tightening in parallel.



Leakage

If there is leakage when the unit is cold but no signs of leakage during operation, no action needs to be taken. If however there is leakage under normal operating conditions, the Minex unit should be further tightened. Checked that the unit is parallel and not out of alignment. Note that the total plate package measurement is the absolute limit! If the unit leaks when the total plate package measurement is reached, try to locate the leakage before disassembling in order to be able to pick out and correct the suspected damaged plates. The gaskets have to be replaced for all leaking plates. It is important that the frame and channel plates are parallel. If not, this might cause leakage.

Storage of gaskets

All gaskets are to be stored under appropriate conditions. Gaskets made of NBR have a shelf life of one year while EPDM gaskets may be stored for up to three years. This is valid for an assembled Minex as well as separate gaskets. These time limits are naturally not valid for a unit in service. In practice, the gasket's lifetime depends on the application and the gasket's exposure to variations in temperature, pressure and chemical influences, which means that it may affect the lifetime both positively and negatively. The reason for the restricted shelf life is that elastomers such as Nitrile and EPDM are oxidized in presence of O_3 , O_2 , UV-light etc. This oxidation causes the rubber to harden and ultimately leads to small cracks in the gaskets.

CLEANING

Thanks to the high degree of turbulence in the Minex, there is a self-cleaning effect in the channels. However, in some applications the fouling tendency can be very high, e.g. when using extremely hard water at high temperatures. There are several different possibilities to clean the unit.

- CIP cleaning (Cleaning In Place): Clean the exchanger by circulating a cleaning liquid. Use a tank with weak acid, 5% phosphoric acid or, if the exchanger is frequently cleaned, 5% oxalic acid. Pump the cleaning liquid through the exchanger. For optimum cleaning, the cleaning solution flow rate should be a minimum of 1.5 times the normal flow rate, preferably in a back-flush mode. After use, do not forget to rinse the heat exchanger thoroughly with clean water. A solution of 1-2% sodium hydroxide (NaOH) or sodium bicarbonate ($NaHCO_3$) before the last rinse ensures that all acid is neutralized. Clean at regular intervals.
- Manual cleaning: Open the unit according to enclosed dismantling directions. When cleaning a multi-pass unit, make sure where the "2-hole" plate is located. Since the gaskets are unglued you can easily clean the plates. Use a fiber brush and water (do not use a steel brush or steel wool). Greasy deposits, e.g. oil, are removed with a soft brush and paraffin (kerosene). Organic deposits are removed with a soft brush and alkaline detergent (2% caustic soda, 50°C (122°F)). Precipitates of calcium components may be removed with either 10% nitric acid (HNO_3) or 2% sodium polymethaphosphat, 50°C (122°F), 2% sodium trimethaphosphate, 50°C (122°F), 5% EDTA. After cleaning, the heat exchanger should be thoroughly flushed with clean water. The gaskets, which have been deformed due to the tightening, have to dry for 24 hours to revert to their original form before assembly. This procedure will avoid the risk of leakage and should not be ignored. (Note! You may want to have a spare set of gaskets on hand so you don't have to wait 24 hours to re-assembly.)

Note that all acids and bases are hazardous and should be handled with great care.

For further information, please consult SWEP's CIP leaflet or your local SWEP representative.

WARRANTY

SWEP offers a 12-month warranty from the date of installation, but in no case longer than 15 months from the date of delivery. The warranty covers manufacturing and material defects.

DISCLAIMER

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

For further information, please consult SWEP's technical information or your local SWEP representative.

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www.swep.net info@swep.net