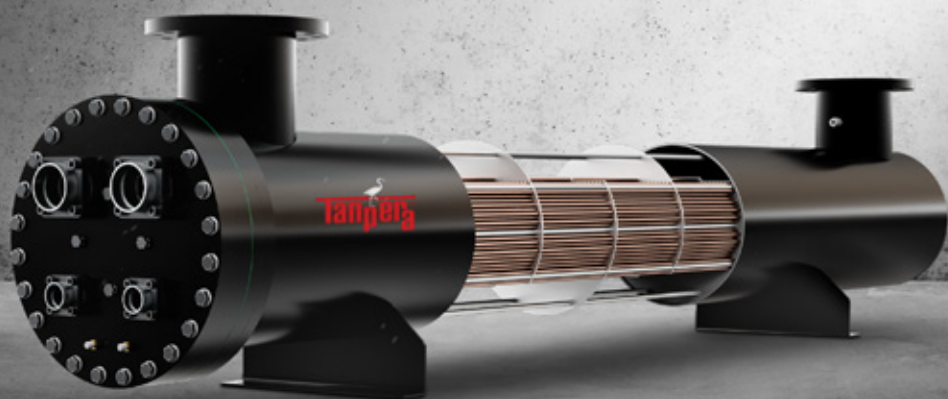




Evaporator User Manual



Project :
Customer :
Heat Exchanger Type :
Serial No :
Year :

The information contained in this document is based on the most current data and materials available at the time of publication. Therefore, due to rapid developments in this field, we do not take responsibility for any changes in technical specifications that may affect the content of this document.

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1. Performance

To achieve the best performance from Tanpera evaporators and keep operating and maintenance costs at a minimum, it is recommended to pay attention to the following points.

- The product must be selected according to the appropriate operating conditions and used accordingly.
- The product should be manufactured from materials suitable for the operating conditions.
- The product must be stored under appropriate conditions before installation.
- The product must be installed in accordance with the instructions.
- The product must be commissioned in accordance with the commissioning instructions.
- The product's cleaning and maintenance intervals must be followed.
- Installation, maintenance, and repair of the product must be carried out by skilled and knowledgeable personnel.

If there is a decrease in the evaporator's performance or any abnormal condition, it may be due to one or more of the following reasons.

- The evaporator may be contaminated.
- The evaporator may not be operating according to the design conditions.
- There may be gas trapped in the product or air remaining in the water line.
- The pipe diameters may have been incorrectly selected or improperly installed.
- The evaporator may have been exposed to corrosive effects.
- Vibrations in the installation line may not have been absorbed.

2. Shipping, Storage, and Preservation Conditions

Tanpera evaporators are properly packaged to protect against potential problems during delivery. If the product will not be installed immediately after delivery, it should be stored in its original packaging.

Considering delays caused by repairs or similar issues due to improper storage, correct storage methods become important. The recommended storage conditions below are intended to facilitate the user. It is advised that the user pays attention to the following conditions.

- ➔ When you receive the heat exchanger, inspect it for any transport damage despite all protective measures. If any transport damage is detected, immediately inform Tanpera and the shipping company. Before accepting the product, note this damage on the invoice or delivery note. Products with removed, damaged, or illegible labels are not covered under warranty.
- ➔ When transporting your heat exchanger, use equipment such as cranes, forklifts, levers, slings, chains, etc. Do not lift the product manually or by physical strength alone. Due to its heavy weight, improper handling may cause permanent bodily injuries.
- ➔ Be careful during transportation. Do not bump or drop the product. The copper tube bundle of your heat exchanger is sensitive to such impacts and may be damaged. Resulting shocks can cause cracks and leaks.
- ➔ If your heat exchanger has not been stored properly, take immediate measures against rust and corrosion.
- ➔ The internal surface of heat exchangers is sealed to prevent constant contact with air. This prevents rust or contamination inside. Make sure that the protective covers or plugs remain on your heat exchanger during storage.
- ➔ During the ordering phase, if the customer specifies storage conditions, a custom packaging method is applied for the customer, and products are stored accordingly at the Tanpera factory before shipping.
- ➔ Before indoor storage, dirt, snow, moisture, dust, and similar residues on the product packaging should be cleaned. Moisture that may accumulate inside or on the product often causes corrosion and rust to begin.
- ➔ Store your Tanpera products in as dry and warm environments as possible, free of moisture. It is recommended that the relative humidity of the storage area be 40% or below. During maintenance and installation, the formation of air and moisture inside the product should also be prevented.
- ➔ It is recommended to use dehumidifiers in the storage area to prevent Tanpera products from being damaged by moisture.

2. Shipping, Storage, and Preservation Conditions

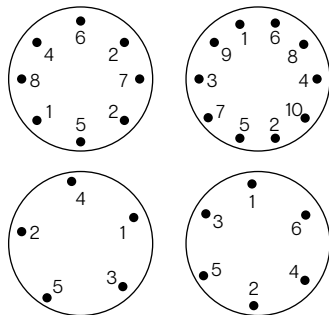
- We recommend keeping records of the products in the storage area and implementing a storage procedure. The following points should be recorded during the storage phase.
 - Storage date
 - Inspector Name and Surname
 - Product Card and Product Serial Number
 - Storage Location
 - Product Coating or Painting Status
 - Internal Condition
 - Moisture Condition
 - Environment and Product Contamination Status
 - Corrective Actions Taken
- Products are shipped painted as standard by Tanpera. The paint acts as a factor that extends the product's lifespan. However, it does not provide complete protection against external factors such as impact, hits, or scratches. Periodic repainting of the products during their usage life will extend the product's lifespan against external effects.
- If there is any paint peeling on the products or corrosion starting from the peeling area, it is recommended to contact Tanpera or immediately repaint the affected area with an appropriate paint. If there is corrosion in the area to be painted, cleaning should first be done using a wire brush, and then the paint repair should be carried out with the paint recommended by Tanpera. Detailed information about the paint can be obtained from Tanpera. However, even if paint defects are repaired, full protection of the product cannot be guaranteed.
- Due to storage conditions, the responsibility for taking precautions against all other potential issues lies with the customer. All Tanpera products must be protected with all necessary measures, not less than the 13 items specified above.



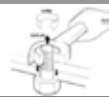
3. Installation

- ➔ Tanpera recommends that the product you purchased be installed by authorized and trained personnel who are knowledgeable about system design, pressure, heat rates and transfers, as well as iron, PVC, and copper piping installations.
- ➔ Before using the heat exchangers, release the test or safety gas inside. Although the products are delivered standard with vacuum, they can also be supplied with 6 bar nitrogen gas upon customer request.
- ➔ Some of the connection elements of the heat exchangers are tightened with thread-locking compound, while others are tightened without it. Over time, sealed connections with gaskets may loosen. To prevent such issues, check the tightness of all bolts on the purchased product. Tighten any loose bolts to the appropriate torque values. Perform the tightening process following a circular tightening procedure. The bolt tightening procedure and torque values are specified in the tables below.

Bolt Tightening Procedure



REQUIRED TIGHTENING TORQUE FOR METRIC BOLTS



Bolt Size	Pitch (mm)	Tightening Torque (Nm)
M5	0,8	6
M6	1	10,5
M8	1,25	25,3
M10	1,5	50,8
M12	1,75	86,9
M14	2	139
M16	2	213
M18	2,5	293
M20	2,5	416

Torque values are given according to grade 8.8 steel bolts used in the products. Do not use the same values for other grades. Bolts and nuts should be lightly lubricated during assembly.

- ➔ The heat exchangers you will use are not suitable for bearing loads. The maximum allowable weight on them should not exceed 400 kg. However, if components such as a compressor are to be mounted on the product, the customer must request a product modification from Tanpera to support these weights.
- ➔ Some hand tools you may need during installation include: bolt wrenches, pipe wrenches, Teflon tapes or other suitable sealing products for pipe connections, torque wrench, various pliers, metal shims, wire brushes, and gaskets in various sizes.
- ➔ It is recommended to install bypass lines and valves on both circuits of the heat exchangers during the installation phase. This provides ease during cleaning, inspection, and maintenance of the products.

3. Installation

- It is recommended to take precautionary measures and provide warnings and explanations during installation, maintenance, or cleaning.
- It is important to install temperature and pressure measuring elements on both circuits of the heat exchanger, positioned close to the product, and to ensure operation within the recommended temperature and pressure values. Tanpera is not responsible for products used outside of these limits.
- Use gas and water connection elements in the dimensions recommended for the product and specified in the technical drawings and catalogs.
- Use matching counter flanges and gaskets suitable for the product flanges.
- The installation where the product is mounted must include an air release valve. A safety valve is mandatory for pressure vessels used with heat exchangers.
- Secure the product in its place of use by using a sufficient number of support and connection elements. This helps prevent system or flow stresses and vibrations, providing protection. Make sure the connection bolts are fully tightened.
- It is recommended that the connection openings be at least one size larger than the bolt diameter to allow easy alignment. This makes centering of the joints easier.
- The use of appropriate liquid level indicators, flow control elements, drain valves, temperature control elements, pressure sensors, alarms, and similar warning components is recommended.
- To avoid any problems caused by flow, sight glasses or flow control alarms should be used for all fluids in gas or liquid phase. This way, insufficient or excessive flow can be monitored, preventing issues such as overflow.
- Correctly identify which fluids the Tanpera product you have installed will operate with. In systems using water, the corrosive effects of water on copper-tube heat exchangers will shorten the product's lifespan. It is recommended to use protective chemicals or water under proper conditions. The conditions related to water are specified in the following sections.
- To prevent an explosion caused by pressure from a compressor, pump, or other equipment in the heat exchanger, a safety valve with appropriate settings must be used. Do not connect the discharge line to a closed circuit, as this will make it difficult to drain the product when necessary.
- During installation, make sure that no foreign objects such as screws, nuts, wrenches, drill bits, etc., fall into or are left inside the product. Before closing the connection points, check this visually and manually. Such objects can cause permanent damage to the heat transfer tubes. Tanpera does not accept responsibility for malfunctions resulting from such situations.

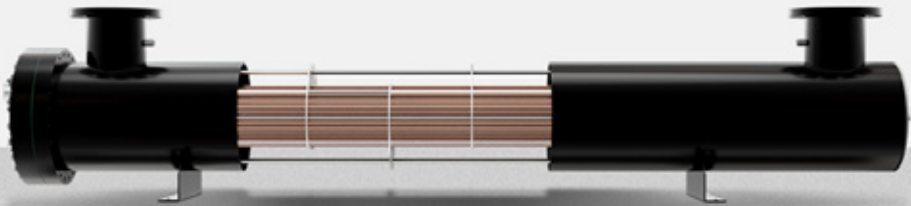
4. Application

- Before starting up the evaporator, make sure that the installation is clean. Ensure that the necessary filters are installed and check them. If a balance tank is present, make sure there is no residue or dirt inside the tank.
- Make sure that the valves are open before operating the product.
- Start up the product gradually.
- After the heat exchanger is completely filled with fluid, you can close the supply valves.
- Make sure that the gasket connections are properly installed. Errors in gasket connections may cause leaks during operation.
- Using the product outside the permitted pressure and temperature limits or with fluids other than those recommended is dangerous. Do not operate the products beyond the limits specified on the product label.
- Take the necessary precautions to prevent possible damage inside the heat exchanger caused by water hammer.
- When the product is not in operation or is shut down for extended periods, store or drain the fluids inside, or enhance the product with chemical additives that provide protection against freezing and corrosion.
- For products operating below the freezing point of the used fluids, use antifreeze chemicals. In water-cooled products, use antifreeze or similar freeze-protection chemicals to prevent freezing risks.
- An example antifreeze usage table for water is provided below as a reference. This table is for illustrative purposes only, and for correct applications, the instructions and usage conditions provided by the antifreeze manufacturer must be followed. Use appropriate measuring devices to check the freezing point of the antifreeze solution to ensure the correct amount of antifreeze has been applied.

Freezing Temperature	1,2 Propylene Glycol % by Weight	Water % by Weight
-10°C	18	82
-15°C	25	75
-20°C	32	68
-25°C	37	63
-30°C	41	59

4. Application

- After any type of application, ensure that there are no external or flow-induced vibrations within the product. Vibrations in the heat exchanger can cause internal issues and shorten its service life.
- The flow rate and flow velocity must not be below or above the recommended limits for the product. Operating outside these limits can cause vibrations inside the product, which may lead to issues in the tube bundle in a short time. Vibrations can cause breakage, tearing, cracking, and abrasion due to rubbing within the tube bundle.
- For heat exchangers that will not be operated for an extended period, apply the procedures recommended for new heat exchangers to protect them from external effects such as freezing and corrosion. Take appropriate measures to prevent freezing and corrosion.
- If the product will be taken out of service for a short period, the water inside should be drained and the internal surfaces should be dried using dry air.
- If the procedure mentioned above cannot be applied, then water flow should be maintained at regular intervals during the day to eliminate the effects of stagnant water such as biological contamination, corrosion, and similar issues.
- During all opening and closing operations, fluid flows must be regulated to prevent thermal shock. Startup and shutdown procedures should not be performed with flow values outside the application temperature range.
- To avoid thermal stress on the product, the fluids should reach a balanced temperature through the use of a bypass. In insulated products, special attention must be paid to sudden stops and restarts of flow. Severe thermal shocks may occur in products exposed to high temperatures for extended periods.



5. Usage Water Conditions

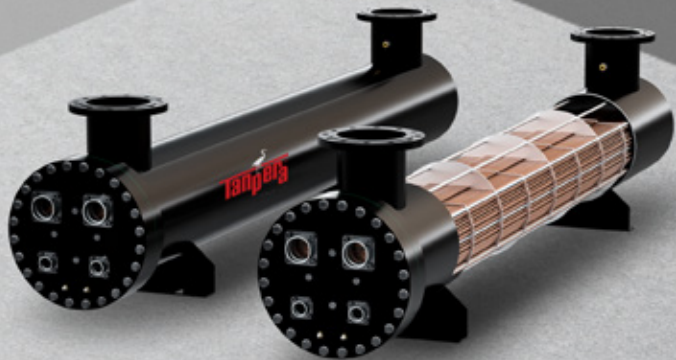
To minimize the physical and corrosive effects of domestic water in Tanpera evaporators, it is recommended to comply with the conditions listed below. The pH level, alkalinity, hardness, ion content, and circulation temperature of the water all play a role in corrosion and scale formation in heat exchangers and other system components. Recommended water properties for cooling systems are provided below. Malfunctions resulting from non-compliance with these water conditions will not be covered under warranty.

- Ammonium ions (NH_4^+) in water are highly harmful to copper. These ions are one of the most critical factors negatively affecting the service life of copper tubes. There must be absolutely no ammonium ions (NH_4^+) present in the water.
- Chloride ions (Cl^-) cause small pits to form on the surfaces of copper tubes due to corrosion. The chloride ion concentration in the water should be below 10 mg/l.
- Sulfate ions (SO_4^{2-}) cause corrosion and the formation of small pits on copper tube surfaces. The concentration of sulfate ions (SO_4^{2-}) in the water should be below 30 mg/l.
- Fluoride ions (F^-) in water lead to acid formation and corrosion. The concentration in the water should be below 0.1 mg/l.
- Iron ions (Fe^{2+} and Fe^{3+}) in water combine with dissolved oxygen to form rust and sludge in the system. Therefore, iron ions should not be present in the water. If the amount of dissolved oxygen in the water is below 5 mg/l, the amount of dissolved iron should also be below 5 mg/l.
- Dissolved silicon in water poses a risk of acid formation and corrosion. Its concentration in the water should be below 1 mg/l.
- The total water hardness (TH) should be greater than 0.5 mmol/l. It is recommended that the total water hardness be between 1 mmol/l and 2.5 mmol/l. A slight deposit layer on the inner or outer surfaces of copper tubes can help limit corrosion. However, excessive water hardness will lead to significant scale buildup inside the copper tubes, obstructing water flow and heat transfer. It is also recommended that the total alkalimetric titre (TAC) of the water be below 100.

5. Usage Water Conditions

- Conditions that would cause sudden changes in the oxygen content of the water should be avoided. Both deoxygenating the water using gases such as nitrogen and oversaturating it with oxygen are harmful. These fluctuations in the oxygen content promote the formation of copper oxide (Cu₂O) and increase the amount of particulate matter.
- A high electrical resistivity of the water reduces the tendency for corrosion in the system. Therefore, it is recommended that the water's electrical resistivity be greater than 30 Ohm.m. The electrical conductivity of the water should be below 20–60 mS/m.
- The ideal pH value of water at 20–25°C should be between 7 and 8 (7 < pH < 8).

Parameter	Unit	Analysis Method	Limit Values
PH	-	SM 4500 H ⁺ B / Electrochemical Method	7<pH<8
Alkalinity	mg/l	SM 2320 B / Titration Method	100
Ammonium	mg/l	SM 4500 NH ₃ B / SM 4500 NH ₃ C Distillation Method / Titrimetric Method	Should Not Be Present
Iron (Fe)	mg/l	EPA 200.7 / ICP OES Metodu	<5
Fluoride	mg/l	SM 4500 F B / SM 4500 F - D Distillation Method / Spectrophotometric Method	<0,1
Conductivity	mg/l	SM 2510 B / Laboratory Method	20<< 60
Chloride	mg/l	SM 4500 Cl B / Iodometric Method I	< 10
Oxygen Saturation	mg/l	SM 4500 O C / Luminescence Electrode Method	-
Silicon (Si)	mg/l	EPA 200.7 / ICP OES Method	< 1
Sulfate	mg/l	SM 4500 SO ₄ E / Turbidimetric Method	< 30
Total Hardness	mg/l	SM 2340 C / EDTA Titrimetric Method	> 0,5



6. Maintenance

To minimize physical and corrosion effects caused by the makeup water in Tanpera evaporators, it is recommended to comply with the conditions specified below. The pH level, alkalinity, hardness, ion content, and circulation temperature of the water affect corrosion and scale formation in heat exchangers and other system components. Recommended water characteristics for cooling systems are provided below. Any malfunctions resulting from non-compliance with the specified water conditions will not be covered under warranty.

- Periodically clean your heat exchangers according to their specific conditions to prevent fouling. Deposits or sludge buildup inside the heat transfer tubes negatively affect the efficiency of the heat exchanger. Noticeable changes in pressure losses or operating pressures can be observed. Regular cleaning is necessary to avoid difficult maintenance and cleaning conditions for your heat exchanger products. Otherwise, blockages and heavy scale deposits will form, making cleaning impossible.
- Neglecting the cleaning of heat exchangers will cause cracks in the tubes. As a result, there may be a need to blind off certain heat transfer tubes. This will lead to significant losses in the product's capacity efficiency. In the blinded tubes, leaks can develop over time from the blinding plugs due to thermal stresses caused by different materials.
- To clean the inside of the heat transfer tubes, open the covers of the heat exchanger and clean the tube interiors with a cleaning rod brush. Additionally, the tubes can be cleaned using chemicals that do not damage the tubes. Consult the manufacturer for advice and information about suitable chemicals.
- If your heat exchanger has a "sacrificial metal-tin" anode rod or plate, check this part during maintenance and replace it with a new one recommended by the manufacturer.
- To inspect and clean the outside of the tube bundle, remove the tube bundle from the shell. This will prepare your heat exchanger for cleaning and inspection.
- Be careful when removing the tube bundle of the heat exchanger. Ensure that the tube bundle is not damaged during removal. Also, during and after the removal process, verify whether the product has been serviced by unauthorized personnel.
- When removing the tube bundle, do not place the load on a single tube or a few tubes in the bundle. During this process, support the tube bundle from the tube sheet and attach the lifting equipment there. If you are going to suspend the tube bundle with a sling, hang it from the tube sheet and baffles—not from the heat transfer tubes.
- Do not transport the tube bundle using equipment such as hooks or clamps, as these can damage the tube bundle. After removing the tube bundle from the shell, place it on a suitable support or stand.

6. Maintenance

- ➔ When removing the tube bundle, a metal support plate can also be used. This way, the tube bundle wrapped around the thin metal plate can be easily removed without any damage.
- ➔ If the heat exchanger has been left in the maintenance area for a long time without any operation, before removing the tube bundle from the shell, gently tap the shell with a hammer to create small impacts. This will eliminate any tightness between the tube bundle and the shell, allowing the tube bundle to be freed and ready for removal.
- ➔ To protect the bent sections of the tube bundle, a suitable protective sheet should be applied to these areas.
- ➔ When removing U-tube bundles, place the tube bundle on a wooden V-shaped support. This way, the tube bundle rests on wooden supports, protecting it from damage on the ground.
- ➔ Do not drag the tube bundle anywhere. As a result, the support plates, baffles, and heat transfer tubes can be easily damaged.
- ➔ Some methods for cleaning the shell or heat transfer tubes in heat exchangers are as follows.
 - Cleaning of shell pipes can be done using hot water and, additionally, non-abrasive cleaning chemicals. Brushing can speed up and enhance this cleaning. This method easily removes sludge and dirt from inside the shell pipe.
 - If there is a salt deposit, it can be easily cleaned with fresh water.
 - Cleaning can also be easily performed with some special cleaning chemicals. However, for suitable cleaning products, information and consultation should be obtained from Tanpera or from cleaning product companies authorized by Tanpera.
- ➔ In some types of heat exchangers, deformation of the tube bundle ends or finned tubes may occur during washing. Cleaning of these types of heat exchangers should be done more carefully without damaging the fin structures. If necessary, chemical cleaners should be used for cleaning these products, and high-pressure spray cleaning methods should be avoided. When needed, consult Tanpera for advice.
- ➔ If the layer to be cleaned is thick and cannot be removed chemically, begin mechanical methods. Tap the shell pipe from inside and outside using a hammer. If you need to use a chisel, ensure that it is not too sharp or pointed. Take extra care to prevent any damage to the tube bundle or shell.

6. Maintenance

- ➔ Do not attempt to clean the inside of the tubes by injecting steam. The thermal stresses caused this way can lead to cracks, fractures, and leaks at the tube connections or joints.

To locate damaged or burst tubes, apply the following methods:

- Remove the heat exchanger cover and securely reattach the tube bundle to the shell connection.
 - Preferably pressurize the shell part of the heat exchanger with water or a similar non-flammable liquid.
 - Check all joints, welds, tube sheet, and tube connections for leaks.
-
- ➔ After a heat exchanger is disassembled, new gaskets must absolutely be used during reassembly.
 - ➔ Used gaskets cannot be re-compressed and lose their sealing properties.
 - ➔ After disassembly and reassembly, if possible, it is recommended to use new and original bolts.

7. Additional Information

- The evaporator should be used in a horizontal position.
- During water filling, any air inside the product must be completely vented.
- Ensure that the pressure drop and operating conditions comply with the catalog values.
- Do not stop the water flow before the refrigerant in the evaporator is fully drained.
- If you are not going to use the evaporator, fill it completely with antifreeze fluid ensuring no air remains inside, or completely drain it making sure the interior is dry.
- Regularly check the chemical properties of the water circulating inside the evaporator. Unsuitable water conditions can damage the evaporator.
- If you experience capacity loss, you can briefly operate the system in reverse for cleaning purposes.
- Keep the evaporator away from vibrations and sources of vibration.
- Prevent the presence of foreign particles in the water.
- Use antifreeze solution below 0 °C.
- Prevent pump cavitation and air formation in the system.
- Do not operate the cooled fluids at temperatures close to their freezing points.
- Do not exceed the allowed water flow rates.
- Construct the water piping with the equivalent dimensions specified for the evaporator model. Deviations from these specifications may cause uneven flows inside the evaporator and potentially damage it.



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