HEAT EXCHANGER TECHNOLOGIES

GENERAL-PURPOSE USER GUIDE

REFKAR
Heat Transfer Solutions

CONTENTS

Introduction

Thank you for choosing and ordering Refkar products. The REFKAR product you have used or you will use has been carefully designed and meticulously produced by our company in order to better meet your needs and ensure that you share your appreciation with others for long years. If you share your satisfaction, complaints and opinions related to the REFKAR product you are using, they will play a role in the enhancements to be performed on the product by our company and help us raise our service and product quality even higher.

Purpose of the Operation Manual

The information in this booklet serves as a manual for the personnel involved in the assembly, maintenance and use of the product. Please read this booklet before you perform any assembly works or practices on any REFKAR products and use your product in accordance with the specified instructions.

Before putting the product into practice, recommendations and rules must be controlled according to the characteristics of the assembly site and the materials to be used, and it must be ensured that the product that is suitable for the practice and controlled with technical drawings is used.

Performance

It is advised to pay attention to the following in order to obtain the best performance from the REFKAR product you will use and not to encounter any use or maintenance difficulties:

- The suitable product must be selected according to the accurate operating temperatures.
- The product with suitable physical characteristics must be selected.
- The product that is suitable for the characteristics of the cooling refrigerant and the refrigerant to be cooled, and whose measurement and capacity data and drawings have been controlled and approved must be selected.
- The product must be reserved under appropriate conditions before assembly.
- Suitable assembly method, connection hardware and installation measurement must be selected.
- Practice method should be correctly selected.
- Attention must be paid to meticulous care and frequent cleaning.
- Assembly, maintenance and repair must be performed by well-equipped, authorized and informed personnel.

Decrease in the product's performance or unusual work performance is related to one or more of the following conditions.

- When the heat exchanger starts to be dirty.
- If required protection components such as taps, etc. are kept on the product during storage.
- If the anticipated working conditions do not match with the product's design conditions.
- If gas is entrapped in the product or air is entrapped / produced in the liquid line.
- Improperly applied pipe installation or pipe installation measurement.
- If heat exchanger's internal parts are exposed to extreme corrosion.
- Vibrations in the assembly line
- Unsuitable or incorrect application.

Delivery, preservation and storage conditions

REFKAR products are secured against any difficulties that may arise in the course of forwarding. If the product is not to be used immediately in the application area, it must be preserved in its original packaging or box / crate. The user accepts the integrity and responsibility of the product they purchase. REFKAR is not to be held responsible for the impairments, damages and failures that may arise in the course of the transfer or storage of the product purchased by the customer.

Considering the delays arising from repairs or similar situations on the required product due to faulty preservation, correct forms of preservation come into prominence. The following advised preservation conditions are intended for providing the user with convenience, and the user will decide which is correct or necessary.

1. When you receive the heat exchanger, identify the transport damages that may arise despite all protective precautions. If any transport damages are identified, immediately inform REFKAR or the transport company. Specify this damage on the invoice or the dispatch note before accepting the product. Products with removed, deformed or illegible labels are not within the scope of warranty.

2. While carrying your heat exchanger, use equipment such as cranes, forklifts, levers, ropes, chains, etc. Do not lift the product manually or with physical strength. These highly heavy products may lead to permanent physical injuries due to incorrect transportation.

3. Be careful in the course of transportation. Do not crash or drop the product. Your heat exchanger's copper pipe bundle is sensitive to such situations and may be damaged. Cracks and leakages may develop.
4. If your heat exchanger is not properly preserved, take immediate precautions against corrosion and abrasion.
5. The internal part of the heat exchanger is closed to avoid continuous contact with air. Therefore rust formation or dirt accumulation is prevented. Be sure that your heat exchanger's protection covers or taps are mounted during preservation.

6. If the customer specifies the storage conditions while giving the order, a packaging type specific to the customer is provided and products are stored in REFKAR factory in this type of packaging before shipment.
7. Dirt, snow, moisture, dust and similar residuals on the product packaging should be removed before moving the exchanger into indoor storage. Accumulation of moisture inside or on the product usually indicates corrosion and rusting have already started.

8. Keep your REFKAR products in dry, warm and moisture-free environments as much as possible. Relative humidity percentage of the product's storage area is recommended to be 40% and lower. Air moisture accumulation inside the product should also be prevented in maintenance and assembly phases.
9. Use of dehumidifiers is recommended in the storage area in order to avoid moisture-related damages on REFKAR products.
10. We recommend that you keep a record of the products in the storage area and comply with the storage procedure. The following matters should be recorded in the stage of storage.
    a. Storage date
    b. Controller's name and surname
    c. Product card and product's serial number
    d. Storage location
    e. Product's coating or paint condition
    f. Internal condition
    g. Moisture condition
    h. Environmental pollution and product contamination
    i. Taken corrective precautions
11. Products are forwarded after being painted by REFKAR as a standard. Paint is a factor that prolongs the product's operational life. However, it is not a complete protection factor against external factors such as impacts, collisions and scratches. Periodically painting the products during the operational life will prolong their life against external factors.
12. If there is a scraping on the product's paint or there is corrosion started by scraping, it is recommended to contact REFKAR or immediately paint the problematic spot with suitable paint. If there is corrosion on the spot to be painted, the spot should at

first be cleaned with a wire brush and then repaired with the paint suggested by REFKAR. Detailed information regarding the paint can be received from REFKAR. However, a complete guaranty is not assured even if the damages on the paint are repaired.

13. It is under the customer's responsibility to take precautions against all other problems that may arise due to storage conditions. All REFKAR products must be protected with all kinds of precautions including but not limited to the above-mentioned 13 articles.

Products you receive are not under protection against natural disasters such as fire, flood or earthquake. Therefore, REFKAR does not assure warranty for its products against damages occurring due to such or similar causes in the storage area.

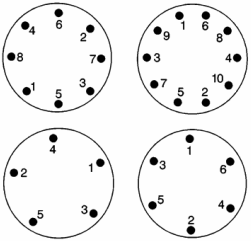
INSTALLATION

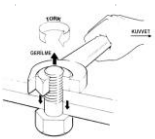
1. REFKAR recommends that the product you purchase is installed by authorized and trained personnel who are familiar with the system design, pressure, heat rates and heat changes, and the installation of iron, PVC and copper pipes.
2. Before using the heat exchangers, evacuate the test or safety gas inside the products. Standard delivery for the products is in vacuum and they can be delivered in 6-bar nitrogen upon request of the customer.

6 bar

3. Some heat exchanger fasteners have been tightened with screw stabilizer liquid while others have been tightened without the liquid. Gaskets may get loose in time in gasket-sealed connections. Against such possibilities, check the tightness of all screws on the product you have purchased. Tighten the loose bolts with specified torque values. Perform the tightening operation according to circular tightening procedure. Bolt tightening procedure and tightening torques are listed in the tables below

"Bolt Tightening Procedure for 8.8 BOLT"





Bolt Size	Step (mm)	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

4. The heat exchangers you will use are not suitable to receive load. The highest permitted weight that can be placed on the product cannot exceed 400 kg. However, if equipment such as a compressor, etc. is to be mounted on the product, the customer must consult with REFKAR for product adjustment to endure the weight in question.

5. Some hand tools that you may need during installation may be specified as wrenches, pipe wrench, teflon bands or other sealing compounds that are suitable for pipe connections, torque-limiting wrench, various pliers, metal shimmers, wire brushes and gaskets in various sizes.

6. It is recommended to place by-pass lines and valves on both circuits of heat exchangers during installation. In this way, the cleaning, surveillance and repair of products are made convenient.
7. It is recommended to take cautionary precautions and pay attention to explanations during installation, maintenance or cleaning.
8. It is important to apply heat and pressure measuring components on locations close to the product on both circuits of the heat exchanger and operate between the suggested heat and pressure values. REFKAR is not responsible for products not used within the limits.

9. Use gas and water connection components within measurements recommended for the product and specified on technical drawings and catalogues.
10. Use counter flanges and gaskets that are suitable for the product's flanges.
11. There must be an air bleeding valve on the installation where the product is mounted. It is compulsory to use a **safety valve** on the pressure vessel heat exchangers you will use.
12. Fasten the product on the area of use by using a sufficient number of support and connection components. This is how you ensure protection avoiding installation or flow stresses and vibrations. Be sure that fitting screws are completely tightened. Connection joints are recommended to be at least one size bigger than bolt diameter to easily reach each other. This makes it easier to center the joints.
13. It is recommended to use suitable liquid level indicators, liquid flow control components, discharge valves, heat control components, pressure sensors, and alarms and similar warning components.
14. Sight glasses or flow control alarms must be used for all fluids in the gas or liquid phase in order not to encounter any flow-related problems. Therefore, deficient or excessive flow is kept under control. Situations such as overflowing, etc. are not encountered.
15. Accurately identify with which fluids the REFKAR product you have installed will operate. In systems operating with water, the corrosive effects of water will shorten the operating life of the product in copper pipe heat exchangers. It is recommended to use protective chemicals or water under correct conditions. Water-related conditions are specified in the subsequent sections.
16. A **safety valve** with appropriate values must be used as a precaution against an explosion that may arise due to the pressure created by the compressor, pump or other equipment in the heat exchanger.

Do not connect the discharge line to a closed circuit. It makes it difficult to discharge the product when necessary.

17. Ensure that no objects such as foreign materials, screws, nuts, tightening switches, drill bits, etc. are dropped or forgotten inside the product during installation. Check this possibility manually and visually prior to closing connection points. Such objects result in permanent damages in heat transfer pipes. REFKAR does not accept responsibility for failures caused by such situations.

INSTALLATION AT CONSTRUCTION SITE

1. If the product you will use is located at the storage area before installation, primarily check the product against any failures. Ensure that there is no dirt or residue, or cutting and piercing parts inside the product. Check the product's paint and damages if any. Parts that remain inside the product may damage both the product and the installation when flow starts running after installation.
2. If the product you will use has been picked up from the company or a dealer instead of the warehouse, check the product against damages that may occur during transport prior to using the product. If the product has been damaged during transport and the damage is significant, inspect the occurrence of the damage and check the protection caps and packaging. If there is a serious damage on the product, it is recommended to immediately report the situation to the transportation company and REFKAR and not to use the product.
3. Ensure that the connection components and connection pipes are mounted with relative ease during installation. If compulsion is required, consult with REFKAR's authorized personnel.
4. Inspect the line against all foreign bodies prior to connecting your heat exchanger to the pipe line. Keep away all wooden, plastic, etc. packaging parts from the product before starting the installation. Do not keep any fluids inside the product before the installation. Do not leave the product containing fluid in open space against the risk of freezing.

IMPLEMENTATION

1. Ensure that the installation is clean before implementing the REFKAR products. Check and ensure that necessary filters are mounted. If there is a balance tank, ensure that there is no dirt or residue inside this tank.
2. Ensure that the valves are switched on before starting the product.
3. Perform the commissioning procedure gradually.
4. You may switch off the supply valves after the heat exchanger is completely filled with fluid.
5. Ensure that the gasket connections are performed correctly. Errors in gasket connections may lead to leakage during implementation.
6. The use of the product outside of the permitted pressure and temperature limits and with fluids other than those recommended is dangerous. Do not use the product you have purchased outside of the limits specified on the product label.
7. Take necessary precautions in order to avoid possible damages that may arise inside the water hammer and the heat exchanger.

8. Discharge and store the fluids inside of the product when the product is not in use or is switched off for long periods of time, or strengthen your product with chemical additions that will provide durability against freezing and corrosion.
9. Use frost inhibiting chemicals in the products operated under the freezing temperatures of the fluids that are used. Use anti-freezing agents or similar frost inhibiting chemicals against the risk of freezing in products cooled with water.
10. An exemplary anti-freezing agent usage table is given below for water use against the risk of freezing. The following table is an example and it is required to act in accordance with the usage conditions specified by the manufacturers of the anti-freezing agents for the right application. Check the freezing temperatures of the necessary measuring devices and anti-freezing solutions in order to tell that a sufficient amount of anti-freezing agent has been used.

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

11. Ensure that there are no external or flow-related vibrations inside the product after all kinds of implementations. Vibrations in the heat exchanger would cause problems inside of the product and shorten its operating life.

12. Flow amounts and flow rates should not be below or above the limits recommended for the product. Flow conditions outside of the limits result in vibrations in the product and in this case problems may arise in the pipe bundle in a short period of time. Fractions, lacerations, fissures and friction-induced damages would occur in the pipe bundle due to vibrations.
13. Perform the procedures to be applied in a new heat exchanger in order to protect the heat exchangers that are not to be operated for a long time from external factors such as freezing, corrosion, etc. Take precautions to prevent freezing and corrosion.
14. If the product is to be deactivated for a short period of time, the water inside the product should be discharged and internal surfaces should be dried with dry air.
15. If the application specified in the 12th article cannot be performed, effects such as biological contamination, corrosion, etc. caused by stable water should be removed by providing periodic water flow.
16. Liquid flows should be adjusted according to thermal shocks in all switching on and off procedures. Commissioning and shutting down procedures should not be performed within the flow values that are outside of the implementation temperatures.
17. Mutual equilibrium temperature of fluids should be ensured through by-pass in order to protect the product from thermal stress. Utmost attention should be paid to sudden flow stoppage and restarting situations. Severe thermal shock may be seen in products exposed to high temperature for long periods of time.

UTILITY WATER CONDITIONS

It is recommended to comply with the following conditions in order to minimize the physical and corrosive effects caused by the utility water in REFKAR Shell&Tube heat exchangers. Water's pH value, alkalinity value, hardness, the amount of ions in the water and the temperature of the circulating water are factors for the formation of corrosion and lime stone in heat exchangers and other installation components. The water characteristics recommended for cooling systems are as follows. Failures that may arise as a result of non-compliance with the specified water characteristics **"ARE NOT REGARDED WITHIN THE SCOPE OF WARRANTY"**.

1. Ammonium ions in water (NH_4^+) are very destructive for copper. These ions are one of the most important factors that affect the operational lives of copper pipes negatively.
There should certainly not be any ammonium ions (NH_4^+) in water.
2. Chlorine ions (Cl^-) lead to the formation of little holes on the surfaces of copper pipes due to corrosion. Chlorine ions in water should not exceed <10 mg/l.
3. Sulfate ions (SO_4^{-2}) result in corrosion and the formation of little holes on the surfaces of copper pipes. Amount of sulfate ions in water (SO_4^{-2}) should not exceed <30 mg/l.
4. Fluorine (F^-) ions in water lead to acid formation and corrosion. Its amount in water should not exceed <0,1 mg/l.
5.Iron (Fe^{+2} and Fe^{+3}) ions combine with dissolved oxygen in water and result in the formation of rust and mud in installation. Therefore, there should not be iron ions in water. If the amount of dissolved oxygen in water is below <5 mg/l, the amount of dissolved iron in water should not exceed <5 mg/l.
6. Dissolved silicon in water has the hazardous potential of forming acid and corrosion.
Its amount in water should not exceed <1 mg/l.
7.Total hardness of water should be TH>0,5 mmol/l. Total hardness of water is recommended to be between 1 mmol/l and 2,5 mmol/l. Formation of deposition on the internal and external surfaces of copper pipes would limit corrosion in copper pipes. However, high water hardness would result in excessive amounts of lime stone formation inside the copper pipes and prevent water flow and heat transfer. Total alkalimetric titration value of water (TAC) is recommended to be below <100.
8. Conditions may cause sudden oxygen changes in water should be avoided. Deoxidization of water with a gas such as nitrogen, etc. is hazardous as well as saturating the water with oxygen. Such irregularities in the oxygen amount of water incite copper oxide (Cu_2O) formation and increment of particle amounts.
9. High electrical resistivity of water decreases corrosion tendency in the system. Therefore, water's electrical resistivity is recommended to be above >30 Ohm.m. Water's electrical conductivity should be below < 20 ÷ 60 mS/m.
10. Water's ideal pH value at 20÷25ºC should be between 7<pH<8.

MAINTENANCE

1. Clean your heat exchangers periodically against contamination according to their specific conditions. Dirt or sludge residue forming in heat transfer pipes negatively affects the efficiency of heat exchangers. Pressure losses or significant changes in

operating pressures are observed. Periodical cleaning is necessary to avoid complicated maintenance and cleaning conditions in your heat exchanger products. Otherwise blockages and material formations such as heavy lime stones, etc. would take place and their cleaning would not be possible to perform.

2. Failing to perform the cleaning of heat exchangers would lead to bursting in pipes. As a result, the probability of having to use the blanking method on heat transfer pipes would arise. And this would result in serious losses in the product's capacity efficiency. Leakages may occur from blanking plugs in time due to the thermal stresses of different materials in blanked pipes.
3. Open the covers of the heat exchanger in order to clean the internal surface of the heat transfer pipes and clean the insides of the pipes with a cleaning rod brush. In addition, cleaning of the pipes' internal surfaces can be performed with chemicals that do not damage the pipes. For this purpose, consult with the manufacturer and inquire about the suitable chemicals.
4. If there is a "sacrificial metal-zinc" anode rod or plate in your heat exchanger, check this part during maintenance and replace it with a new one recommended by the manufacturer.

5. Remove the pipe bundle from the body tube in order to check and clean the external surfaces of the pipe bundle. This is how your heat exchanger becomes ready for cleaning and control.
6. Be careful while removing the pipe bundle of the heat exchanger. Ensure that the pipe bundle is not damaged during removal. Additionally, check if the product has been taken to maintenance by unknown persons during and after the removal process.
7. Do not connect the load to a single pipe or a few pipes in the pipe bundle while removing the pipe bundle. During this process, receive support from the mirror sheet where the pipe bundle is connected, and use loading equipment after connecting it here. If you are to suspend the pipe bundle with a lasso rope, suspend it from the mirror sheet and guiding curtains instead of the heat transfer pipes.
8. Do not carry the pipe bundle using equipment such as hooks and swivels. Such equipment may damage the pipe bundle. Place the pipe bundle on a suitable stand/base after removing it from the body.
9. A metal bedding plate can be used while removing the pipe bundle. In this way, the pipe bundle wrapped in a thin metal plate can easily be removed from its place without getting any damages.
10. If the heat exchanger has been kept in the maintenance site for a long period of time without any procedures performed on it, hammer the body with small strikes before removing the pipe bundle from the body. This is how congestions of the pipe bundle inside the body are removed, and the pipe bundle is released to be ready for removal.
11. A suitable guard sheet should be applied here in order to protect the twisted parts of the pipe bundle.
12. When you extract the U pipe bundles, place this pipe bundle on a V-shaped wooden stand. In this way, the pipe bundle is bedded on the wooden stand against the damages it could get on the floor.
13. Do not drag the pipe bundle anywhere. This could easily damage the support

sheets, guiding curtains and heat transfer pipes.

14. Some methods recommended for the cleaning of body pipes or heat transfer pipes in the heat exchangers are as follows.
    a. Cleaning can be performed in body pipes with hot water and in addition cleaning chemicals that are not abrasive. This cleaning process can be accelerated and strengthened with a brush. Mud and dirt can easily be removed from the body pipes through this method.
    b. If there is a salty formation, it can easily be removed with clean water.
    c. Cleaning can also be performed easily with some special cleaning chemicals. However, you should inquire and consult with REFKAR or the cleaning products company authorized by REFKAR for the suitable cleaning products.
15. Deformation may be observed on the tips of pipe bundles or, if any, in the finned pipe structures during washing in certain types of exchangers. Cleaning should be performed more carefully on such heat exchanger types without disrupting the fin structures. Chemical cleaning materials should be used in the cleaning of these products if necessary, and high-pressure spray cleaning methods should be avoided. You should ask REFKAR for advice when necessary.
16. If the layer to be cleaned is thick and cannot be cleaned with chemicals, initiate using mechanical methods. Expose the body pipe to impacts from inside and outside with the help of a hammer. If you need to use a chisel, be sure that the chisel is not very sharp or pointed. Pay utmost attention not to damage the pipe bundle or the body.
17. Do not try to clean the pipes by raising steam into them. Thermal stresses caused by this method may result in breakages, fractures and leakages in pipe connections or joints.
18. Apply the following methods to find the damaged or burst pipes:
    a. Remove the cover of the heat exchanger and fasten the pipe bundle on the body connection again.
    b. Pressurize the body part of the heat exchanger preferably with water or similar non-flammable liquids.
    c. Check all joints, welded points and mirror sheet pipe connection points against leakages.
19. After a heat exchanger is dismantled and disintegrated, it is compulsory to use new gaskets during reassembly.
20. Used gaskets cannot be squeezed again and lose their sealing capability.
21. It is recommended to use new and original bolts if possible following the disassembly and assembly procedures.

WARNINGS

Do not, under any circumstances, open and loosen covers and connection points when your heat exchanger is under pressure or pressurized. Do not perform procedures such as welding on the product, and do not perforate it with a drill or with other drilling devices. Such physical implementations may result in an explosion and therefore injuries and loss of life.

Use handling equipments while moving your heat exchanger. Do not raise or lift the

product manually or with body strength. Use safety goggles, safety helmets, gloves and suitable clothing while performing maintenance. Do not perform any processes on the product prior to putting on your work shoes. Physical injuries and disabilities may ensue when these precautions are not taken. REFKAR is not responsible for such cases.

Avoid direct contact with the fluids circulating inside your heat exchanger. Fluids inside the product may be harmful to health. Be sure that gas has been discharged or stored in a safe place before performing any procedures on the products in which gases circulate. If fluids are liquids, do not perform any procedures on the product before studying the safety procedures of the liquid circulating inside the product. REFKAR is not responsible for the inconveniences that may arise due to improper practices.

You may find metal particles and cleaning material residues in the cleaned product while performing maintenance on your heat exchanger. Take precautions to protect yourself from them. Use safety goggles to protect your eyes from chemicals. Use gas masks when necessary.

Do not spray pressurized air into the heat exchanger while operating with flammable fluids or similar cleaning solutions.

PRACTICAL INFORMATION

- The evaporator should be used in horizontal position.
- The water should be evacuated from the product before filling water.
- Make sure that the pressure drop and application conditions specified in the catalog are secured.
- Do not stop the water flow until the liquid coolant in the evaporator is evacuated.
- When not in use, fill the evaporator fully with antifreeze without any air bubbles or fully drain it and make sure that it is dry.
- Regularly check the chemical properties of the coolant circulating in the evaporator. Unsuitable coolant conditions may damage the evaporator.
- Reverse operate the system for cleaning in case of diminished performance.
- Keep the evaporator away from vibration or sources of vibration.
- Prevent foreign particles in the coolant.
- Use antifreeze solution under 0 °C.
- Prevent pump cavitation and formation of air in the system.
- Do not operate the cooled liquids close to freezing temperature.
- Do not exceed the allowed water flow.
- Observe the water installation specifications in the evaporator model. Otherwise, there may be unstable flows in the evaporator. The evaporator may be damaged.

Refkar Soğutma ve Isı Transfer Cihazları San. Ve Tic. Ltd. Şti.
KOSKOOP Org. San. Böl. Ömerli Mah.
Seciye Sk. No.9 Arnavutköy / Istanbul - Türkiye
Tel: +90 212 671 95 99 – PBX Fax: +90 212 671 91 44
www.refkar.com / info@refkar.com