R+L HYDRAULICS
HYDRAULIC COMPONENTS BY TIMKEN

Operating instructions

Shell-and-tube heat exchanger

BNZ series

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1 Introduction

1.1 About this instruction manual

This operating manual will familiarize you with the use of the BNZ series shell-and-tube heat exchanger from R+L Hydraulics GmbH. The instructions allow you to get started quickly and contain all the necessary information for the safe and competent use of the heat exchangers.

This guide discusses the functionality and handling of heat exchangers of the BNZ series. Further information can be found in the corresponding data sheets. Information on other series is available on request from R+L Hydraulics GmbH or at www.rl-hydraulics.com.

Knowledge of this manual is mandatory for the use of a shell-and-tube heat exchanger of the BNZ series from R+L Hydraulics GmbH. Therefore, please familiarize yourself with the contents and follow in particular the safety instructions when handling the heat exchangers. This ensures the full use of the product's performance. Product changes in the interest of technical development are reserved.

1.2 Instructions for use

The operating instructions are divided into 9 chapters. On each page, you will find the chapter title on the right or left side of the header. The footer contains the status of the operating instructions in the form of an issue date and the page number. To make it easier for you to navigate, the operating instructions contain cross-references that you can use to find your way around the document.

When working with the electronic document, click on the left mouse button to go directly to the referenced location. You can also reach the desired location from the table of contents and the table of figures.

The following warning and information symbols as well as signal words are used in this operating manual:

DANGER
Warning of possible dangers to life and limb

DANGER
Warning of possible dangers to life and limb due to poisoning

ATTENTION
Warning of possible damage to property and equipment

HINT
Application tips and useful information

HINT
Environmental protection notice

1.3 Intended use

Shell-and-tube heat exchangers from R+L Hydraulics GmbH are designed for use with specific media, pressures, temperatures, operating characteristics, etc. The exact specification must be determined with R+L Hydraulics GmbH before the use of a heat exchanger on the basis of the operational requirements and conditions available to the operator. The technical conditions of use of each heat exchanger can be seen on the nameplate and in the data sheet.

The shell-and-tube heat exchanger may only be operated by trained personnel in compliance with all safety instructions listed in these operating instructions. Safe and error-free operation is only guaranteed when used as intended in accordance with the instructions in this manual.

Any use beyond this is considered not to be in accordance with its intended purpose. For all personal injury and property damage resulting from improper use, it is not the manufacturer who is liable, but only the operator.

1.4 Warranty and liability

In principle, the general terms and conditions of sale and delivery handed over by R+L Hydraulics GmbH to the operator of the shell-and-tube heat exchanger apply. If these are not available, they must be requested from the manufacturer.

Warranty and liability claims for personal injury and property damage are excluded if, among other things, they are attributable to one or more of the following causes:

- Improper use of the heat exchanger
- Improper commissioning, installation, operation and maintenance or servicing of the heat exchanger
- Structural changes to the heat exchanger
- Operation of the heat exchanger in the event of improperly installed connections to the system systems and defective or improperly installed safety devices
- Failure to observe the safety regulations and instructions in this operating manual
- Use of other spare and wear parts as well as operating fluids and cleaning agents as recommended by the manufacturer

R+L Hydraulics GmbH exclusively assumes warranty and liability for material and manufacturing defects.

2 Safety

2.1 Standards and regulations

The shell-and-tube heat exchanger is built in accordance with the currently valid rules of technology and is operationally reliable. The basic safety and health requirements of the applicable laws, standards and directives were applied in the design of the heat exchanger. The safety of the heat exchanger is confirmed, if necessary, by the CE marking and the declaration of conformity.

All safety information in this operating manual refers to the currently valid national laws and the regulations of the European Union. In other countries, the applicable laws and state regulations must be complied with.

In addition to the safety instructions in this operating manual, the generally applicable regulations for accident prevention and environmental protection must be observed and complied with. All information in the operating instructions must be followed without restriction at all times. In addition, all safety instructions in the "Data sheet Warnings and Safety Instructions for Hydraulic Systems" must be observed.

2.2 Basic safety measures

The following basic safety measures must be observed at all times:

- ☐ The shell-and-tube heat exchanger may only be used as intended.
- ☐ The heat exchanger may only be installed, operated and maintained by trained and instructed specialists. The staff must have read and understood the operating instructions. This includes, in particular, knowledge of how the risk of injury to the operator and third parties can be averted.
- ☐ All safety instructions in this operating manual and in all applicable documents must be observed and adhered to.
- ☐ Unauthorized persons must not have access to the heat exchanger.
- ☐ Loss of use and environmental damage due to incorrect handling must be ruled out.
- ☐ During transport, assembly and disassembly, operation, care and maintenance, the relevant regulations on occupational safety and environmental protection must be observed.
- ☐ All work on the heat exchanger must be carried out carefully and with a "safety" in mind.

- When installing the heat exchanger in a system, the manufacturer of the system is obliged to include the regulations, notes and descriptions contained in this operating manual in his operating instructions.
- Spare parts must always be purchased from R+L Hydraulics GmbH. R+L Hydraulics GmbH assumes no liability for damage resulting from the use of spare parts from other manufacturers.

2.3 Technical condition

The following should be noted:

- In order to avoid hazards and to ensure optimum performance, no changes or modifications may be made to the heat exchanger.
- The operator is obliged to operate the heat exchanger only in a perfect, safe condition. The technical condition must comply with legal requirements and regulations at all times.
- The heat exchanger must be checked for damage and proper condition before each commissioning of the system in which it is integrated.
- Any changes to the heat exchanger that affect safety must be reported to the operator immediately by the personnel.
- The heat exchanger must only be connected to the supply lines provided and designed for this purpose.

2.4 Safety requirements for assembly and installation

The following safety requirements must be met when assembling and installing the shell-and-tube heat exchanger:

- As a matter of principle, the heat exchanger may only be installed by trained and instructed specialists.
- Unauthorized assembly or installation work is not permitted.
- During transport, the components of the heat exchanger must be secured in accordance with the regulations of the transport aid used.
- Only sufficiently dimensioned hoists and slings may be used for transport.

2.5 Safety instructions for operation

The following safety instructions must be observed when operating the shell-and-tube heat exchanger:

- ☐ On site, the operator must provide safety devices such as safety valves, thermal protection covers, temperature sensors, etc., depending on the operational requirements. The heat exchanger may only be operated if all safety devices are in place and functional. The proper condition of the safety equipment must be checked regularly, and any defects that may occur must be rectified immediately.
- ☐ The heat exchanger must be equipped with mechanical protection against unauthorised access and contact.
- ☐ The heat exchanger must not be exposed to overtemperature or overpressure.
- ☐ The operational reliability of the heat exchanger must be ensured at all times.
- ☐ Throughout operation, it must be ensured that the operating conditions correspond to the use of the heat exchanger.
- ☐ The system must be shut down immediately if changes to the heat exchanger are detected during operation, such as an increased operating temperature.
- ☐ Work on the heat exchanger may only be carried out when the system is at a standstill.
- ☐ A sign must be placed at the switch-on point of the system indicating that work is being done on the heat exchanger.
- ☐ Welding work on heat exchangers must not be carried out.

2.6 Requirements for staff

Before starting all activities, all personnel must have been familiarized with the dangers of handling shell-and-tube heat exchangers.
The heat exchanger can pose a risk of injury if it is operated by untrained persons.

Every person who is commissioned to start, operate or maintain the heat exchanger must have read and understood the complete operating instructions. This also applies if the personnel concerned have already worked with the heat exchanger or have been trained.

The operating instructions must be accessible to the staff at all times. It is advisable to record the acknowledgment of the content of the operating instructions in writing. Knowledge of the contents of the operating instructions is one of the prerequisites for protecting people from danger, avoiding errors and operating the heat exchanger safely and trouble-free.

Ultimately, the operator or the personnel authorised by him, who have to handle heat exchangers in accordance with their operational tasks, are ultimately responsible for accident-free operation.

To ensure safe handling of the shell-and-tube heat exchanger, personnel are required to:

- ☐ Smoking, eating and drinking are not allowed in the area of the heat exchanger.
- ☐ Working on the heat exchanger in case of fatigue, influence of alcohol and medication is not allowed.
- ☐ The staff must not have any physical limitations that temporarily or permanently restrict attention and judgment.
- ☐ Personnel must wear protective clothing, protective gloves and, if necessary, safety goggles and respiratory protection in accordance with the work at hand.
- ☐ All safety instructions in this operating manual and in all applicable documents must be observed and complied with without restriction at all times.
- ☐ If hazards that could lead to personal injury are detected, the system in which the heat exchanger is integrated must be switched off immediately.
- ☐ Personnel must have in-depth knowledge of the following operating procedures, regulations, behaviors and components: – Operating procedures in the interaction of the heat exchanger with the Enclosure
  - – Safety devices of the heat exchanger and their proper functioning
  - – Demarcations, fuses and markings of the heat exchanger's hazardous area
  - – Behaviour and measures in case of danger
- ☐ Maintenance, servicing and repair work on the heat exchanger may only be carried out by trained specialists.

2.7 Handling of auxiliary and operating materials

For all lubricants, operating materials and cleaning agents used in connection with the operation or maintenance of the heat exchanger, the regulations and EC safety data sheets of the respective manufacturer regarding storage, handling, use and disposal must be observed.

The following must be observed when handling auxiliary and operating materials as well as cleaning agents:

- ☐ No substances may be used whose properties are unknown. If necessary, the manufacturer must be consulted.

- Lubricants and operating materials, cleaning agents and their containers must not be disposed of as household waste or end up in the sewer system and soil. The applicable regulations must be strictly observed for disposal.
- The provisions of the safety data sheets for the handling of approved cleaning agents must be observed. Among other things, the following measures must be initiated:
  - After skin contact, clean skin with soap and water
  - After eye contact, rinse your eyes under running water for at least 10 minutes, consult a specialist if necessary
  - After inhalation, supply fresh air or oxygen, consult a specialist if necessary

2.8 Warning and nameplates

The following signage is located on the shell-and-tube heat exchanger (see Fig. 1):

- Nameplate
- Hot Surface Warning Sign

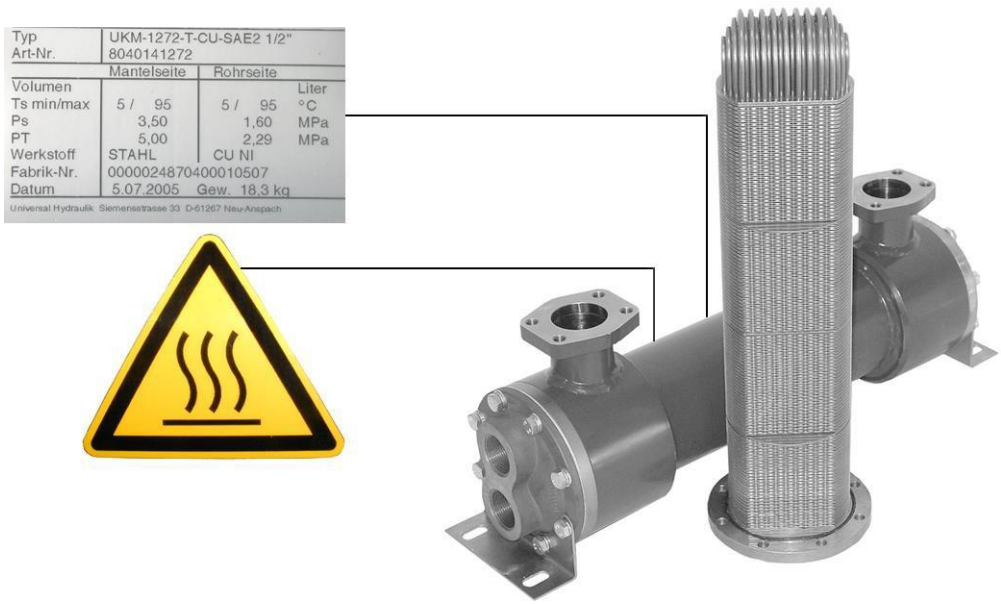

Fig. 1: Signs on the heat exchanger

3 Specifications

3.1 Oil/Water Heat Exchanger Series BNZ

Designation	Value
Operating pressure pipes max	16 bar
Operating temperature min/max	5 °C/95 °C

Table 1: Technical data BNZ series

HINT
Specifications for technical data, such as dimensions, performance data and calculation examples of all heat exchangers of the BNZ series and can be found in the corresponding data sheets.

3.2 Water quality requirements

HINT
All information on water quality requirements are recommendations. In exceptional cases, unforeseen reactions may occur due to certain concentrations of ingredients.

When assessing the available cooling water for use in shell-and-tube heat exchangers, water quality and constituents are important.

The water quality is determined by:

- ☐ Water hardness
- ☐ pH value of the water

3.2.1 Water hardness

The water hardness indicates the content of hardeners (carbonates and bicarbonates).

The hardeners accumulate on the pipe surfaces, especially at higher temperatures, and lead to a reduction in the performance of the heat exchanger. The critical temperature is 63 °C. In the case of very hard water, these deposits must be taken into account when designing the heat exchanger.

Degree of hardness	Water quality
0 – 5 °dH	very soft water
5 – 10 °dH	soft water
10 – 20 °dH	medium-hard water
20 – 30 °dH	hard water
> 30 °dH	very hard water

Table 2: Classification of water quality according to German hardness °dH

The rule of thumb for the conversion into German hardness is:

- ☐ 10 mg/l hardening agent corresponds to 1 °dH

3.2.2 pH

The following applies to shell-and-tube heat exchangers with copper and copper-nickel tubes:

- ☐ pH value not < 6. Smaller values can lead to corrosion problems.

For alkaline water:

- ☐ Water hardness not < 6°dH. Smaller values can lead to corrosion due to free carbonic acid.

pH	Water quality
4,5	Strongly acidic
4,5 – 6,0	sour
6,0 – 6,8	Slightly acidic
7,0	neutral
7,2 – 7,7	Slightly alkaline
7,7 – 8,2	alkaline
8,2	Strongly alkaline

Table 3: Classification of water quality according to pH value

3.2.3 Cooling water assessment by ingredients

The following table gives an overview of the resistance of copper pipes to water constituents in non-drinking water.

Assessment criterion	Approximate concentration range in mg/l	Assessment	Assessment
		Cu-DHP	CuNi10Fe1Mn
pH	< 6	0	0
	6 to 9	+	+
	> 9	0	0
Chloride	up to 1000	+	+
	> 1000	0	+ (<25000mg/l)
Sulfate	up to 70	+	+
	70 to 300	0	+
	> 300	–	+ (<3000mg/l)
Nitrate	up to 100	+	+
	> 100	0	0
Free (aggressive) carbonic acid	up to 20	+	+
	20 to 50	0	0
	> 50	–	-
Oxygen	up to 2*)	+	+
	> 2	0	+
Ammonium	up to 2	+	+
	2 to 20	0	+
	> 20	–	0
Iron (dissolved)	up to 10	+	0
	> 10	0	-
Manganese (dissolved)	up to 1	+	0
	> 1	0	-
free chlorine	up to 5	+	Continuous chlorination <0.5 mg/l
	> 5	0	Shock chlorination <3.0 mg/l
Sulfide		–	0
Ammonia		–	+ (<15mg/l)

Table 4: Assessment of cooling water quality by ingredients

Explanation of the appraisal table column:

+: Usually good resistance

0: Corrosion problems can arise, especially if several factors are rated 0

–: its use is not recommended

*): SF copper has proven to be very effective in the complete absence of oxygen and sulphides dissolved in the water

3.2.4 Cooling water types/special features

Industrial water

The following special features must be observed:

- ☐ Usually treated water (not drinking water)
- ☐ Often has heavy impurities
- ☐ A water analysis is necessary for assessment
- ☐ Copper, brass and steel have good resistance to industrial water

Stream and river water

- ☐ The use of copper-nickel tubes is recommended
- ☐ Cast iron parts must be protected against corrosion by a suitable coating
- ☐ Usually treated water (not drinking water)
- ☐ Often has heavy impurities
- ☐ A water analysis is necessary for assessment

Seawater

- ☐ High content of NaCl, thus good electrolyte
- ☐ When pairing different materials, there is a risk of electrolytic corrosion
- ☐ Materials that are not far apart in the voltage series or use zinc anode are required
- ☐ Brass and copper-nickel alloys have good resistance to seawater

Brackish water

- ☐ Mixture of lake and river water
- ☐ Usually high content of ammonia and chloride, so do not use brass
- ☐ High content of NaCl, thus good electrolyte
- ☐ When pairing different materials, there is a risk of electrolytic corrosion
- ☐ Materials that are not far apart in the voltage series or use zinc anode are required

3.2.5 Flow velocity of water

		Flow rate for heat exchange tubes1) (m/s)				
Material designation		acc. to Lite-Temperatur e	VBG-R-455P		DIN 85004-2 : 1996-06	Guidelines from industrial data
Abbreviation	Number	clean water	Low particulate matter	Sand or Contains suspended solids		
Cu-DHP	CW024A	2	1,5	-		0,9..... 2 [3)]
CuNi10Fe1Mn	CW352H	3,5	2,4	2,0	1.0 - 3.5 [2)]	1,8 ..... 3,5 [3)]

Table 5: Compilation of practical, maximum recommended flow speeds

[1)] : Values for line pipe may be higher

[2)] : Depending on the pipe geometry; Series of standards only covers CuNi10Fe1Mn/ CuNi10Fe1,6Mn

[3)] : Depending on pipe diameter and degree of contamination of the water

HINT
Avoid stagnation, if the circulation is not conditioned, corrosion damage can occur.

The excellent performance properties of the copper-nickel materials are primarily ensured by the formation of a protective layer of Cu(I) oxide. The construction of this layer requires a certain amount of time. The operating conditions of the run-in operation of a new turbine are therefore of decisive importance for the service life.

Resistance to chemicals is determined by the normal voltage series. Here, the copper stands above the hydrogen. This means that it cannot be attacked directly, but only via oxidation. In aqueous solutions and non-oxidizing acids, copper is therefore not attacked in the absence of oxidizing agents.

Copper alloys, on the other hand, are also resistant to some of the weakly oxidizing media, as well as to many slightly acidic to slightly alkaline salt solutions, organic, reducing or slightly oxidizing mineral acids or alkalis, etc.

Copper materials also have at least good resistance to a large number of other common media such as heating oils, fuels or many gases. Copper is not attacked by weakly attacking media, e.g. in the atmosphere or in oxygenated water, as it is able to form protective layers. For copper materials, sulphide impurities, ammonia or ammonia-containing

substances. High iron and/or manganese contents in water as well as extreme contamination with coarse or suspended solids or sand can also have a critical effect - depending on the alloy and system. Copper materials are not suitable for strongly oxidizing acids.

3.2.6 Suitability for seawater

The heat exchangers were developed for operation with seawater as a cooling element, among other things. Nevertheless, there are a few things to consider in operation.

Pitting corrosion on water pipes can have many causes.

- Sand sucked in will cause wear on the pipe surfaces, and these fresh wear spots are then good points of attack for corrosion.
- Particularly critical is the introduction of ferritic rust particles or metal particles, which cause local pitting corrosion on the inner walls of pipes

The origin of these particles is usually the harbour basin or the ship's internal iron pipes for water transport

- Acidic metabolites from biofouling also support the corrosion process

The water cover of the radiator is made of gray cast iron, the surface of which is chemically nickel-plated. The electrochemical potential of the nickel layer is close to that of the water pipes and the tube floor in the voltage series. A zinc anode is not necessary here.

It also becomes critical here if ferritic material (rust) is introduced into this area. Then an attack on the nickel plating is possible and pitting corrosion can occur on the lid.

It will have a positive effect if the heat exchanger is installed vertically so that the particles sink downwards when the water is at a standstill. The aim was to prevent the water from draining off, as the oxygen introduced with the incoming air certainly promotes corrosion.

A good way to keep ferritic particles, sand and biological material out of the heat exchanger is appropriate filtration with a fine filter.

4 Technical description

The shell-and-tube heat exchangers are essentially composed of the following components:

- ☐ Housing with inlet and outlet nozzles (see chapter 4.3)
- ☐ Replaceable tube bundle with aluminum fins
- ☐ Dismountable lids with inlet and outlet nozzles (see section 4.3)
- ☐ Mounting Mounting Bracket (BNZ)
- ☐ Mounting flange for tank installation ()

HINT

Specifications for technical data, such as dimensions, performance data and calculation examples of all heat exchangers of the BNZ series and can be found in the corresponding data sheets.

4.1 Construction

4.1.1 BNZ

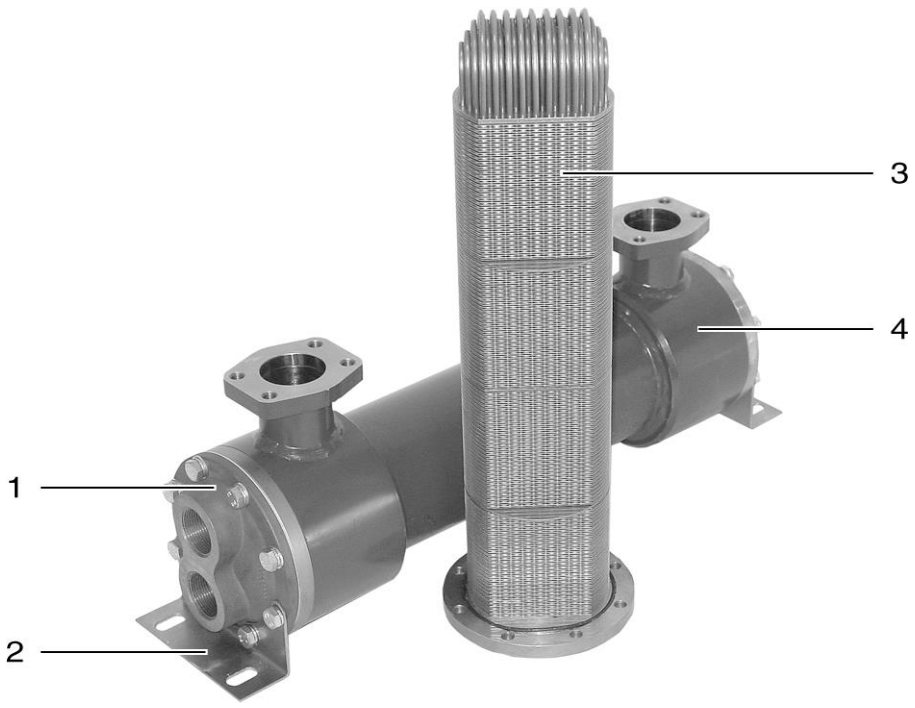

Fig. 2: Components Shell-and-tube heat exchanger (BNZ series)

1 Lid with inlet and outlet nozzle
2 Bolt-on bracket for mounting
3 Tube bundle with aluminum fins
4 Jacket with inlet and outlet nozzles

The tube bundle of a heat exchanger of the BNZ series is replaceably mounted in the jacket. The seal between the jacket and the tube bundle is provided by a round ring. Two covers are screwed to the flanges on the jacket on the entry and exit sides. The seal is provided by flat gaskets between the jacket and the covers. Additional cooling surface is achieved by aluminium fins. These are pushed onto the tube bundles made of copper or copper-nickel tubes and metallically connected to them.
The media can be drained from the heat exchanger in a non-pressurised state via one drain opening at a time (e.g. for the purpose of maintenance or disassembly).

4.2 Description

Shell-and-tube heat exchangers of the BNZ series enable heat exchange between a wide variety of media due to a wide variety of material pairings.

In the case of heat exchangers of the BNZ series, medium 2 (e.g. hydraulic oil) is introduced via an inlet nozzle located on the jacket, guided via deflection segments and discharged via an outlet nozzle.

Via the inlet and outlet nozzles on the covers, medium 1 is passed through the tube bundle twice or several times. In this process, the heat from medium 2 is transferred to medium 1 via the surface of the aluminium fins and the tube bundles and dissipated to the outside with the fluid flow of medium 1.

4.3 Connections

4.3.1 BNZ

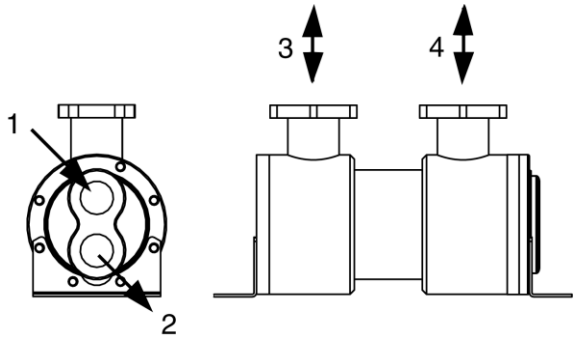

Fig. 4: Connections on the heat exchanger 2-way type "T"

1 Admission Medium 1
2 Exit Medium 1
3 Entry/Exit Medium 2
4 Entry/Exit Medium 2

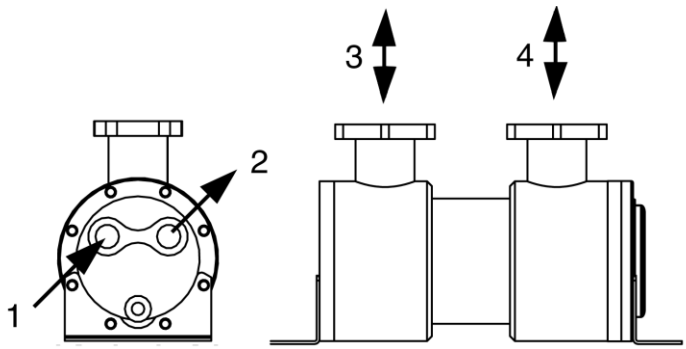

Fig. 5: Connections on the heat exchanger 4-way type "F"

1 Admission Medium 1
2 Exit Medium 1
3 Entry/Exit Medium 2
4 Entry/Exit Medium 2

5 Transport and storage

DANGER

Risk of injury due to improper transport.
The total mass of heat exchangers of the BNZ series and can be up to 150 kg. For this reason, transport may only be carried out with sufficiently dimensioned hoists and slings in accordance with DIN 15003 "Hoists; Load Handling Devices, Loads, Forces, Concepts" and BGV D8 are carried out.

ATTENTION

Warning of possible damage to sealing surfaces.
During transport, care must be taken to ensure that the sealing surfaces of the connection flanges do not get scratched.

ATTENTION

Warning of possible damage to the tube bundles.
When transporting and storing tube bundles, care must be taken to ensure that the fins and tubes are not damaged or bent.

HINT

Risk of contamination by preservatives.
When treated with preservatives, they must not get into the soil or the sewer system. They must be disposed of in accordance with the applicable environmental protection regulations. The same applies to deconservation.

The heat exchanger is transported in cardboard boxes or on wooden pallets, depending on the weight. All openings on the heat exchanger are closed with plugs.

For the storage of the heat exchanger, it must be ensured that all media connections are closed with plugs. The heat exchanger must be protected against corrosion by means of preservatives (e.g. anti-corrosion oil). The storage period of the heat exchanger must not exceed 2 years. When reinstalling, the preservatives must be removed as residue-free as possible.

In order to prevent frost damage at sub-zero temperatures, water must be drained from the heat exchanger when water is used as a cooling medium. Most standard models have drain openings for this purpose. In the case of models without a drain, such a drain must be installed in the outlet pipe for medium 1.

6 Assembly/disassembly

DANGER
Injury.
Before the heat exchanger is installed or dismantled, the system must be taken out of operation and secured against restarting.

DANGER
Risk of leakage of media and thus risk of contamination. If the heat exchanger is located in a system with a tank, the
During the installation or disassembly of the heat exchanger, check whether the tank level is above the installation position of the heat exchanger. If this is the case, the tank must be drained beforehand.

DANGER
Risk of injury due to improper transport.
The total mass of heat exchangers of the BNZ series and can be up to 150 kg. During assembly and dismantling work, care must be taken to ensure that sufficiently dimensioned hoists and slings in accordance with DIN 15003 "Hoists; Load Handling Devices, Loads, Forces, Terms" and BGV D8 are used.

6.1 Installation conditions

The full utilization of the heat exchanger's performance depends on certain measures to be taken into account during assembly and installation.

- ☐ Only use pipes and fittings of the same or matching material for the connection of the heat exchanger (note the purity of the type).
- ☐ Check the heat exchanger for debris and debris in the connection ports to ensure that the media is free to pass through.
- ☐ Connect the heat exchanger so that the drain ports for the media are at the bottom of the heat exchanger.
- ☐ When connecting to the piping system, avoid tensions at the connection points. If necessary, support the pipelines properly.
- ☐ If you use an automatic throttle valve, it must be installed at the entrance to the heat exchanger.
- ☐ Route the outlet pipe Medium 1 so that the heat exchanger is constantly flooded with Medium 1.

- For the installation of heat exchangers of the series, it is important to ensure that the flange counterpart on the tank fits perfectly and has a flat surface. The tank mounting flange must be firmly connected to the tank.
- For the installation of heat exchangers of the series, it is also important to ensure that the heat exchanger is not exposed to high loads and vibrations. For vibration damping, an appropriate cushion for the heat exchanger must be installed.

6.2 Installing and connecting the heat exchanger

The heat exchanger must be permanently installed in the intended place and the pipe connections must be properly installed.

ATTENTION
Risk of damage to the system.
When connecting the inlet and outlet pipes, the correct assignment must be observed. Observe the piping plans.

ATTENTION
Risk of cracking.
If sealing tape is used on the pipe threads, the resistance between the connecting parts increases and the risk of cracking in the castings of the heat exchanger increases. The threads must not be tightened too tightly.

ATTENTION
Risk of destruction of heat exchanger components.
In the case of heat exchangers with lake and brackish water cooling circuit (medium 1), a zinc anode must be installed to prevent electrolytic corrosion.

ATTENTION
Warning of reduced performance.
When installing heat exchangers of the BNZ series, it is preferable to install them horizontally with the drain opening facing downwards. In the case of an upright or inclined installation position, a reduction in performance is to be expected. In this installation position, the drain must always be mounted at the bottom, otherwise it is not possible to empty the heat exchanger.
When horizontally mounting heat exchangers of the series, it is important to ensure that the heat exchanger is rotated so that the drain opening points downwards.

To install it, proceed as follows:

ATTENTION

Risk of cracking due to improper tightening of the fastening screws on connection flanges. The screws must be tightened evenly crosswise.

HINT

Series 500 heat exchangers are not equipped with a drain for medium 1. In order to ensure proper draining, e.g. in the event of repairs, a drain must be installed in the outlet pipe of medium 1.

- ☐ If necessary, drain the tank
- ☐ Attach the heat exchanger:
  - – If necessary, screw BNZ series to a solid foundation or another fixed surface with the intended mounting brackets
  - – Screw the series firmly to the tank via tank mounting flange with associated seal
- ☐ Connect the inlet and outlet cable medium 1 to the corresponding connection sockets of the covers (see chapter 4.3)
- ☐ Connect the inlet and outlet pipe Medium 2 with the associated seals to the connection sockets on the jacket side (see Chapter 4.3), tightening the fastening screws on the covers and flanges of the supply lines evenly crosswise

In order to ensure the proper functioning of the heat exchanger in different systems, the following measures can be taken:

- ☐ Install safety valve in the inlet line of medium 1 or 2 to protect against severe flow and pressure fluctuations
- ☐ install filters in the inlet line of medium 1 or 2 to protect the heat exchanger from contamination and sludge,
  e.g. if the cooling water does not come from the municipal water supply
- ☐ If seawater or brackish water is used as medium 1 (cooling medium), install the zinc anode on the inlet side of the lid or inlet pipe (see section 8.1.3) to prevent electrolytic corrosion on components of the heat exchanger
- ☐ Install automatic throttle valve in the respective inlet line to compensate for overpressure

HINT
For information on the selection and installation of safety and throttle valves as well as filters, please contact R+L Hydraulics GmbH.

6.3 Dismantling the heat exchanger

DANGER
Risk of injury from pressurized media.
Before dismantling work on the heat exchanger, all systems must be depressurized and secured in accordance with the applicable accident prevention regulations.

DANGER
Risk of burns on hot components.
Burning can occur when touching heated components (e.g. supply lines) of the heat exchanger. Before the heat exchanger and the supply lines can be dismantled, the components must first cool down.

DANGER
Risk of contamination from drained media.
When the media are drained, they must not get into the ground or the sewer system. They must be collected and disposed of in secure containers in accordance with the applicable environmental protection regulations.

ATTENTION
Risk of injury due to falling of the heat exchanger.
Before dismantling, the heat exchanger must be secured against falling with sufficiently dimensioned hoists and slings.

To disassemble, follow these steps:

1. Decommission the system and properly secure it against reactivation
2. Depressurize the heat exchanger and connected system lines and shut them off using the appropriate valves
3. Drain the media completely via the drain plugs or drains provided for this purpose, empty the tank if necessary
4. Disconnect the inlet and outlet cable for medium 2 from the connection sockets on the jacket side

5. Detach the inlet and outlet cable for medium 1 from the connection sockets of the covers
6. Dismantling the heat exchanger:

– For the BNZ series, loosen the fastening screws at the mounting bracket, remove the heat exchanger with a sufficiently dimensioned hoist and place it securely
– In the case of the series, loosen the fastening screws on the tank mounting flange, remove the heat exchanger with a sufficiently dimensioned hoist and place it securely

7 Operation

After installation in the system, the heat exchanger can be put into operation and operated without any further preparatory measures. After commissioning, the heat exchanger must be checked for correct functioning.

The following checks must be carried out for this purpose:

- ☐ Check connection points for leaks
- ☐ If necessary, check valves, fittings and filters for clear passage and proper function
- ☐ Check that the heat exchanger is working correctly

ATTENTION

Risk of plant damage due to loss of power.
A loss of performance can be due to an accumulation of oil sludge on the jacket side or limescale deposits on the pipe side. See Chapter 8.2.

HINT

For the purpose of better determining maintenance intervals, it is advisable to record all parameters that allow conclusions to be drawn about the performance of newly installed heat exchangers.

HINT

If faults occur during operation that cannot be rectified immediately, R+L Hydraulics GmbH must be contacted.

Special features of heat exchangers with sea or brackish water cooling circuit:

ATTENTION

Risk of property damage to components due to aggressive cooling water media such as sea or brackish water.
Sea water, brackish water and other corrosive liquids are not allowed to be used in the standard models. The use of these aggressive cooling media requires special materials.

The use of heat exchangers, in which medium 2 is cooled with sea and brackish water, requires special materials. For operating conditions of this kind, R+L Hydraulics GmbH should be consulted in any case.

Heat exchangers with lake and brackish water cooling must be equipped with a zinc anode on the inlet side.

8 Maintenance, repair and cleaning

DANGER

Risk of leakage of media and thus risk of contamination.

If the heat exchanger is located in a system with a tank, it must be checked whether the tank level is above the installation position of the heat exchanger before repairing or cleaning the heat exchanger. If this is the case, the tank must be drained beforehand.

HINT

Repair of the tube bundles of the heat exchanger is only to be carried out in an emergency. In general, R+L Hydraulics GmbH should be contacted for this purpose. Symptoms of failure must be analysed and reported to the manufacturer.

HINT

Contact the manufacturer to order spare and wear parts.

R+L Hydraulics GmbH
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D-58791 Werdohl

8.1 Maintenance

8.1.1 Maintenance

DANGER

Risk of loss of power.

The maintenance intervals must be set in such a way that a loss of performance of the heat exchanger does not jeopardize the operation of the system.

The service life of a heat exchanger depends to a large extent on the water quality and the ingredients. The operator is responsible for determining maintenance intervals. For this purpose, the performance parameters and performance data determined during operation must be used.

The following further information should be observed:

- ☐ If using a zinc anode, check it for wear and tear two weeks after first use
- ☐ Specify inspection intervals during visual inspection of the anode, the corrosion strength determined on the zinc metal can serve as a basis for determining it

☐ Replace zinc anode if 70% of zinc is lost

8.1.2 Replacing the tube bundle

ATTENTION

Risk of damage to the tube bundle.
Do not tilt the tube bundle during disassembly or assembly to prevent damage to the tube bundle and the fins.

HINT

For disassembly, there are 2 threaded holes on the flange side of the tube bundle for screwing in jack screws.

1. Switch off the system and secure it against being switched on again
2. Shut off all media lines and depressurize the heat exchanger
3. Drain all media, drain the tank if necessary
4. Dismantle all piping on the lid
5. Remove the fastening screws on the lid and pull the tube bundles out of the jacket
6. Clean the jacket chamber of the heat exchanger (see chapter 8.2.3)
7. Equip the new tube bundle with a new round ring and carefully insert it into the jacket
8. Install the cover with a new flat gasket (see chapter 8.2.4 for seal replacement), tighten the fastening screws evenly crosswise
9. Reassemble and bleed all media pipes

8.1.3 Zinc anode replacement

The zinc anode is replaced as follows:

1. Switch off the system and secure it against being switched on again
2. Shutting off the inlet and outlet line Medium 1
3. Depressurize the heat exchanger and drain medium 1
4. Unscrew the zinc anode, assess wear and replace if necessary
5. Before switching the system back on, bleed the lines

8.2 Cleaning

The tube bundle of the heat exchanger can be cleaned from the inside and outside. The performance parameters and performance specifications determined during operation are to be used to determine the cleaning intervals. The intervals must be set in such a way that a loss of performance of the heat exchanger does not jeopardize the operation of the system.

8.2.1 Safety instructions for cleaning

DANGER

Risk of injury due to chemical burns or poisoning.
When cleaning the tube bundle (e.g. with hydrochloric acid) and the jacket space (e.g. with trichloroethylene), failure to comply with the applicable occupational health and safety regulations can lead to chemical burns on parts of the body and eye damage.
Therefore, it is imperative that you comply with the applicable occupational health and safety regulations when handling these or other cleaning agents.
When working with aggressive cleaning media, wear protective clothing, protective gloves and, if necessary, safety goggles and respiratory protection.

ATTENTION

Risk of contamination of the medium.
Experience has shown that it is not possible to remove the cleaning agent without leaving any residue. For this reason, when selecting cleaning agents, it is important to ensure that the compatibility of cleaning agent and medium is guaranteed.

ATTENTION

Risk of destruction of heat exchanger components.
Before using other comparable aggressive cleaning agents, always contact R+L Hydraulics GmbH in order to rule out damage caused by incorrect treatment of the functional components.

ATTENTION

Risk of damage to heat exchanger components.
Before restarting, properly vent the heat exchanger and connected systems.

HINT
Risk of contamination by cleaning agents.
When using cleaning agents, such as hydrochloric acid, it is important to ensure that they are not disposed of improperly under any circumstances.
When disposing of them, it is imperative to observe the country-specific environmental protection regulations.

8.2.2 Cleaning tube bundles

DANGER
Injury.
For cleaning the tube bundle, be sure to observe the safety instructions listed in Chapter 8.2.1.

ATTENTION
Risk of corrosion.
The aluminium fins of the tube bundle must not come into contact with hydrochloric acid during cleaning.

ATTENTION
Risk of corrosion due to scratches.
Scratches on the inner surface of the tube bundles can lead to increased corrosion. For this reason, a brush with soft bristles should be used for interior cleaning.

HINT
For the use of cleaning agents, please consult R+L Hydraulics GmbH.

Before the tube bundle can be cleaned, it must be removed from the heat exchanger. To do this, proceed as described in chap. 8.1.2.

The following measures are recommended for cleaning:

- ☐ To remove limescale deposits, a mixture of 50% hydrochloric acid with inhibitors and 50% water can be used on the inner pipe side.
- ☐ For the internal cleaning of the tube bundle with a Ø of the pipes of <5 mm, the tube bundle can be immersed in an ultrasonic bath or rinsed with hydrochloric acid.

- ☐ An appropriate cleaning agent must be used to remove contamination from other media (consultation with R+L Hydraulics GmbH necessary).
- ☐ The internal cleaning of the tube bundle can be carried out with a Ø of the pipes of
  >5 mm with a brush. Make sure you use a soft-bristled brush so that the surface of the pipe walls is not scratched.
- ☐ Exterior cleaning can be done by immersing the tube bundle in an ultrasonic bath or by rinsing it with trichloroethylene.
- ☐ Once the cleaning work is complete, make sure that all cleaning agents are removed from the pipes with as little residue as possible before the heat exchanger is put back into operation.

The following steps are required for cleaning:

1. Switch off the system and secure it against being switched on again
2. Shutting off the inlet and outlet line Medium 1
3. Depressurize the heat exchanger and drain medium 1
4. Remove the tube bundle (see chapter 8.1.2)
5. Perform cleaning
6. Reinstall the tube bundle (see chapter 8.1.2)
7. Before switching the system back on, bleed the lines

8.2.3 Cleaning the coat room

DANGER
Injury.
For cleaning the coat room, be sure to observe the safety instructions listed in chapter 8.2.1.

Sludge may accumulate in the jacket chamber of the heat exchanger, making cleaning necessary. To do this, the heat exchanger must be dismantled (see Chapter 6.3) and the tube bundle must be removed (see Chapter 8.1.2).

The following measures are recommended for cleaning:

- ☐ Depending on the degree of soiling, rinse the jacket chamber once or several times with a commercially available solvent such as trichloroethylene.
- ☐ Once the cleaning work has been completed, make sure that all cleaning agents are removed from the jacket with as little residue as possible before the heat exchanger is put back into operation.

8.2.4 Reinstallation after cleaning measures

DANGER

Risk of media leakage under pressure.
Before installing new seals, the sealing surfaces must be thoroughly cleaned of seal residues. Unclean sealing surfaces can lead to injuries, e.g. to the eyes, if media escape under pressure conditions when recommissioned.

ATTENTION

Risk of damage to sealing surfaces.
Do not clean sealing surfaces with sharp objects. Grooves in the sealing surfaces can cause leaks.

Before each reinstallation after cleaning measures, the following activities must be carried out:

- ☐ Remove old flat gaskets
- ☐ Clean sealing surfaces completely of sealing residues, making sure that the sealing surfaces are not damaged under any circumstances
- ☐ Use new flat gaskets, making sure they fit correctly
- ☐ Always replace O-rings

9 Disposal

HINT

All lubricants and operating materials, cleaning agents and their containers must not be disposed of as household waste or end up in the sewer system and soil. For the disposal of these substances and the heat exchanger, the country-specific environmental protection regulations must be strictly observed.

In the event of disposal, the heat exchanger must be treated as hazardous waste.