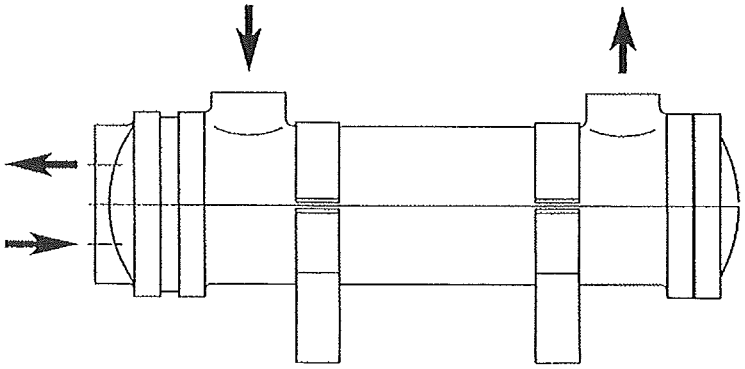
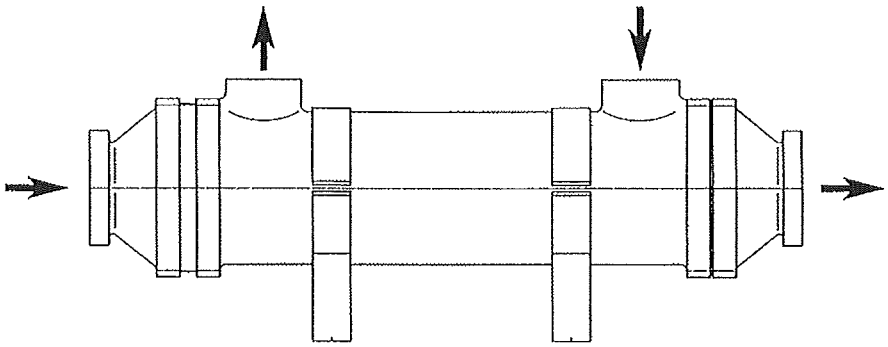
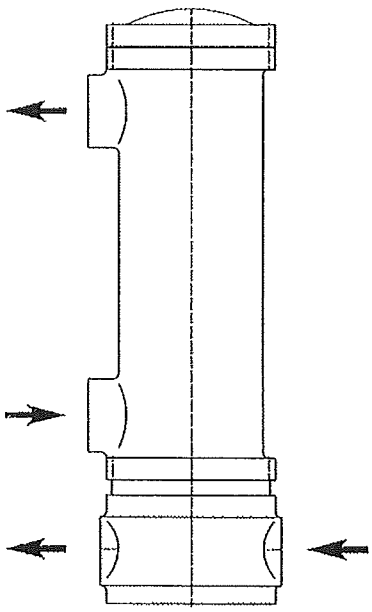
Operating instructions for heat exchangers of the type series OK high-performance cooler



Two-flow-design horizotal



One-flow-design



Two-flow-design vertical

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Apparatus description

The heat exchangers of the type series OK are tube bundle apparatus which are equipped with straight smooth tubes. The apparatus is divided into two spaces separated from one another by fixed walls in which different media flow. The criterion for the designation of these spaces is oriented to the flowing media along the actual heat transfer elements (tubes).

Medium around the tubes = shell side
Medium through the tubes = tube side

The apparatus is a construction consisting of a cylindrical shell made of aluminium with inlet and outlet connection for the medium on the shell side. A tube bundle which is fastened through a flange connection together with the nozzle chamber located in front of the bundle is installed in this shell. The supply and discharge connections of the medium of the tube side are located at the nozzle chamber (horizontal construction), respectively at the foot chamber (vertical construction). In case of an 1-flow-construction on the tube side, nozzle chambers are located at both ends of the apparatus. The tube bundle consists of a large number of tubes. The tube plate with the larger diameter is clamped firmly between the shell flange and nozzle chamber. So that temperature-induced changes of length can expand without obstruction, the bundle with the small tube plate is supported floating in the shell space. The seal is provided by one O-ring on the moving tube plate.
A separating web plate is located in the nozzle chamber to guide the cooling medium.
The heat exchanger is equipped with movable stand feet.

Mode of operation

The heat exchanger (oil cooler) is used for recooling oil. Water is used as a rule as cooling medium. The oil is guided in the shell space around the tubes by means of flow baffles, the cooling medium flows in two paths through the tubes of the bundle. Because of the temperature gradient between oil and cooling medium, as well as due to constructional measures resulting from the thermal design of the apparatus, optimum heat transfer is guaranteed taking account of maximum pressure losses that have to be complied with.

Delivery

The apparatus is delivered as complete assembled unit.
The spaces subject to pressure are subjected to a pressure test according to the valid pressure vessel and acceptance regulations.
Before leaving the factory the apparatus is checked outside and inside for cleanliness (purity). The connections are then closed.

Installation

It is recommended to subject the apparatus to a visual inspection before its final installation and commissioning (transport damages, impurities).

Commissioning

Before commissioning the heat exchanger, the spaces must be filled with the corresponding media. For this purpose there must be corresponding venting connections within the discharge lines of the two medias. The discharge lines must be opened during filling until the medium escapes from these. Only then is it guaranteed that venting has been perfect and the heat exchanger reaches its full capacity. After filling close these openings correctly and pressure-tight.
Pay attention to the correct assignment when connecting the supply and discharge lines. A confusion can lead to a reduction in capacity (see principle sketch page 1).

According to the oil grade, a strong rise of the viscosity of the oil can be expected with recooling. This can cause a reduction of the oil circulation and overloading of the pump motor. This effect can arise if before the oil circulation the water circuit has already cooled down the oil in the apparatus too strongly. It is therefore recommended that both circuits are put into operation carefully and temperature-monitored.

If possible, an uninterrupted operation lasting for several weeks should take place during the starting phase so that a firm adhesive protective layer (oxide film) can build up on the cooling medium side of the bundle reeding.

Operation

The operation of the apparatus has to correspond to the kind of stressing indicated in the strength calculation.
Indications regarding the allowable internal and external pressures, the ambient and working temperatures as well as regarding the statical pressure and the filling weights under working and test conditions can be taken from the information list on the main drawing.

Allowable nozzle forces and moments are shown on the drawing and are allowed to be passed from the connected tube connections into the apparatus but must not be exceeded. If corresponding indications are missing the manufacturer assumes that the loads are neglectably low.

It is recommended to control the apparatus at regular intervals.
You are recommended to install pressure gauges in the supply and discharge lines of the cooling medium. The differential pressure should be observed regularly. Should the pressure rise, this indicates contamination.

To avoid damages caused by erosion take care that the max. flow rates recommended for the tube material used are not exceeded. If there are suspended matters within the cooling medium their deposits on the cooling medium side should be avoided by a minimum flow rate of ca. 1 m/s.

The life of heat exchangers depends on different influencing variables as for example suitable construction (design), resistant material choice and corrosion protection.
Regarding corrosion resistance it is very important that the chemical composition of the medias flowing in the apparatus is known and considered when choosing the materials. These conditions must be guaranteed during the operation of the apparatus.

If changes in the type of operation of the heat exchangers occur (e. g. temperatures, flow velocity) or medias changed (chem. behaviour) these have to be checked with regard to the construction and to the component material.

Inspections

Examine the apparatus at regular intervals. In the case of a damage emerging medium has to be considered. According to the operating conditions emerging fluids under pressure as well as hot surfaces have to be considered.

The inspecting personal has to know the operating conditions and observe the required safety measures (safety equipment).
Should leaks occur, then tighten crosswise the bolted connection in the region of the leak. If this should not lead to the success aimed at, replacing the gaskets is required.

In the case of leaks within the apparatus which could lead to an unacceptable rise of pressure in a connection system the operator of the plant has to foresee the corresponding safety devices (safety valves, rupture disks).

Should the media have been mixed, then this can be due to the tube/tube plate fastening or to a defective tube. In the case of a defect on the tube/tube plate fastening, it is possible to re-roll or re-weld according to type of fastening.
In the case of re-rolling, roll only over the tube plate thickness, less 5 mm at both ends.

Leaking tubes can be replaced. These must be drilled out from the tube sheet for this purpose. The drilled holes must be cleaned perfectly before the new tubes are installed and fastened. If a cooling tube replacement is not possible, the function of the heat exchanger can be guaranteed further by plugging these tubes. For this purpose, conical plugs (conicity 1:20) are driven into the tubes at the tube sheet. Driving in the plugs too hard must be avoided to conserve neighbouring tubes.

Maintenance and inspection advices

For maintenance and inspection work the technical documents of the apparatus have to be put at the personal's disposal. Experts also have to be available.
The recommended spare parts should be kept at stock.

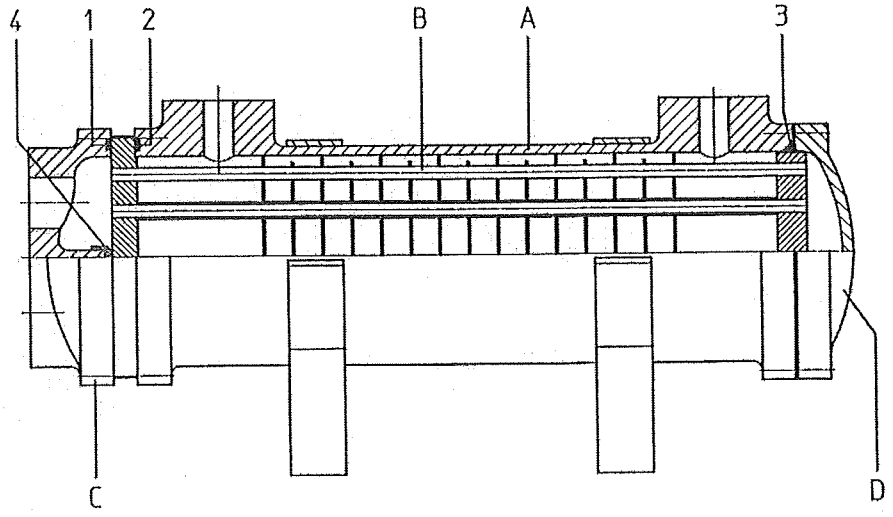
Replacement of gaskets

If gaskets have to be replaced, take special care that residual parts of old gaskets are removed and the sealing surfaces are not damaged.
When inserting the new gasket pay attention to perfect seating. Trouble-free sealing is guaranteed only if these points are observed. In general, it should be observed that on the occurance of a defective gasket the entire set will be replaced.

Leaks can occur at the following places:

a. between nozzle chamber flange and tube plate
b. between tube plate and shell flange
c. between shell flange and reversing cover flange

Replace the gaskets as follows:
To replace the gaskets, the entire heat exchanger must be put into a pressureless condition. Empty the two spaces of the apparatus. On the tube side the heat exchanger has to be emptied by removing the supply and discharge lines. On the shell side emptying is carried out by withdrawing the bundle.



Main components	Gaskets
A shell	1 o-ring nozzle chamber
B bundle	2 o-ring shell flange
C nozzle chamber	3 o-ring expansion region
D reversing cover	4 profile gasket at the web

For removal the bolts of the flange connection nozzle chamber / shell flange and shell flange / reversing cover are loosened. The bundle can be withdrawn after removing both covers.

Remove the old gaskets. Before inserting the new gaskets, take special care that the sealing surfaces are freed from residues of the old gasket. Work with very great care when cleaning the sealing surfaces so that these surfaces are not damaged.

The gaskets and components are assembled in the reverse order of disassembly. A leak test is required after tightening the bolted connections.

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1-flow-construction:

a. between nozzle chamber flange and tube plate
b. between tube plate and shell flange
c. between shell flange and nozzle chamber flange

Replace the gaskets as follows:
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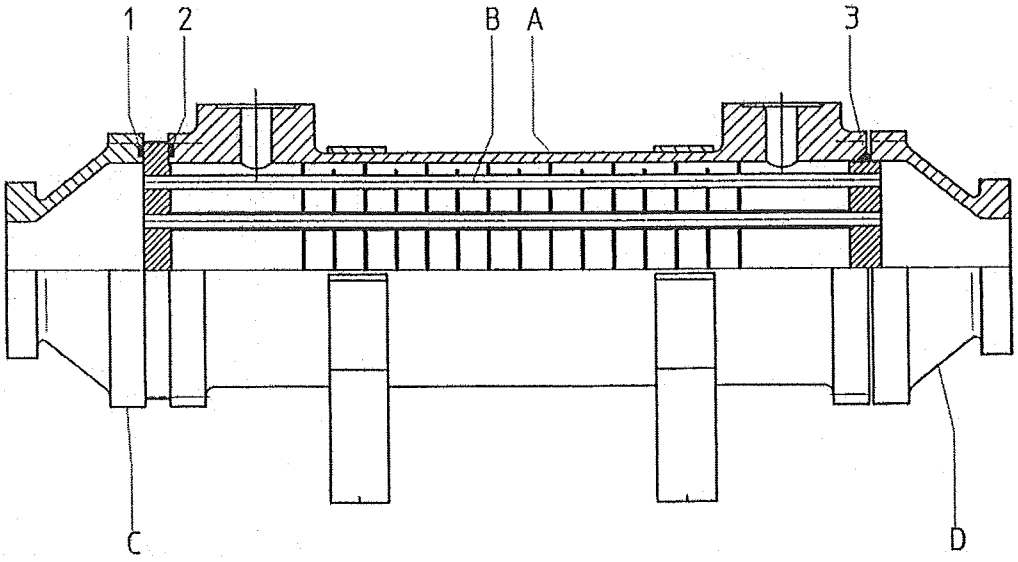


Main components	Gaskets
A shell	1 o-ring nozzle chamber
B bundle	2 o-ring shell flange
C nozzle chamber	3 o-ring expansion region
D nozzle chamber	

For removal the bolts of the flange connection nozzle chamber / shell flange and shell flange / reversing cover are loosened. The bundle can be withdrawn after removing both covers.

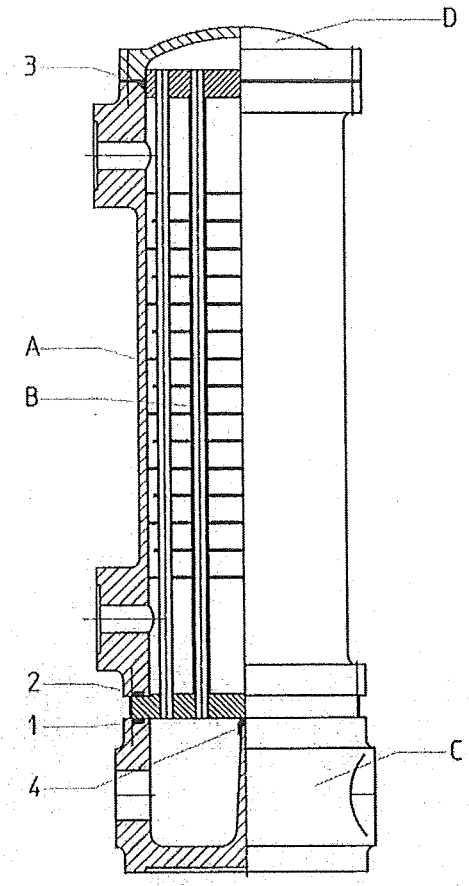
Remove the old gaskets. Before inserting the new gaskets, take special care that the sealing surfaces are freed from residues of the old gasket. Work with very great care when cleaning the sealing surfaces so that these surfaces are not damaged.

The gaskets and components are assembled in the reverse order of disassembly. A leak test is required after tightening the bolted connections.

Vertical construction

a. between foot chamber flange and tube plate
b. between tube plate and shell flange
c. between shell flange and reversing cover flange

Replace the gaskets as follows:
To replace the gaskets, the entire heat exchanger must be put into a pressureless condition. Empty the two spaces of the apparatus. On the tube side the heat exchanger has to be emptied by removing the supply and discharge lines. On the shell side emptying is carried out by withdrawing the bundle.



Main components

A shell
B bundle
C foot chamber
D reversing cover

Gaskets

1 o-ring foot chamber
2 o-ring shell flange
3 o-ring expansion region
4 profile gasket at the web

For removal the bolts of the flange connection nozzle chamber / shell flange and shell flange / reversing cover are loosened. The bundle can be withdrawn after removing both covers.

Remove the old gaskets. Before inserting the new gaskets, take special care that the sealing surfaces are freed from residues of the old gasket. Work with very great care when cleaning the sealing surfaces so that these surfaces are not damaged.

The gaskets and components are assembled in the reverse order of disassembly. A leak test is required after tightening the bolted connections.

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Surface protection

For protection against corrosion the components of the chambers at the cooling medium side receive a corrosion protection. This can be a multi-layer coat, a thermally applied plastic coat or rubberization. The type of the coating is according to the requirements of the cooling medium quality respectively according to the customer's requirements.
Basically care must be taken with coatings that these are not damaged in repair or cleaning work. Regular inspection of the coating is recommended.

A regular inspection of the coating respectively of the components is required. In the case of advanced corrosion the existing wall thicknesses have to be determined and compared to the mechanical requirements of the strength calculation. If unacceptable undershoots of wall thicknesses are determined these have to be removed or the allowable operating values adjusted to the existing dimensions. If the latter applies the documentation also has to be adjusted.

In the case of damaged coatings improvement is possible as a rule (repair set). Reference must be made in this case to the instructions of the manufacturers of the coating material.

Cleaning

It is necessary to clean the apparatus at certain time intervals depending on the contamination level of the media used.
It is possible that on the cooling medium side there are deposits which are biological (e.g. mildew) and microbiological (virus, bacteria) dangerous for the maintenance personal. Under consideration of the prevailing conditions the corresponding safety measures must be taken (safety clothes, gas masks).
Cleaning on the tube side is limited to the inlet and outlet cover, the reversing cover and the inside of the tubes. To clean the inside of the tubes (mechanically) a nylon brush can be used (OET spare part). This is a brush with a long handle which is guided into the tubes in the bundle. After brushing the inner wall of the tube, the tube must be blown out.
Cleaning on a chemical basis is possible in the case of impurities which cannot be removed with the brush method. In this case the tubes are cleaned chemically in a flushing process with corresponding chemicals. This method is problematic since on one hand the contamination should be dissolved but on the other hand the tube material must not be attacked.
If this cleaning method should be used, we recommend calling in a specialist company.
Cleaning the bundle on the shell side can be carried out by washing and blowing out.

Still-standing / Intermissions

By resting cooling medium (water) which stands for a longer period – more than 8 days – within the tubes or the shell space of the cooler attacks of corrosion are reinforced. Depending on the composition of the cooling medium this can leed to destruction of the tubes and other parts within a disproportionately short period of time. Therefore, it is absolutely necessary to empty the apparatus during still-standing times extending over a lengthy period.
Intermissions must not last longer than 8 days for apparatus filled with cooling medium. Nomally, no damages can be expected during this time if afterwards operation is started again.

If emptying the apparatus is not possible due to operative reasons then a circulation of the cooling medium on the cooling medium side has to be guaranteed. This flowing-through avoids attacks of corrosion which would arise by resting cooling medium.
In the case of cold weather the apparatus also has to be emptied (risk of freezing).

Spare part holding
It is recommended that at least one complete set of gaskets is held per heat exchanger (OET spare part).
In the case of leaks on cooling tubes conical metal plugs should be provided for closing the tube ends in order to restore operational readiness (see point Inspections).
Should a tube defect occur, then inspecting the entire tubing is recommended. Use a new tube bundle in the case of larger tube defects.

Safety advices
It has to be guaranteed by suitable steps that the allowed limits of the operating conditions are complied with during operation.
The operator has to pay attention to the possibility of solution of instable fluids within the apparatus during the process.
In the case of an external fire the operator has to guarantee by suitable safety devices that the entire system is excluded from any danger which could arise by the operating media in the apparatus when overheating.
It is expressively pointed out that welding work at pressurized parts of the vessel are forbidden.
Personnel experienced and trained in dealing with heavy loads are needed for maintenance and repair work.
The accident prevention regulations have to be observed.