TECHNICAL REPORT

Modular system increases flexibility and reduces costs

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LEDERLE Hermetic

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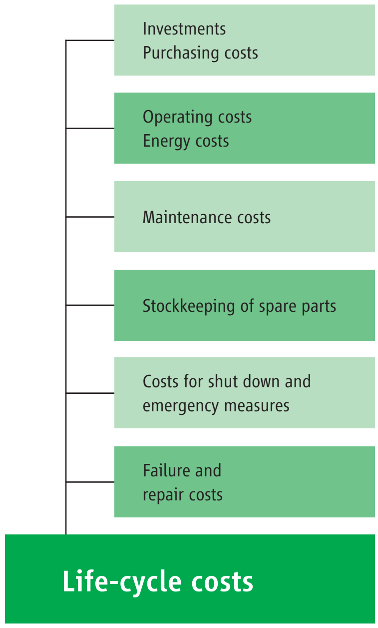

Figure 1: Life-cycle costs of centrifugal pump

The purchasing process for centrifugal pumps now also involves considering the life-cycle costs. Looking at the total costs a centrifugal pump generates in the course of its service life, the sealing system constitutes a significant proportion. This is why centrifugal pumps without shaft seals are increasingly being used for conveying media in chemical engineering and process technology. This development has been accelerated by the tightening of legal restrictions and by increased environmental awareness in the chemical and petrochemical industry.

1. INTRODUCTION

Pumps without seals include canned motor pumps and magnetically coupled pumps. Only canned motor pumps are covered here, focussing primarily on the balanced combination of the hydraulic parts and the canned motor. Canned motor pumps can be easily modified for changed operating conditions thanks to a modular construction system. The total costs of a centrifugal pump over its working life are calculated primarily using the investment costs, and the costs for installation, energy, maintenance, servicing and repairs. As the purchase costs for a pump normally only represent 5 to 10 % of the total costs, it is well worth taking a look at the life-cycle costs of pumps in the medium- to long-term. [Figure 1]

Depending on the operator's point of view, the results are by their very nature variable, but they all indicate that considering the investment costs alone is not enough in the long-term.

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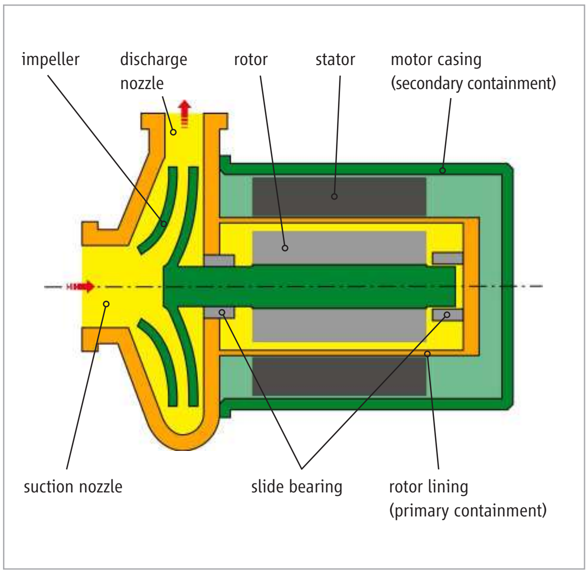

Figure 2: Simplified diagram of a canned motor pump

2. FUNCTIONAL PRINCIPLE OF CANNED MOTOR PUMPS

Canned motor pumps are characterised by a compact, integrated unit. The motor and pump form a unit with the rotor and the impeller fitted onto a common shaft. The rotor is guided by two identical, medium-lubricated slide bearings. The stator of the drive motor is separated from the rotor using a cylindrical can. [Figure 2]

The rotor compartment itself, along with the hydraulic section of the pump, create a combined compartment which is filled with pumping medium during operation. The heat loss from the motor is carried off by a partial flow between the motor and the stator. At the same time, the partial flow lubricates both slide bearings in the rotor compartment. The can, which is a hermetically sealed component, and the motor casing offer primary and secondary containment, respectively.

Aside from the short, compact design and the very low noise level, this is what differentiates the canned motor pump from the magnetically coupled pump. If in doubt, then, canned motor pumps will always be the preferred option for dangerous, toxic, explosive and valuable media.

3. TACKLING THE PROBLEM

In the chemical industry, virtually any type of media can be conveyed. Due to the large number of different pumping tasks, a modular system was developed which tackles these many and varied applications with the minimum amount of engineering required and with as few different versions as possible. [Figure 3]

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a) CN...B: Return of partial flow to suction side

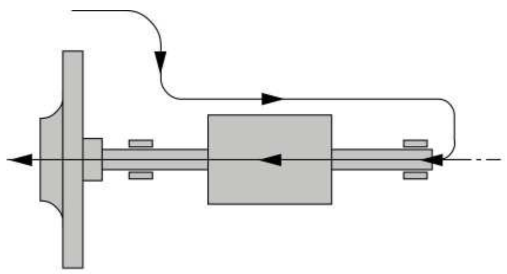

Figure 3a: The carrying of the Partial Flow of various types

b) CNF...B: Return of partial flow to discharge side

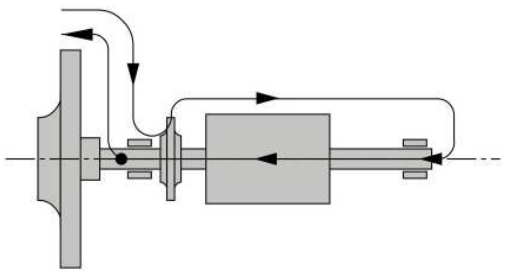

Figure 3b: The carrying of the Partial Flow of various types

a) For conveying aggressive, poisonous, explosive, valuable, flammable, radioactive and mildly volatile fluids, e.g. sulphuric acid, nitric acid, hydrofluoric acid, hydrocyanic acid, ethanoic acid, formic acid, etc. the standard canned motor pump CN...B is used. An important construction feature of this basic design is the internal partial flow return line. The partial flow for cooling the motor and lubricating the slide bearings is taken internally from the impeller discharge and after flowing through the motor, i.e. the gap between the rotor and stator, returned back through the hollow shaft on the suction side of the impeller.

   Fluids close to boiling point or which are already boiling (liquid gases), cannot be conveyed without precompression using this type.

b) For conveying liquid gases such as ammonia, freon, propane, butane, vinyl chloride, ethylene oxide, chlorine, phosgene, propylene, carbon hydride etc. the CNF...B type is used, which was designed especially for this application.

   This single-stage pump design can also be used to convey liquid gases with extremely steep vapour pressure curves (e.g. CO_2). The special design feature is the internal return of the partial flow, which means that no external pipe is required to return the partial flow to the supply tank or separator. The partial flow for cooling the motor and lubricating the slide bearings is taken internally from the impeller and after flowing through the motor is returned to the pressure side; by use of an auxiliary impeller to counteract the additional hydraulic pressure losses which occur on this route.

   The partial flow return to the pressure side means that there is always sufficient reserve pressure available from the boiling point curve of the medium being conveyed.

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c) CNK...B: Cooling-/lubricating circuit

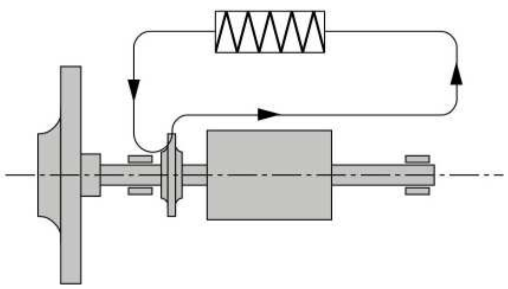

Figure 3c: The carrying of the Partial Flow of various types

c) For conveying hot, organic heat transfer oils and hot bath liquids, the CNK...B has been developed. In addition, the version CNK...B can also be used for all media as given under a).

The medium being conveyed reaches the impeller through the inlet chamber and is conveyed through it to the discharge nozzle. The direct heat transfer from the hydraulic to the motor section prevents a thermal barrier. The motor heat loss is carried off by a secondary cooling-/lubricating circuit in a separately installed heat exchanger. This cooling-/lubricating circuit also simultaneously lubricates the slide bearings. Thus the fluids at temperature up to +400°C can be delivered on the discharge side while the secondary cooling circuit is at low temperature level. This construction is also suitable for the proportioning of process liquids.

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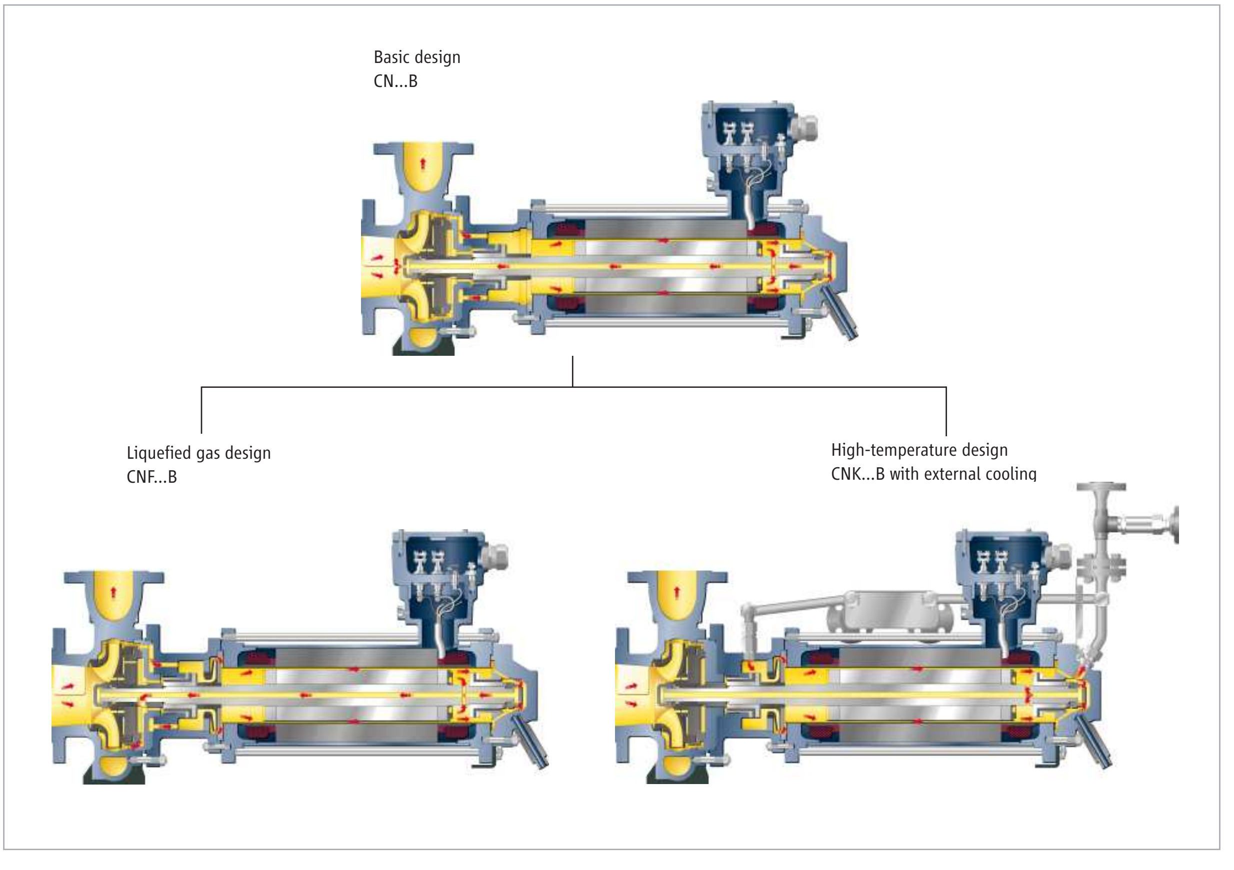
Because of the various designs, a modular system was sought which meets these requirements with as few components or modules as possible, using a high number of standard components which can be combined independently. A modular system which offers the ideal technological design solution for canned motor pumps for the relevant application in combination with the materials and motor sizes available was developed. [Figure 4]

The modular system consists of 23 pump sizes and 8 motor sizes, as well as 2 adapters which simultaneously act as heat barriers. Various hydraulic pump sizes can be fitted to the various motor sizes. This means that flow rates up to 300 m^3/h and differential heads up to 160 m can be achieved. The maximum shaft output is 126 kW.

Figure 4: Modular Construction „Design options"



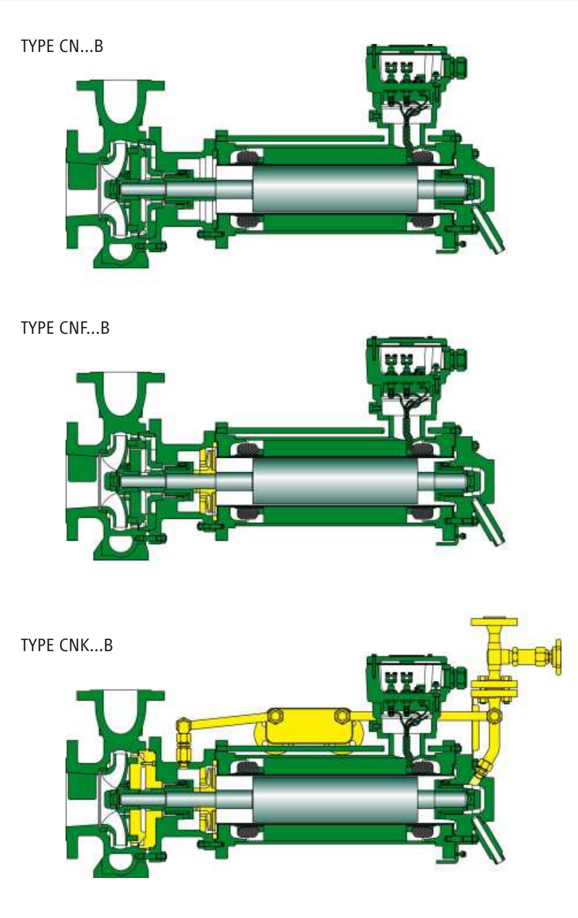


Figure 5: Modular construction principle

In addition to the combination options within a pump size and application, this modular system also permits an optimised technical layout of the pumps for the relevant application. Subsequent changes in operating conditions can be allowed for relatively easily using this modular system. For example, for the same pump size, modules can be used to create all 3 versions CN...B, CNF...B and CNK...B. In addition to the basic model CN...B, it is possible to use an auxiliary impeller and a sleeve to create a CNF...B variant for liquid gases. All other parts of the basic CN...B design can be used as they are. For a high temperature application with the relevant cooling unit on the pump (CNK...B) only 2 further components or modules are required: An additional casing cover and a cooling unit with pipes. All other parts of these three designs are identical. Figure 5 shows this modular construction.

This means that thanks to the high interchangeability of the components, the modular system allows the user to refit pumps quickly and flexibly. Within the same pump size, all basic variants can therefore be modified to a liquid gas or a cooled variant without changing the pump dimensions, using various motor sizes which are modified using an adapter system.

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4. RESULT AND EFFECTS

The results of this modular system are:

- Standardised hydraulics and motors which can be produced from existing stock.
- The in-house production process means short delivery times for all 3 types.
- The stocks of spare parts are reduced to a minimum for different versions of one pump size.
- Conversions due to a subsequent change in operating conditions are made easier for the user.
- It may be possible to reduce costs thanks to the increased quantities required of individual components / modules.
- The material quality is increased further by using forged parts (e.g. adapters). With the exception of the pump casing, all parts which come into contact with the medium are made from forged material.
- Two slide bearings of the same size, lubricated with medium and made from SiC 30 / tungsten carbide are used for each pump size.

5. SUMMARY

The CN/CNF/CNK...B modular system from HERMETIC increases usefulness to the customer. Lower service life costs, shorter delivery times and flexible conversion options are the most exceptional features of this new innovation. At the heart of the modular system is an adapter system which permits the creation of hydraulic/motor combinations which are physically and technically appropriate and which meet the features given above.

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