CHEMICAL

OIL & GAS

REFRIGERATION

POWER GENERATION

SERVICE

Convincing worldwide: HERMETIC pumps in solar thermal applications

LEDERLE Hermetic

Simply the best pump technology

CLEAR SIGHT AND RESPONSIBILITY

The technical power potential of solar thermal power generation is much higher than worldwide power consumption.

Newest generations of solar thermal power plants are able to produce energy in the range from 50 to 250 megawatt, and thus they are most appropriate for the industrial generation of low-cost current. When integrating a thermal storage, the current additionally can be planned and supplied reliably after sunset.

Solar thermal power plants have the potential to reduce the dependence on fossil resources considerably and to replace traditionally heated power plants. They are concentrated on climate compatibility, sustainability of power supply and security of supply.

Solar energy nearly is inexhaustible:
Every year, the sun sends 1.080.000.000 terawatt-hours energy to the earth – the 60.000-fold of world's power requirement.

The suitable solution for forward-looking technologies.

In solar thermal power plants (CSP = Concentrating Solar Power), canned motor pumps preferably are used in the field of high temperature applications.

While in parabolic trough power plants and Fresnel collector plants with heat transfer oil intermediate circuit synthetic thermal oil is circulated with a temperature of up to 400 °C, water is used as heat transfer medium in solar thermal power plants with direct evaporation (DISS = Direct Solar System).

The different designs of solar thermal power plants are based on sophisticated and complicated processes. High pumping fluid temperatures, high system pressures and changing rated flows determine the profile of pump requirements and can be implemented according to demand by the use of canned motor pumps.

HERMETIC pumps provide solutions for special requirements.

Your power generation is based on:	*Our solution:*
high availability	We provide you with a reliable and nearly maintenance-free pump technology to safe and optimize various processes.
environment protection and operational safety	The leakage-free pump technology ensures a safe conveying of different circuit fluids.
complex plant conditions	Simple constructions allow safe operating methods and minimize the complexity. Thus, it can be reached more process safety.
various applications	We can put a wide range of pumps at your disposal for standardized applications as well as for customized processes.

INNOVATION AND EXPERIENCE

HERMETIC pumps are made fit to your process conditions and requirements. They became integrated into your system as a significant component of your power plant. The only thing that counts is: ***Availability at maximum safety.***

The products of the company HERMETIC-Pumpen GmbH stand for best quality and maximum operational safety in the chemical and petrochemical industry, as well as in refrigeration and power generation.

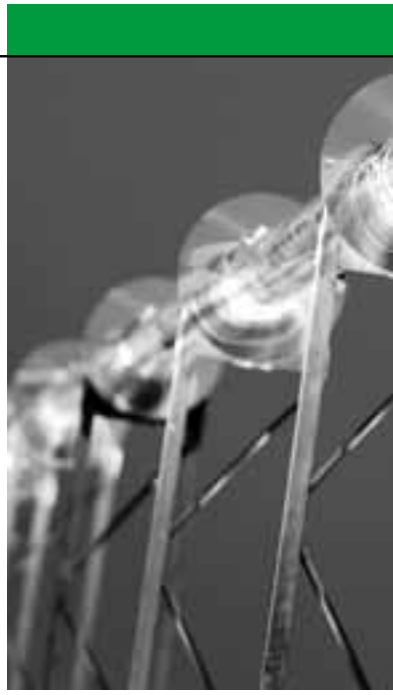
HERMETIC engineers combine selected materials suitable for process and individual solutions to sophisticated units. Products are developed in partnership with our customers in a flexible construction and production process coming up to the special process requirements.

Long service lives and low life-cycle costs are a main characteristic of HERMETIC products from the beginning.

An integral part of our developments are the requirements for explosion protection according to the directive 94/9/EC (ATEX).

The complete production line of HERMETIC-Pumpen GmbH is an essential contribution in observing the directive 96/61/EC, the so-called IPPC directive (Integrated Pollution Prevention and Control), respectively.

HERMETIC pumps are **"Best Available Technology"** when handling dangerous and harmful fluids.



We offer a highest level of safety – also with extreme parameters.

HERMETIC pumps are designed for extreme conditions.

Thus, they always are used if conventional technologies come to their limit.

High system pressures, strong temperature fluctuations, most difficult pumping liquids – HERMETIC pumps won't be impressed by that. But they convince with impressive performance!

For others it is "extreme", for us it is standard

- changing pumping fluid temperatures
- high system pressures up to 120 MPa
- explosive and flammable fluids

High potential risk originating from the medium to be conveyed

The fluid to be conveyed can have a high or very high risk potential and thus could be dangerous for human being and environment. An absolute tightness of the pumps must be guaranteed.

Fluids to be conveyed at extreme temperatures

In the different technologies of solar heat, extremely high temperatures can be found making additional demands on safety and availability of the pumps.

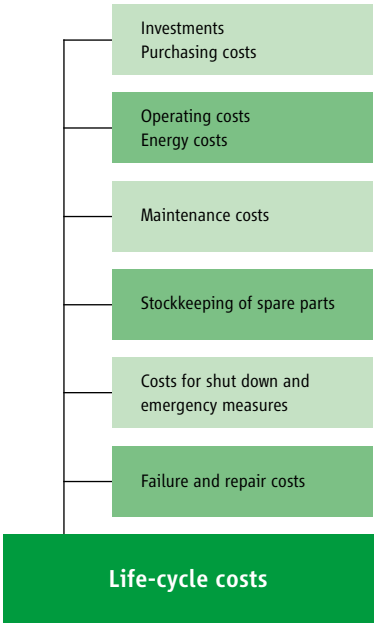
HERMETIC pumps are in a position to convey liquids with a temperature of up to +450 °C.

YOU MAY COUNT ON US

The purchasing process for pumps now also involves considering the life-cycle costs. Looking at the total costs a pump generates in the course of its service life, the sealing system constitutes a significant proportion.

Sealless pumps are used more and more for the handling of liquids. This development is accelerated by increased requirements regarding reliability, plant safety, strengthening of statutory requirements and the increased environmental awareness.

The total costs of a 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 longterm.



Life-cycle costs.

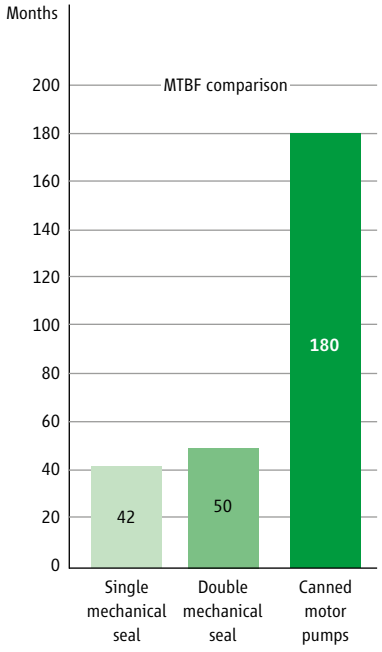
Depending on the operator's point of view, the results are by their very nature variable, but they all indicate that considering the investment costs alone is not enough in the long-term.

Right figure shows the MTBF values (MTBF = Mean Time Between Failure) between different pump systems. The values for this system show that canned motor pumps (CMP) have a much higher MTBF value than standard pumps with mechanical seal (single- and double-stage).

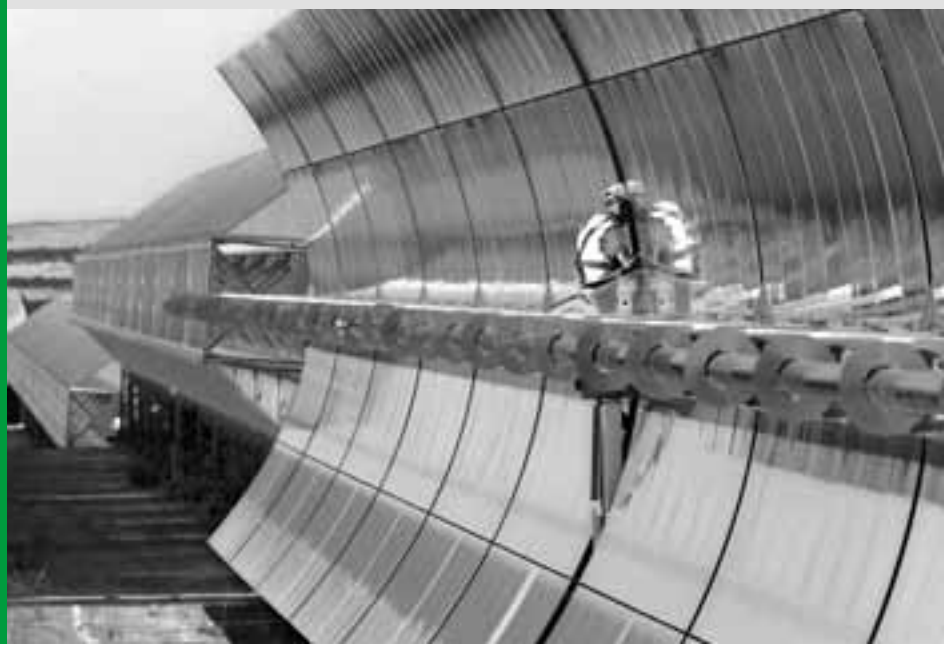
When focussing the life-cycle costs the economic efficiency of the total system plays an important role. There are partly too many safety factors which need to be taken into account when a system is planned. Consequently, the pump operation is often not effected at its best efficiency.

Studies executed by the "Hydraulic Institute" and "Europump" show that the greatest potential to reduce lifecycle costs depends on the correct dimensioning of the plant. An important portion of the pressure losses in the system is resulted in the dimensioning of tubes and valves, particularly the one of the control and regulating valve.

Through the use of frequency converters there is no further need to install valves for the regulation of the volume flow. Moreover, because of the variable number of rotations, the pump can be operated at different required operating points. Thus, the operation of this pump is effected at a considerably increased efficiency, compared with the throttling via valves.



HERMETIC PUMPS IN SOLAR THERMAL POWER PLANTS



Example of use:
Parabolic Trough Power Plants with Heat Transfer Oil Intermediate Circuits (CSP)

Parabolic trough power stations are considered a proven technology and are already currently being constructed on an industrial scale. They consist of the solar element, the storage block and the power block. Parabolic trough solar thermal power stations use a pipe (receiver) with a heat transfer fluid in the focal line of the parabolic trough. One axis of the receiver tracks the sun's axis in such a way that the sunlight is always concentrated onto the heat transfer pipe. The concentrated solar radiation heats the heat transfer fluid, generally a synthetic heat transfer oil, to approximately 400 °C. Individual troughs are connected to one another using distribution lines. These distribution lines carry the heat transfer oil to a heat exchanger, which vaporizes water. Just as in a conventional power plant, this steam drives a steam turbine. The steam turbines' output is transferred to a generator to produce electricity. If a thermal storage block is integrated into the system (molten salt storage block) then provision of electricity becomes plannable, since the solar thermal power station can then also generate electricity after sundown.

Example of use:
Parabolic Trough Power Stations with Direct Vaporization (DISS)

Technical developments help to increase efficiency and to reduce costs. Water is heated in the absorbers at high pressure directly to 400 °C. This vapour immediately can be transmitted into a turbine, so that the heat transfer oil (thermal oil) and the heat exchangers are no more necessary.

For such applications, high-pressure canned motor pumps, so-called recirculation pumps, can be used.

Examples of solar thermal power plants.

Diagram of a CSP plant

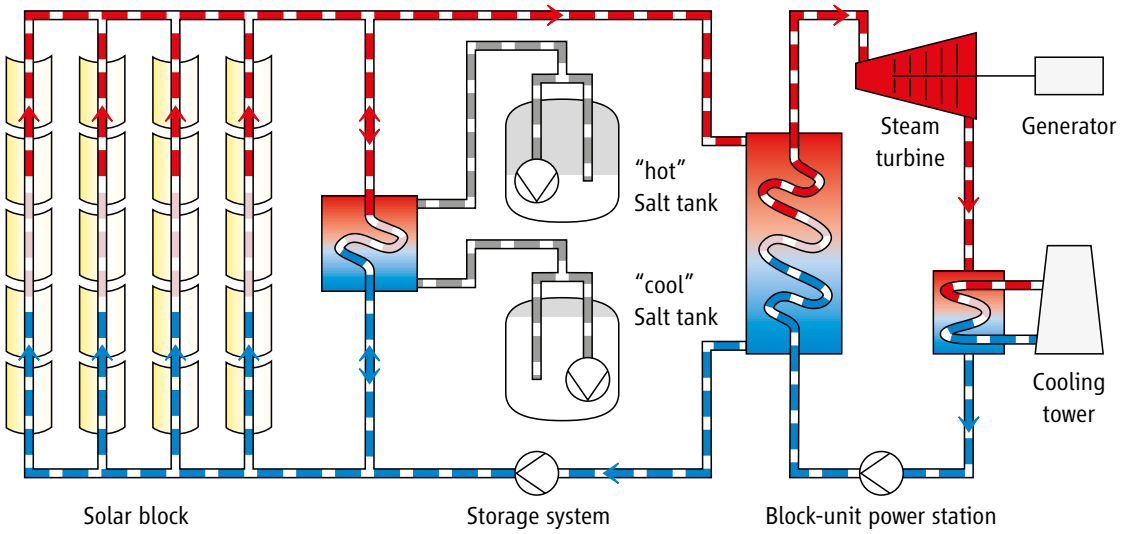
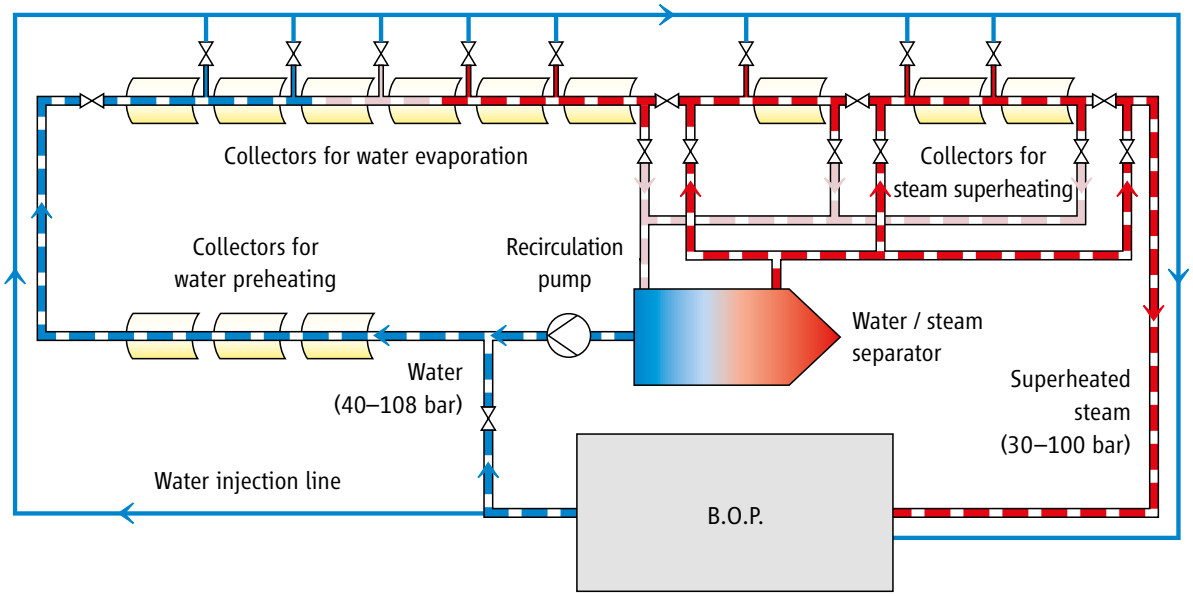


Diagram of a DISS pilot plant



TECHNOLOGY AT THE HIGHEST STAGE

One critical item when using conventional centrifugal pumps is to seal the shaft passages on the pump casing. The high rate of repairs is a reason for the steadily increasing use of sealless pumps.

The canned motor pump is not equipped with shaft seals which are susceptible to faults or with ball bearings sensitive to wear. Thus longer lifetimes can be reached. Fewer repairs with expensive spare parts additionally offer considerable reduction of life-cycle costs.

Hence the canned motor pump contributes to a great extent to an optimisation of process costs as well as to the fulfilment of international environment protection requirements.

The advantages of the canned motor pump can be summarized as follows:

- 100% leakage-free thanks to double containment design.
- Canned motor pumps comply with the most significant requirements regarding environmental protection.
- Extremely low noise level.
- Virtual lack of wear and minimized maintenance.
- High availability and long service life.
- Due to the sealless construction and the fluid-lubricated, hydrodynamic slide bearings, an expensive and complex installation of lubricating and cooling systems is not necessary.
- Due to construction of the canned motor pump, cost-intensive wearing parts such as mechanical shaft seals, buffer fluid systems or ball bearings do not apply. As a consequence 3- to 4-fold MTBF values (Mean Time Between Failure) can be reached. Reduced maintenance costs and long lifetimes are the result.
- Easy installation, since no shaft alignment of motor and coupling is required.

Pump principle of canned motor pumps.

Functional principle of canned motor pumps

Canned motor pumps are characterized by a compact, integrated unit without mechanical seal. 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 on the drive motor is separated from the rotor space using a thin stator liner. The rotor cavity itself, along with the hydraulic section of the pump, creates a combined cavity which needs to be filled with pumping medium before commissioning. The heat loss from the motor is carried off by a partial flow between the rotor and the stator. At the same time, the partial flow lubricates both slide bearings in the rotor cavity.

Both, the can which is a hermetically sealed component, and the motor casing are used as a safety containment. Because of that, canned motor pumps always ensure a highest safety level when conveying dangerous, toxic, explosive and valuable media.

Diagram of a single-stage canned motor pump

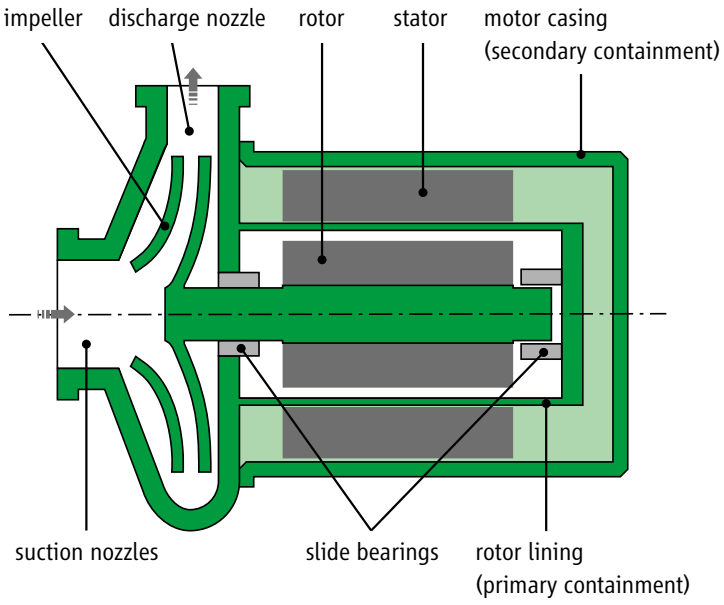
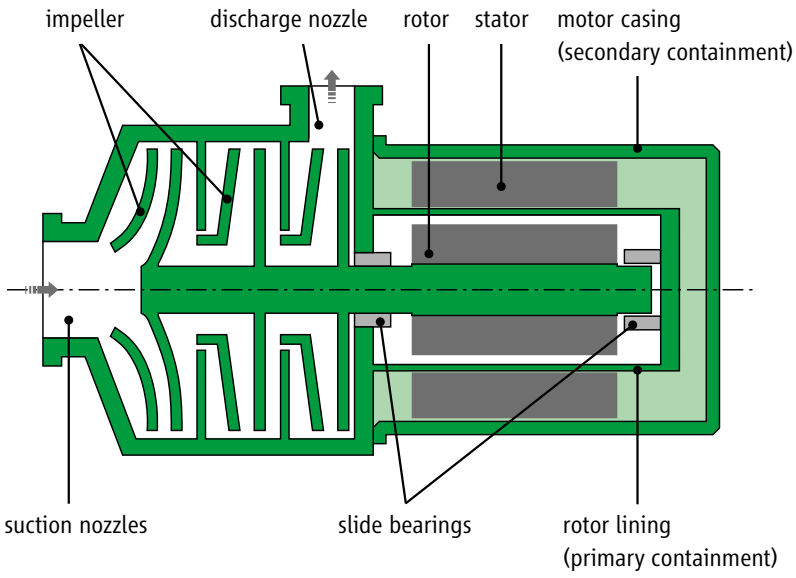


Diagram of a multistage canned motor pump



CONSTRUCTION PRINCIPLES FOR HIGH-TEMPERATURE APPLICATIONS

Canned motor pumps with internally cooled motors

If not enough quality coolant, or no coolant at all, is available to cool the motor, then a different design principle must be employed. In addition, no matter what conveyed fluid is used, it will always need to be heated before initial operation; in the pump as well as in the canned motor. The temperatures required for this are generally in a range exceeding the maximum permitted temperature for the above-mentioned Insulation Class H. This is where canned motors equipped with special Insulation Class C windings come into play. So-called "hot motors" make it possible to solve various pumping tasks in the high temperature field. A silicone-ceramic insulating material is used, thus ensuring that appropriate measures to avoid oxidation of the copper wire can be taken. Windings of this type are able to withstand constant temperatures of 450 °C at the winding ends. They are rated for economical motor loads of up to 400 °C (temperature of the conveyed fluid). Fins at the centre of the motor's casing improve heat dissipation via natural convection.

Pump type CNPF 150x100x290

Canned motor pumps with externally cooled motors

In this design, the pump is spatially separated from the canned motor by an intermediate component acting as a thermal barrier. This prevents heat transfer from the conveyed fluid to the motor. A relatively narrow, long circumferential gap equalizes the pressure differential between the hydraulics and the rotor cavity. An auxiliary impeller is installed in the motor itself, recirculating the fluid in the rotor cavity through a heat exchanger mounted around the motor or a separately mounted external heat exchanger. Motor heat loss is absorbed by a cooling fluid. This creates two pump circuits with different temperatures. The operational circuit can be rated at temperatures of up to 450 °C, while the conveyed fluid in the secondary cooling / lubricating circuit has much lower temperatures of between 60 °C and 80 °C. As a result, the motor windings can be manufactured in long-lived Insulation Class H. Due to the pressure equalization in the thermal barrier's circumferential gap, there is hardly any fluid exchange between the two temperature levels.

This cooling option and/or alignment can be used for single and multistage canned motor pumps.

Should no cooling water be available, then various models of air heat exchanger can also be used. These include simple honeycomb heat exchangers with ventilators, mounted above the unit and fixed to the base plate. Separately installed system dry air heat exchangers (also with axial ventilators) are used for higher pump ratings.

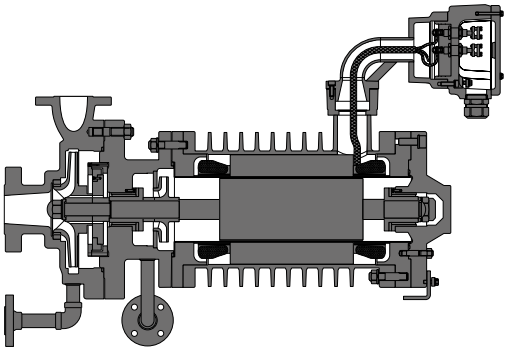
Pump type CNPK 100x50x400

Pump type CNPK 250-630

Single-stage canned motor pumps.

Technical Facts:

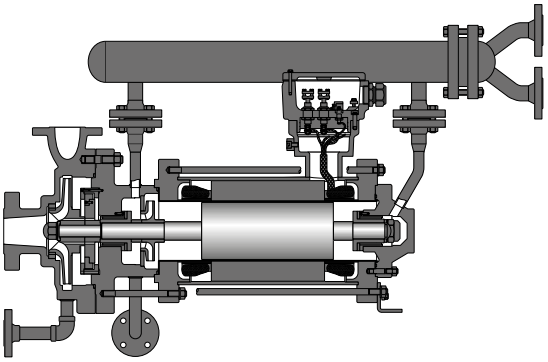
- Dimensions and performance curves in accordance with EN 22858, ISO 2858 or API 685
- Explosion protection according to EC design test certificate in line with Directive 94/9/EC (ATEX) ⟨Ex⟩ II 2 G Ex de IIC / IIB T1 to T6
- Capacity: max. 1600 m³/h
- Head: max. 240 m
- Pressure ratings: PN 16 to PN 1200
- Material: S-5, S-6, C-6, A-8 special materials are possible on demand



Type CNPF

- High-temperature design without external cooler
- Process design
- Completely designed according to the API 685

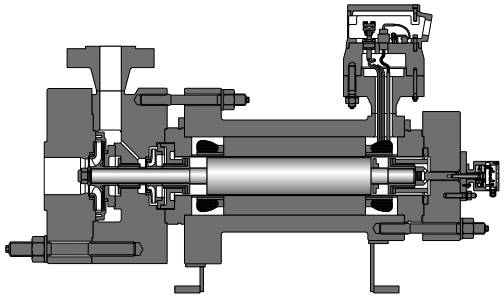
Capacity:	max. 1200 m³/h
Head:	max. 240 m
Rotating speed:	1450 to 3500 rpm
Operating temperature:	–120 °C to +360 °C
Viscosity:	max. 300 mm²/s
Pressure rating:	PN 50



Type CNPKf

- High-temperature design with tubular cooler
- Process design
- Completely designed according to the API 685

Capacity:	max. 1200 m³/h
Head:	max. 240 m
Rotating speed:	1450 to 3500 rpm
Operating temperature:	–120 °C to +425 °C
Viscosity:	max. 300 mm²/s
Pressure rating:	PN 50



Type CNKH

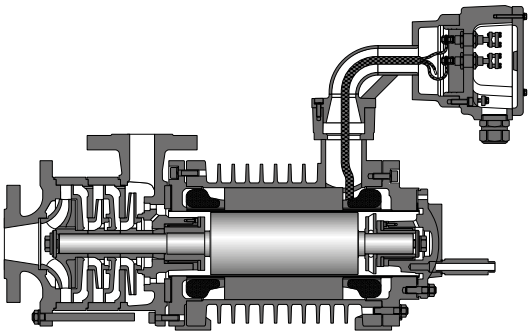
- Design for high system pressures

Capacity:	max. 1600 m³/h
Head:	max. 220 m
Rotating speed:	1450 to 3500 rpm
Operating temperature:	–120 °C to +360 °C
Viscosity:	max. 300 mm²/s
Pressure rating:	up to PN 1200

Multistage canned motor pumps.

Technical Facts:

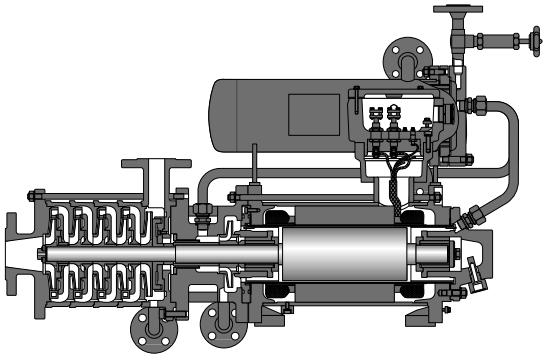
- Explosion protection according to EC design test certificate in line with Directive 94/9/EC (ATEX) Ⓔx II 2 G Ex de IIC / IIB T1 to T6
- Capacity: max. 350 m³/h
- Head: max. 2300 m
- Pressure ratings: PN 16 to PN 1200
- Design variants are possible with pressure vessel for reduction of static seals and use at higher system pressures
- Material: S-5, S-6, C-6, A-8 special materials are possible on demand



Type CAM

- High-temperature design without external cooler

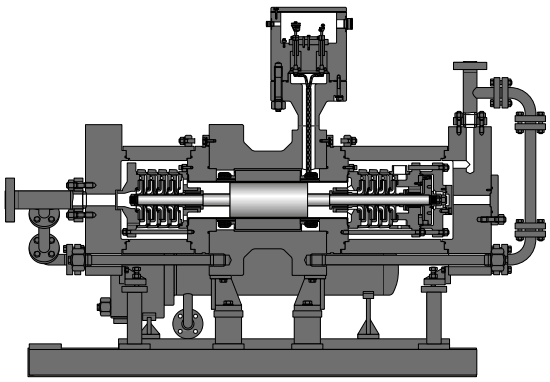
Capacity:	max. 350 m³/h
Head:	max. 1100 m
Rotating speed:	2900 to 3500 rpm
Operating temperature:	–100 °C to +360 °C
Viscosity:	max. 300 mm²/s
Pressure ratings:	PN 16 to PN 100



Type CAMKr and CAMKrT

- High-temperature design with tubular cooler

Capacity:	max. 350 m³/h
Head:	max. 1100 m
Rotating speed:	2900 to 3500 rpm
Operating temperature:	max. +400 °C
Viscosity:	max. 300 mm²/s
Pressure ratings:	PN 16 to PN 100



Type CAMH-Tandem

- Tandem design
- With pressure barrel for high system pressures

Capacity:	max. 350 m³/h
Head:	max. 1200 m
Rotating speed:	2900 to 3500 rpm
Operating temperature:	–120 °C to +100 °C
Viscosity:	max. 300 mm²/s
Pressure ratings:	up to PN 500

Among others, our products comply with:

- Directive 2006/42/EC (Machinery Directive)
- Explosion protection acc. to Directive 94/9/EC (ATEX); UL; KOSHA; NEPSI; CQST; CSA; Rostechnadzor
- Directive 96/61/EC (IPPC Directive)
- Directive 1999/13/EC (VOC Directive)
- TA-Luft
- RCC-M, Niveau 1, 2, 3

HERMETIC-Pumpen GmbH is certified acc. to:

- ISO 9001:2008
- GOST; GOST "R"
- Directive 94/9/EC
- AD 2000 HP 0; Directive 97/23/EC
- DIN EN ISO 3834-2
- KTA 1401; AVS D 100 / 50; IAEA 50-C-Q
- Certified company acc. to § 19 I WH

Images at page 5/8: Solar Millennium AG

Convincing service.

Important features are readiness, mobility, flexibility, availability and reliability. We are anxious to ensure a pump operation at best availability and efficiency to our customers.

Installation and commissioning

- service effected on site by own service technicians

Spare part servicing

- prompt and longstanding availability
- customized assistance in spare part stockkeeping

Repair and overhauling

- professional repairs including test run executed by the parent factory
- or executed by one of our service stations worldwide

Retrofit

- retrofit of your centrifugal pumps by installing a canned motor to comply with the requirements of the IPPC Directive

Maintenance and service agreement

- concepts individually worked out to increase the availability of your production facilities

Training and workshops

- extra qualification of your staff to ensure the course of your manufacture

ENERGIE / E / 01 / 2012

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