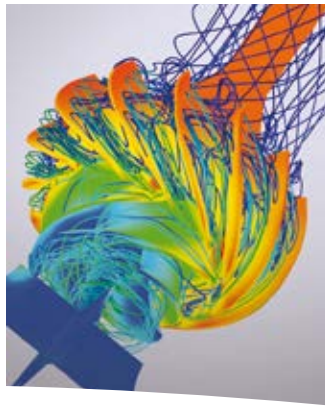




***SIHI® Pumps  
For High Temperature Systems***



***Experience In Motion***



## ***Pump Supplier to the World***

*Flowserve is the driving force in the global industrial pump marketplace. No other pump company in the world has the depth or breadth of expertise in the successful application of pre-engineered, engineered, and special purpose pumps and systems.*

### ***Life Cycle Cost Solutions***

Flowserve provides pumping solutions that permit customers to reduce total life cycle costs and improve productivity, profitability and pumping system reliability.

### ***Market-Focused Customer Support***

Product and industry specialists develop effective proposals and solutions directed toward market and customer preferences. They offer technical advice and assistance throughout each stage of the product life cycle, beginning with the initial inquiry.

### ***Broad Product Lines***

Flowserve offers a wide range of complementary pump types, from pre-engineered process pumps to highly engineered and special purpose pumps and systems. Pumps are built to recognized global standards and customer specifications.

Pump designs include:

- Single-stage process
- Between bearings single-stage
- Between bearings multistage
- Vertical
- Submersible motor
- Positive displacement
- Vacuum & Compressor
- Nuclear
- Specialty

### ***Product Brands of Distinction***

*ACEC™ Centrifugal Pumps*

*Aldrich™ Pumps*

*Byron Jackson® Pumps*

*Calder™ Energy Recovery Devices*

*Cameron™ Pumps*

*Durco® Process Pumps*

*Flowserve® Pumps*

*IDP® Pumps*

*INNOMAG® Sealless Pumps*

*Lawrence Pumps®*

*Niigata Worthington™ Pumps*

*Pacific® Pumps*

*Pleuger® Pumps*

*Scienco™ Pumps*

*Sier-Bath® Rotary Pumps*

*SIHI® Pumps*

*TKL™ Pumps*

*United Centrifugal® Pumps*

*Western Land Roller™ Irrigation Pumps*

*Wilson-Snyder® Pumps*

*Worthington® Pumps*

*Worthington Simpson™ Pumps*



## Handling hot media liquids in all safety

Many industrial processes require heating or cooling to control their process characteristics. Only when pre-defined parameters of the processes, like temperature are obtained, the process can be started.

Maintaining a constant temperature level or changing temperature conditions can easily be done by the use of indirect heating by means of thermal fluids. To obtain the exchange between the user and the heater, thermal fluids are warmed up and circulated in closed loops.

The operating temperatures of these thermal fluids loops varies mostly from 100 °C (212 °F) up to 400 °C (752 °F). Dependent from the temperature, many different thermal fluids are available on the market.

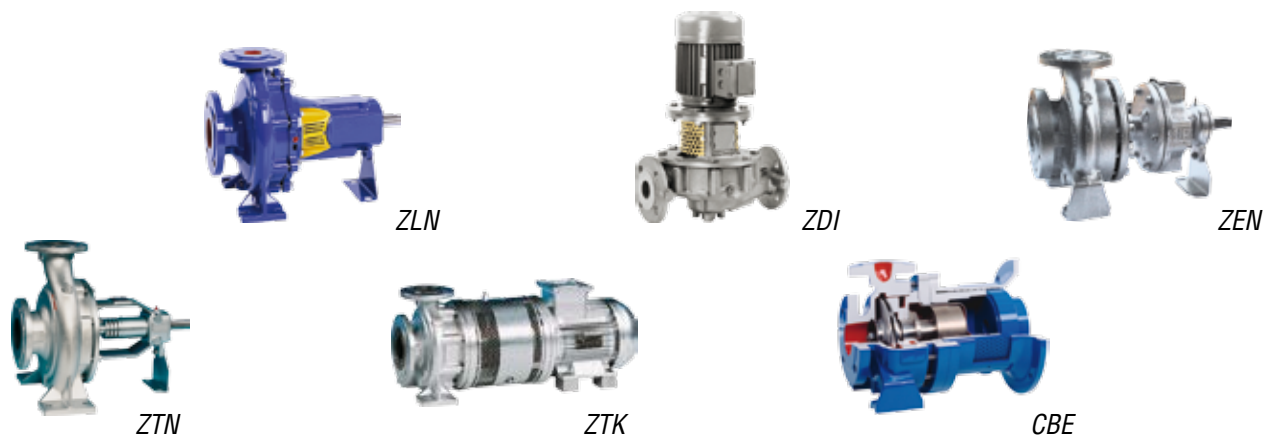
To circulate these thermal fluids, volute casing pumps are widely used. Depending from the temperature and heat transfer media, different type of pumps are developed to circulate the fluids in the most efficient and economical way.

### Industries / Markets

- Chemistry
- Pharmaceutical
- Energy
- Plastics manufacturing
- Paper production
- Wood processing
- Building systems
- Floor coverings

### Applications

- Hot water circulation
- Thermal oil circulation
- Heating
- Increasing pressure
- Heat transport





Hot water pumps  
for up to 150 °C  
(302 °F)



### ZLN – The standard hot water pump

Up to a temperature of 140 °C (284 °F) and when properly selected, the ZLN, a standard water pump as per EN 733, can be used with uncooled, balanced mechanical seals.

Product circulation ensures that the mechanical seal is permanently surrounded by the medium, thus preventing dry running.



ZLN

### ZDI – The hot water inline pump

The economical inline design is becoming increasingly popular in hot water applications, because it can be installed inline in any pipeline system and thus compensates for pipeline forces in an ideal manner. The ZDI uses a stub shaft connection, which permits use of a standard motor for a compact design.

The maximum pumping temperature for the uncooled ZDI hot water design is limited to 150 °C (302 °F). The process design makes it possible to disassemble the complete pump without having to separate the pump casing from the pipeline system.

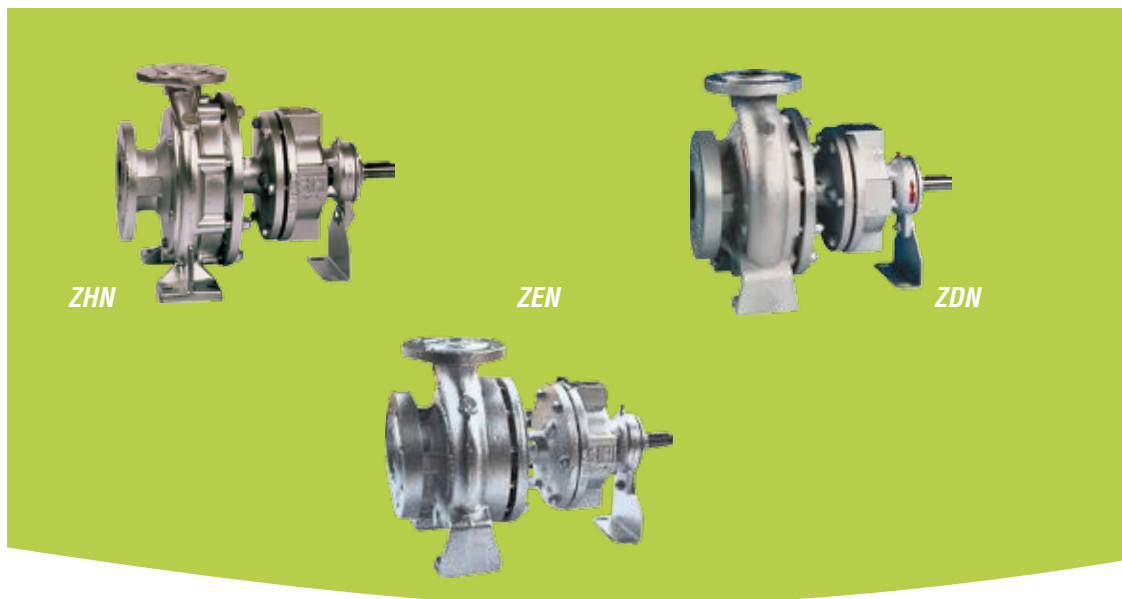


ZDI

### Technical data

Technical data	ZLN	ZDI
Flow rate	1800 m <sup>3</sup> /h (7926 US gpm)	140 m <sup>3</sup> /h (616 US gpm)
Delivery head	140 m (459 ft)	60 m (197 ft)
Temperature	140 °C (284 °F) un-cooled	150 °C (302 °F) un-cooled
Casing pressure	PN 16	PN 25
Material	Ductile iron	Ductile iron

Hot water pumps  
for up to 230 °C  
(446 °F)



Handling hot water requires very special pump designs as the operating pressure increases exponentially with the temperature increase. Special developments of the seal housing are integrated to achieve exceptional long MTBF times by guaranteeing the optimal seal faces lubrication under all circumstances.

Many pump and mechanical seal manufactures offering standard pumps with uncooled mechanical seals up to 180 °C (356 °F). Praxis however has proven that the poor lubrication characteristics of water under these extreme pressure and temperature conditions lead to short MTBF times of the equipment.

The combination of uncooled sealing device and the special pump construction make this pump design unique in its kind. It is not only offering the saving of the use of cooling water, but also increase the MTBF time to a normal expected life time of a mechanical seal.

### ZHN, ZDN, ZEN – The hot water pumps

In the volute casing pumps ZHN, ZDN, and ZEN, the mechanical seal has been moved to the drive side or “cold end” of the pump. In this way, a double heat barrier results in a more favourable temperature decrease on the drive side. Even at a temperature of up to 230 °C (446 °F), the use of an uncooled mechanical seal is no problem because the temperature in this area does not exceed 100 °C (212 °F). This eliminates the need for cooling water and the installation costs for external cooling of the shaft seal.

In hot water applications, however, it is not enough just to place the seal on the “cold end”, because this medium tends to vaporise during heating.

Due to centrifugal forces, gas bubbles are deposited on the smallest rotating parts. In general, this means the sliding surfaces of the mechanical seal. The pumps counter these physical conditions by using a gas separator in the area of the mechanical seal. At the highest point, there is a collecting chamber for the resulting gases. This space can be vented by means of a valve both when the system is at a standstill and when starting up of the plant.

### Technical data

Technical data	ZHN	ZDN	ZEN
Flow rate	600 m <sup>3</sup> /h (2642 US gpm)	600 m <sup>3</sup> /h (2642 US gpm)	600 m <sup>3</sup> /h (2642 US gpm)
Delivery head	90 m (295 ft)	90 m (295 ft)	90 m (295 ft)
Temperature	180 °C (356 °F) un-cooled	207 °C (404 °F) un-cooled	230 °C (446 °F) un-cooled
Casing pressure	PN 16	PN 25	PN 40
Material	Ductile iron	Ductile iron	Ductile iron, cast steel

Hot water pumps  
for up to 350 °C  
(662 °F)



*In opposite to water, organic or synthetic heat transfer media offer the option of heating, cooling or controlling temperature without high system pressures. Operating at temperatures of up to 350 °C (662 °F) is possible in pressure less systems, and the upper temperature limit is currently 400 °C (752 °F).*

*In connection with developments in the area of heat transfer installations and their liquids, the standard DIN 4754 has been compiled. Among other things, this standard specifies the safety requirements and the operation of pumps in thermal oil circulation systems. Here, too, volute casing pumps as per EN 733 have become the technology of choice.*

### ZTN, ZTK, ZTI – The thermal oil pumps

For thermal pumping at temperatures of up to 350 °C (662 °F) in thermal systems, the models ZTN, ZTK and ZTI have been developed. The higher requirements for operational safety, environmental friendliness and reduction of operating costs have been met consistently in these designs. The same goes for the contents of the standards DIN 4754 and EN 733. All pressure loaded components are made of tough materials such as GGG 40.3 (Ductile iron).

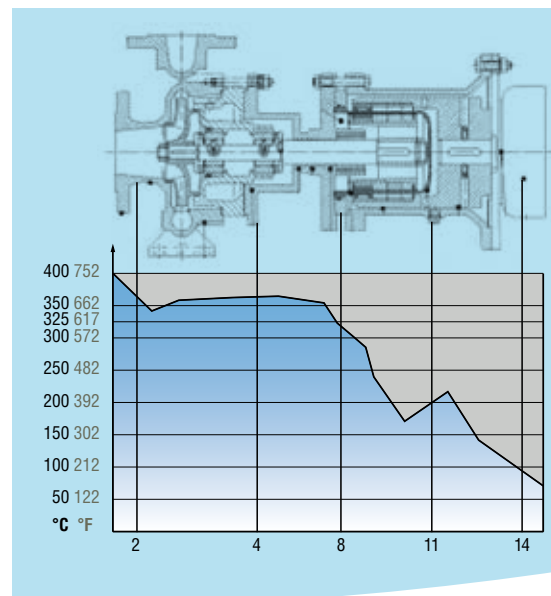
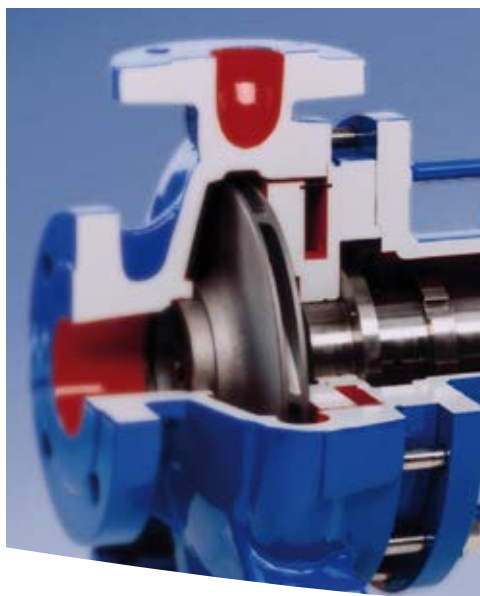
The heat barrier located behind the hydraulic system can be used to substantially reduce heat losses. In addition, the pumps have a thermally isolated bearing carrier. A sliding sealing cartridge compensates any expansion that occurs due to heat, thus preventing distortion between the pump and cooling. An additional throttle gap achieves a favourable decrease in temperature with regard to the shaft seal. This makes it possible to use simple, uncooled shaft seals.

The models differ only in the form of the pump casing. While the ZTK has a volute casing with axial intake and radial discharge connection, the ZTI has an inline casing, which can be installed directly in the pipeline system. Both pumps are designed as compact assemblies.

### Technical data

	ZTN	ZTK	ZTI
Flow rate	1000 m³/h (4403 US gpm)	200 m³/h (880 US gpm)	200 m³/h (880 US gpm)
Delivery head	90 m (295 ft)	60 m (196 ft)	60 m (196 ft)
Temperature	350 °C (662 °F) un-cooled	350 °C (662 °F) un-cooled	350 °C (662 °F) un-cooled
Casing pressure	PN 16	PN 16	PN 16
Material	Ductile iron	Ductile iron	Ductile iron

**Thermal oil pump with magnetic coupling up to 400 °C (752 °F)**



Based on an increasing environmental consciousness, tighter regulations (such as TA-Luft, German Technical Instructions on Air Quality Control) and the justified demand for more safety, sealless pumps are increasingly being used. In particular, when pumping synthetic heat transfer media, which can be classified as hazardous to health, magnetically coupled pumps have become the technology of choice. A hermetically sealed magnetic coupling, however, is also the optimal solution when it must be ensured that the heat transfer medium does not come into contact with the atmosphere, especially with oxygen.

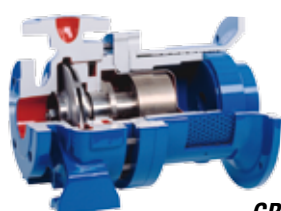
**CBE –The compact magnetically coupled pumps up to 400 °C (752 °F)**

Up to a temperature of 300 °C (572 °F), the CBE in close-coupled design has proven to be a good solution. This magnetically coupled design is not only hermetically sealed, but also requires no maintenance. The highly wear-resistant silicon carbide/tungsten carbide sleeve bearings result in long service life, and the deep drawn containment shroud with a wall thickness of 1.6 mm offers additional full safety. The magnets are made of high-quality samarium cobalt (SmCo). They are characterized by a high magnetic energy density, magnet size and can withstand high temperatures loads.

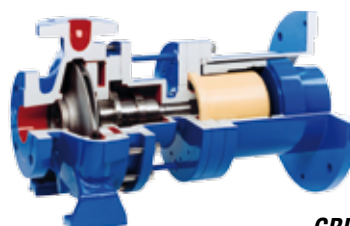
For temperatures of up to 400 °C (752 °F), a design with a heat barrier where a “dead ended” magnetic chamber is used. The heat barrier separates the pump thermally from the magnetic coupling and prevents the flow of heat into the magnet chamber. To ensure that additional heat is not generated by eddy current losses in the isolation shroud, a shroud of industrial ceramic (zirconium oxide) is used. This material is not conductive and will not generate any additional heat in the magnet chamber with the highest possible efficiency.

**Technical data**

	CBE
Flow rate	650 m³/h (2862 US gpm)
Delivery head	150 m (492 ft)
Temperature	max. 400 °C (752 °F) uncooled
Casing pressure	PN 25
Material	Ductile iron, stainless steel



**CBE 300**

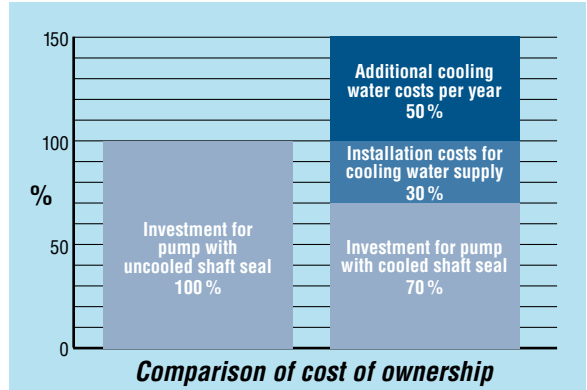


**CBE 400**



### Advantages

- Uncooled shaft seal
- No cooling water costs
- Low installation costs
- Longer service life
- High efficiency
- Simple maintenance
- Low life cycle costs



## Hot water pumps in detail

### Long lasting efficiency

- Closed impeller permitting 'neck' wear-rings to be retrofitted

### High efficiency & low power

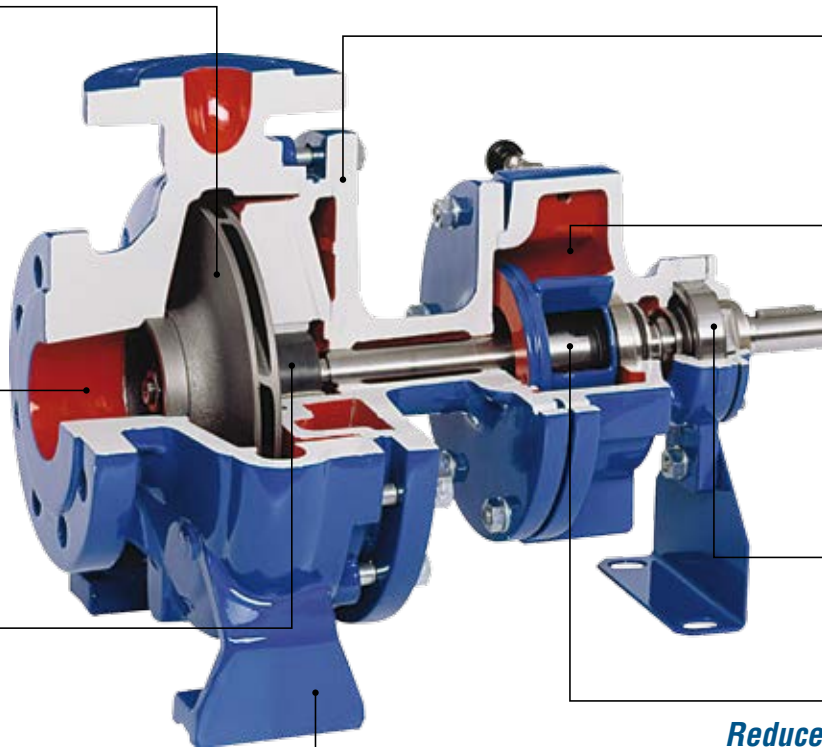
- Advanced fluid dynamic design

### Low NPSH

- High quality impeller and suction profile

### Robust rotating assembly

- Long-life ball bearing
- Sleeve bearing



### Simple removal

- Back pull-out design

### Un-cooled seal

- Vapour separation and removal in this unique seal chamber
- Large volume seal chamber located at cool drive-end
- Low shaft deflection

### Long life

- Anti-friction bearing

### Reduced spare parts cost

- Standard mechanical seal to DIN 24960

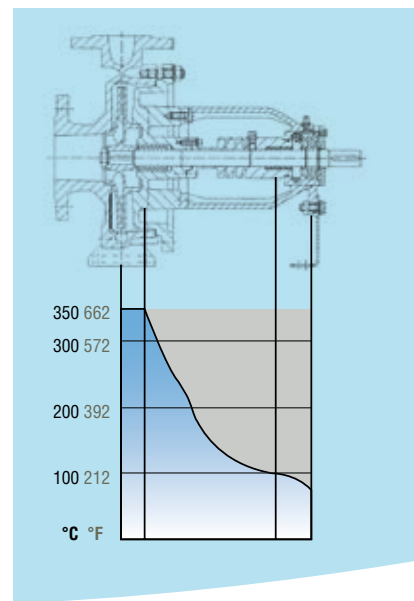
### Stable with temperature fluctuations

- Provision for thermal expansion



### Advantages

- Uncooled shaft seal
- Reduced heat losses
- Thermally isolated bearing carrier
- Improved safety
- High efficiency
- Simple maintenance
- Low life cycle costs



## Thermal oil pumps in detail

### Long lasting efficiency

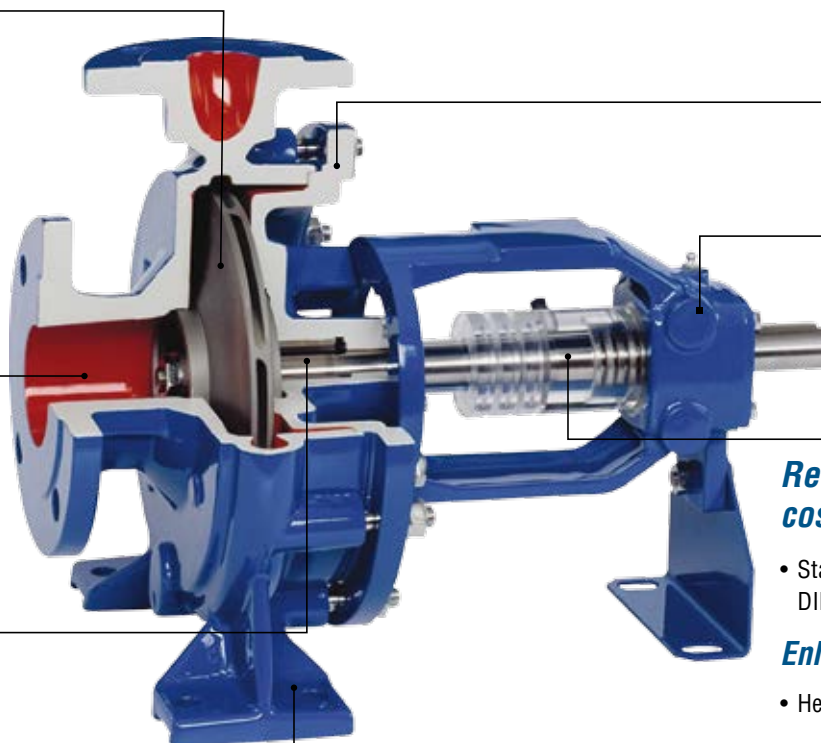
- Closed impeller permitting 'neck' wear-rings to be retrofitted

### High efficiency & low power

- Advanced fluid dynamic design

### Low NPSH

- High quality impeller and suction profile



### Simple removal

- Back pull-out design

### Triple protection

- Mechanical seal backed by lip seals and bearing assembly

### Reduced spare parts cost

- Standard mechanical seal to DIN 24960 and basic lip seals

### Enhanced seal life

- Heat dissipation with air-fin cooling

### Robust rotating assembly

- Long-life ball bearing
- Sleeve bearing

### Stable with temperature fluctuations

- Provision for thermal expansion

*Hot water and thermal oil pumps*



**Hot water pumps**

*up to 150 °C (302 °F) uncooled*



ZLN



ZDI

*up to 230 °C (446 °F) uncooled*



ZHN



ZDN



ZEN

**Thermal oil pumps**

*up to 350 °C (662 °F) uncooled*



ZTN



ZTK



ZTI

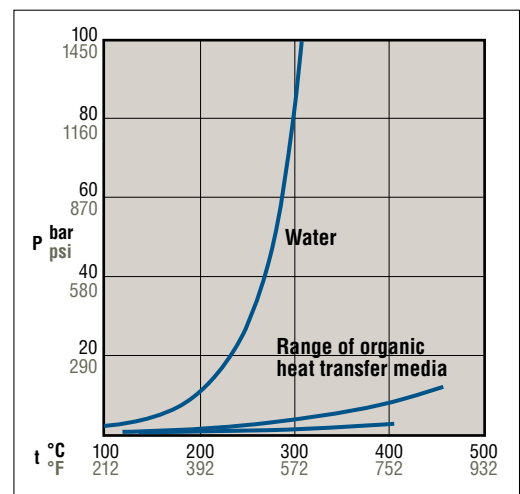
*up to 400 °C (752 °F) uncooled*



CBE

Because of its low environmental impact and high specific-heat capacity, water is preferred in the temperature range for up to about 200 °C (392 °F).

Due to the steam pressure, which increases greatly as the temperature rises, organic liquid heat transfer media are preferred in the temperature range from 200 °C (392 °F) to 400 °C (752 °F).



**Global Service  
and Technical  
Support**



## Life Cycle Cost Solutions

Typically, 90% of the total life cycle cost (LCC) of a pumping system is accumulated after the equipment is purchased and installed. Flowserve has developed a comprehensive suite of solutions aimed at providing customers with unprecedented value and cost savings throughout the life span of the pumping system. These solutions account for every facet of life cycle cost, including:

### Capital Expenses

- Initial purchase
- Installation

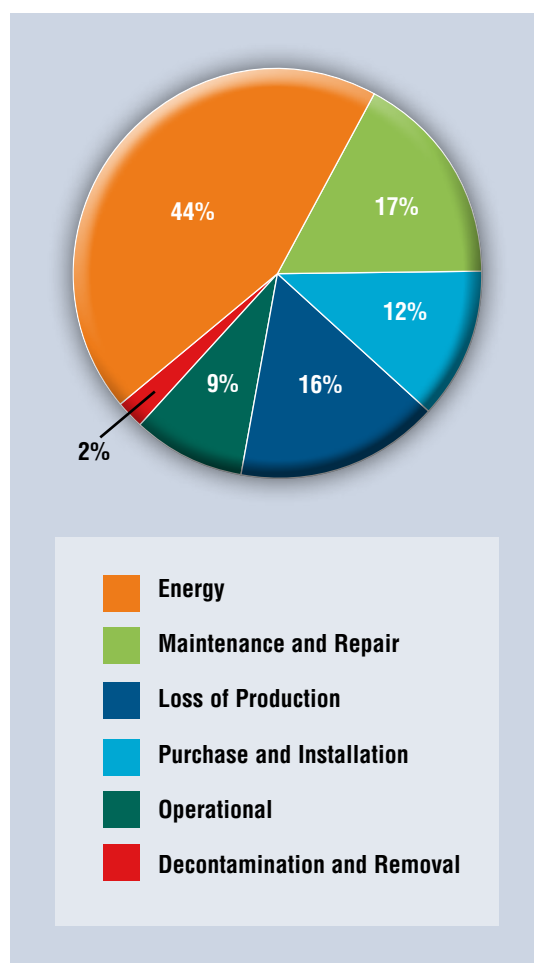
### Operating Expenses

- Energy consumption
- Maintenance
- Production losses
- Environmental
- Inventory
- Operating
- Removal

### Innovative Life Cycle Cost Solutions

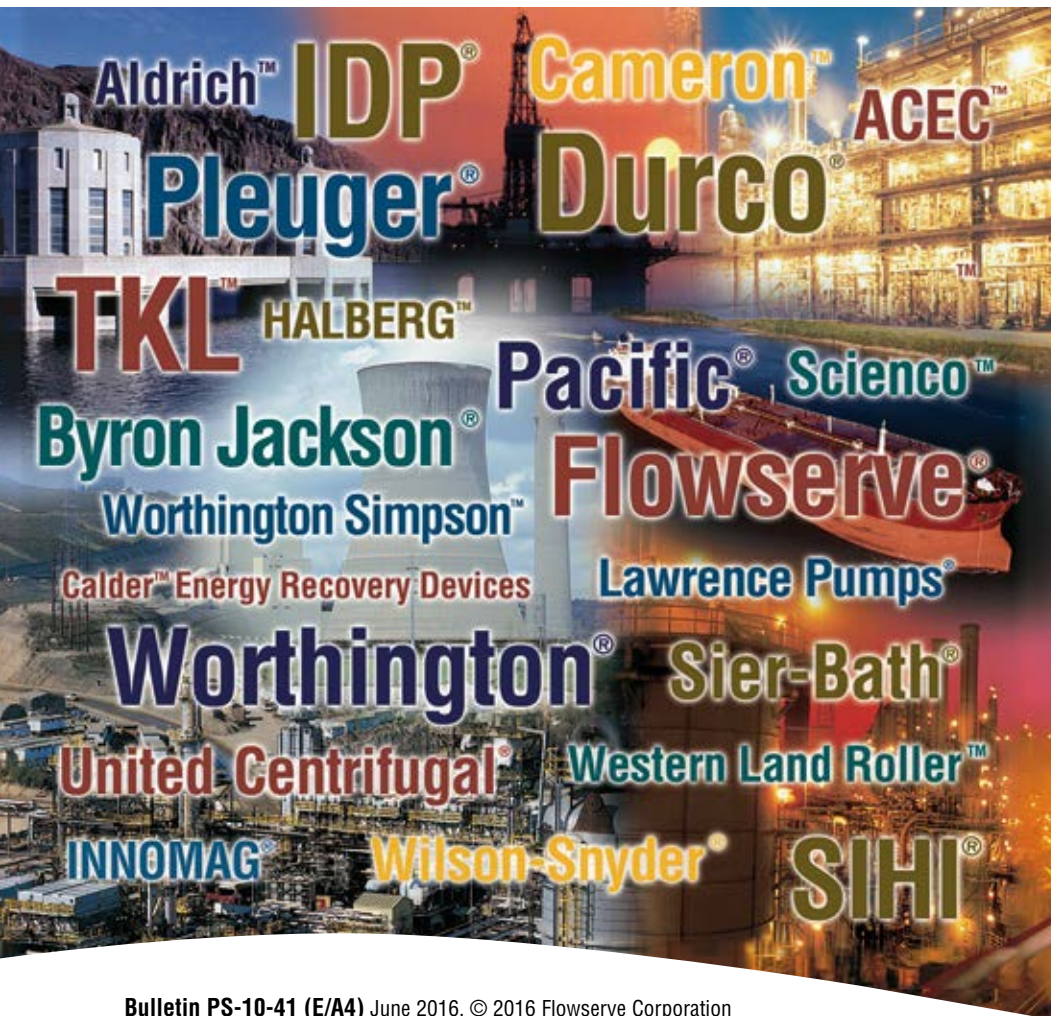
- New Pump Selection
- Turnkey Engineering and Field Service
- Energy Management
- Pump Availability
- Proactive Maintenance
- Inventory Management

### Typical Pump Life Cycle Costs<sup>1</sup>



<sup>1</sup> While exact values may differ, these percentages are consistent with those published by leading pump manufacturers and end users, as well as industry associations and government agencies worldwide.





Bulletin PS-10-41 (E/A4) June 2016. © 2016 Flowserve Corporation

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