

## **AHLSTAR end suction single stage centrifugal pumps**



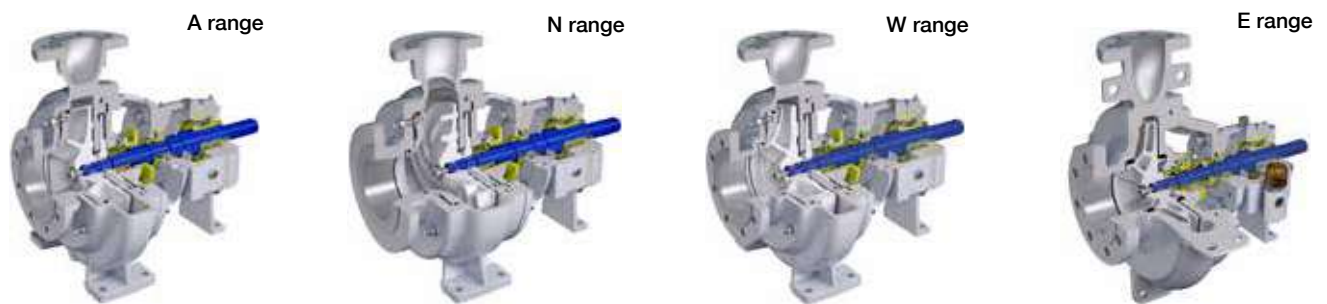
# AHLSTAR end suction single stage centrifugal pumps

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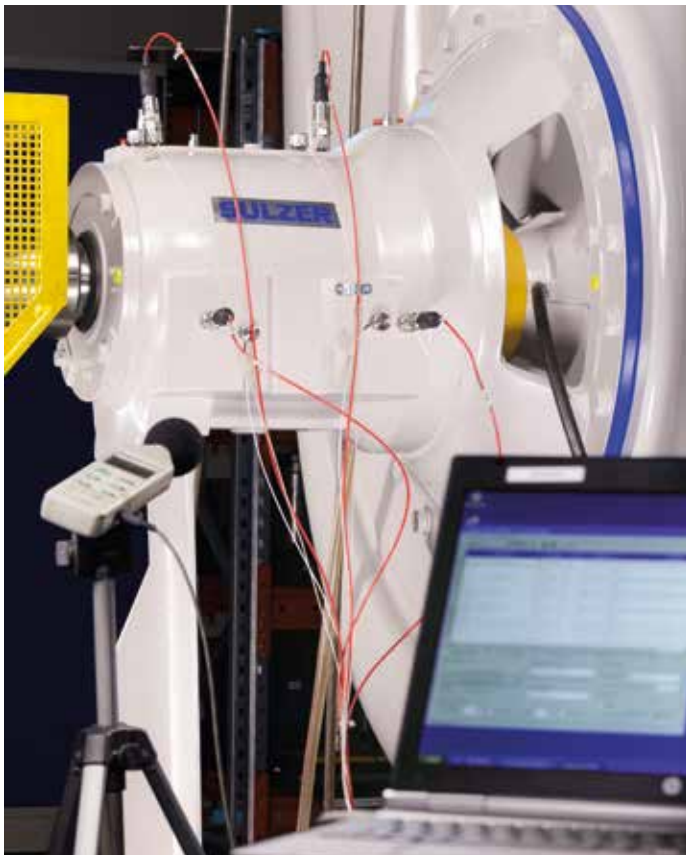
*Since our very first designs in the mid 1980s up to the most recent state-of-the-art range, we have delivered more than 150'000 AHLSTAR pumps worldwide – all designed to exceed standard requirements and customer expectations.*

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The AHLSTAR range, comprised of the A, N, W and E ranges, has been designed in accordance with ISO 5199 and ISO 2858 international standards, and has been even further developed to surpass market standards and ensure excellent performance and reliability.



## Hydraulic design simulation and full-scale testing laboratory



Through revolutionary methods, we have improved the performance and reliability of our pumps. Here at Sulzer, we place great emphasis on innovation and research and development. Using our own simulation tools, we can quickly analyze various hydraulic designs and then test the final design options in real operational conditions at our own full-scale laboratory.

# Hydraulic coverage for the most demanding applications

*AHLSTAR pumps have been designed to meet the most demanding hydraulic coverage requirements and for all types of liquid, making it the ideal range for challenging pumping operations.*



Oil and gas



Hydrocarbon processing



Power generation



Pulp, paper and board



General industry



Chemical process industry



Water and wastewater

| Liquid                                  | Temperature<br>up to 210°C /<br>410°F | Pressure<br>up to 16/25 bar /<br>230/360 psi | Gas content<br>up to 70% | Liquid position<br>below or above<br>the pump | Corrosion<br>pH from 0 to 14 |
|---|---------------------------------------|--|--------------------------|---|------------------------------|
| Clean and slightly contaminated liquids |                                       |  |                          |   |                              |
| Viscous liquids                         |                                       |  |                          |   |                              |
| Fibrous slurries                        |                                       |  |                          |   |                              |
| Non-fibrous slurries                    |                                       |  |                          |   |                              |
| Large solids containing liquids         |                                       |  |                          |   |                              |

## Features and benefits

### 1 Versatile range of reliable and efficient EnerSave™ impellers

- Reduces life cycle costs, energy consumption, operation time and downtime

### 2 Innovative and reliable integrated degassing and self-priming units

- For a variety of applications with difficult liquids
- Designed to help the centrifugal pump start quickly when the liquid level is below the pump in self-priming applications

### 3 Robust, reliable and patented Rotokey impeller mounting

- Enables fast and simple dismantling and reassembly
- Helps minimize maintenance costs

### 4 Externally adjustable patented side plate

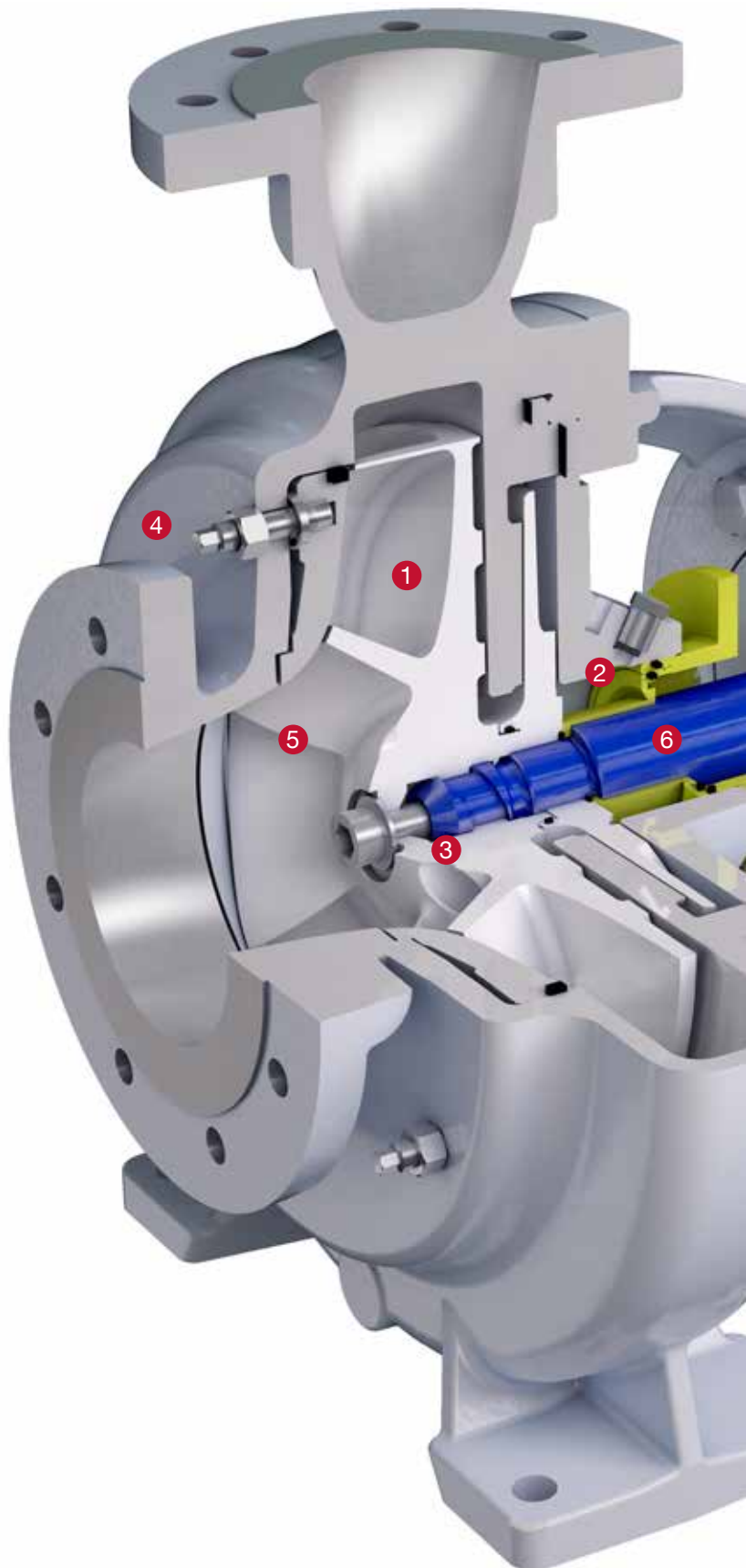
- Allows fast and simple impeller clearance setting, thereby minimizing life cycle costs and ensuring continued high efficiency

### 5 Patented balancing holes

- Ensure efficient liquid circulation behind the impeller and in the seal chamber
- Guarantee optimum shaft seal performance by reducing unexpected shutdowns and minimizing operation and maintenance costs

### 6 Proven WaterLess™ shaft seal

- Effective dynamic, single and double mechanical seals and gland packing
- Fast and simple installation
- No measurement required



**7 Heavy-duty shaft**

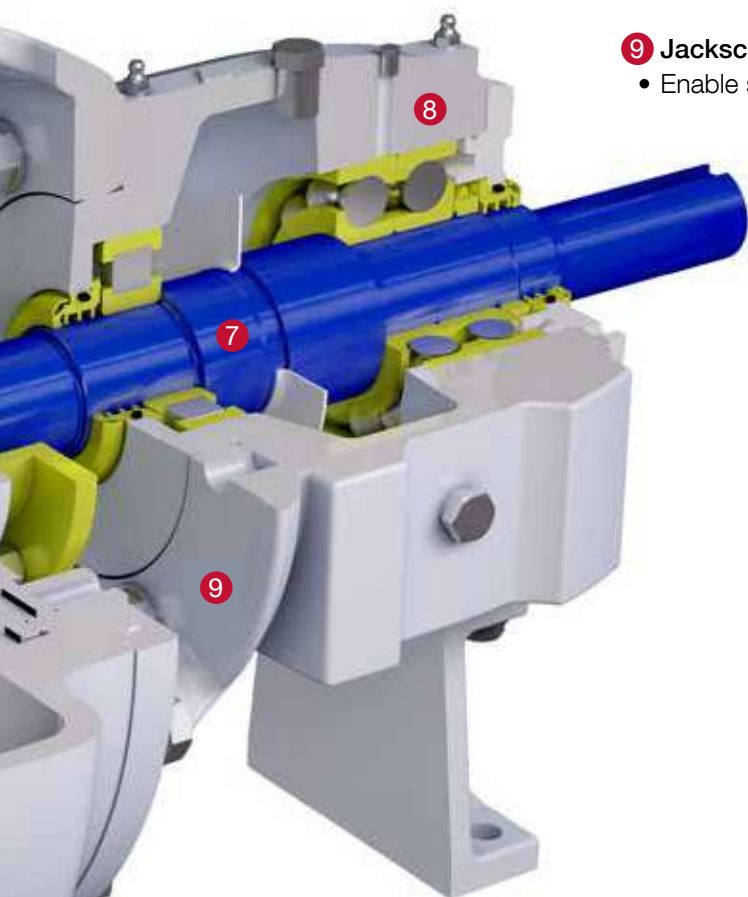
- Reduces deflection at stuffing box to <0.05 mm / 0.002 in
- Helps extend shaft seal lifecycle and reduces unexpected shutdowns and maintenance costs

**8 Reliable bearing unit**

- Reliable, simplified, heavy-duty bearing unit minimizes unexpected shutdowns and reduces maintenance costs
- Includes oil and grease lubrication for all performance needs: grease lubrication for applications up to 120°C / 250°F; and oil lubrication for up to 180°C / 355°F

**9 Jackscrews**

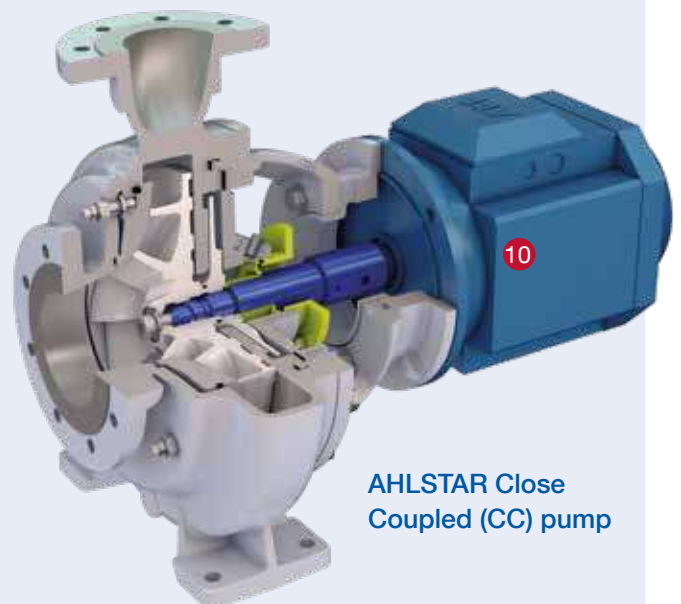
- Enable simple dismantling and minimizes maintenance costs



AHLSTAR Long  
Coupled (LC) pump

**10 Standard IEC dimensioned flange or flange/feet electric motor with heavy-duty bearing unit**

- Shrink fitted sturdy shaft with the same dimensions as the AHLSTAR LC pump shaft
- Interchangeability of wet end and sealing unit components



AHLSTAR Close  
Coupled (CC) pump

# AHLSTAR A range type A

## Operating data



|              |   |
|--------------|---|
| Capacities   | 11'000 m <sup>3</sup> /h / 48'400 USgpm                     |
| Heads        | 160 m / 525 ft  |
| Temperatures | 180°C / 356°F   |
| Frequencies  | 50 or 60 Hz   |
| Pressures    | 16/25 bar, 230/360 psi<br>depending on<br>material and size |

## Impeller options



Low flow  
impeller



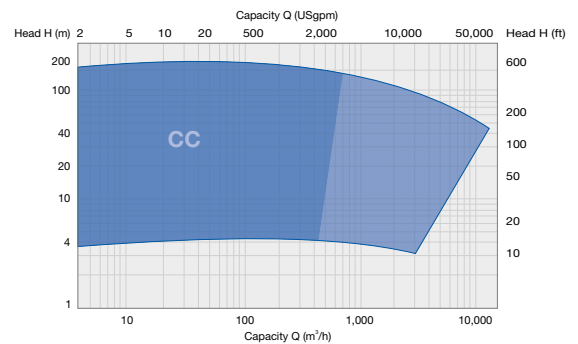
Open  
impeller



Special open  
impeller



Vortex  
impeller



# AHLSTAR A range type APP/T

## Operating data



|              |   |
|--------------|---|
| Capacities   | 9'000 m <sup>3</sup> /h / 39'600 USgpm                      |
| Heads        | 160 m / 525 ft  |
| Temperatures | 180°C / 356°F   |
| Frequencies  | 50 or 60 Hz   |
| Pressures    | 16/25 bar, 230/360 psi<br>depending on<br>material and size |

## Impeller options



Closed  
impeller



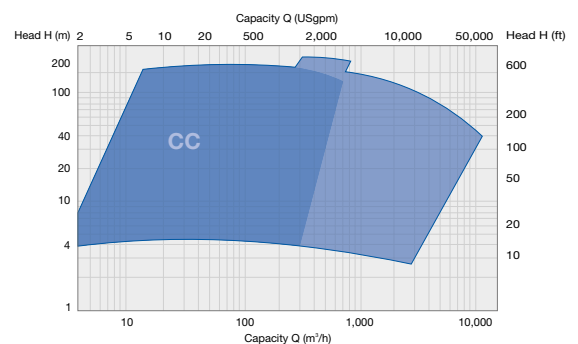
Open  
impeller



Special open  
impeller



Low pulse  
impeller



# AHLSTAR N range type NPP/T

## Operating data



|              |   |
|--------------|---|
| Capacities   | 2'000 m <sup>3</sup> /h / 8'800 USgpm                 |
| Heads        | 90 m / 295 ft   |
| Temperatures | 180°C / 356°F   |
| Frequencies  | 50 or 60 Hz   |
| Pressures    | 16 bar / 230 psi<br>depending on<br>material and size |

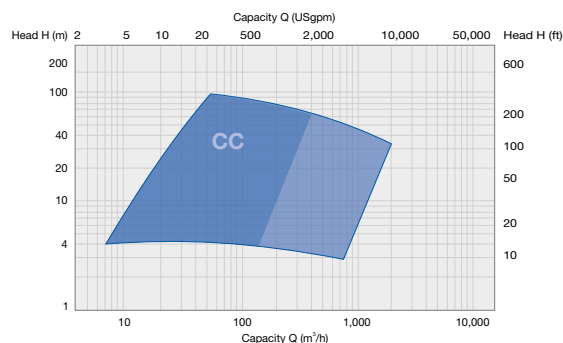
## Impeller options



Non-clogging closed  
(channel type) impeller



Non-clogging  
vortex impeller



# AHLSTAR W range type WPP/T

## Operating data



|              |   |
|--------------|---|
| Capacities   | 7'000 m <sup>3</sup> /h / 31'000 USgpm                |
| Heads        | 110 m / 360 ft  |
| Temperatures | 180°C / 356°F   |
| Frequencies  | 50 or 60 Hz   |
| Pressures    | 16 bar / 230 psi<br>depending on<br>material and size |

## Impeller options



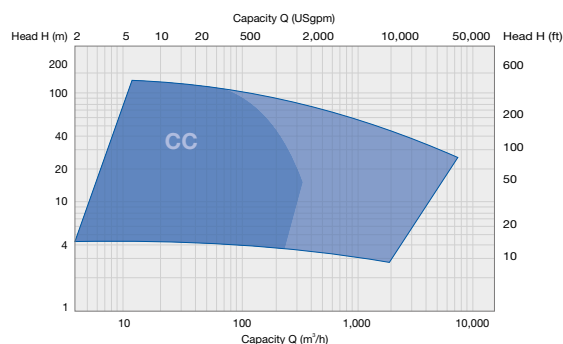
Wear-resistant  
closed impeller



Wear-resistant  
open impeller

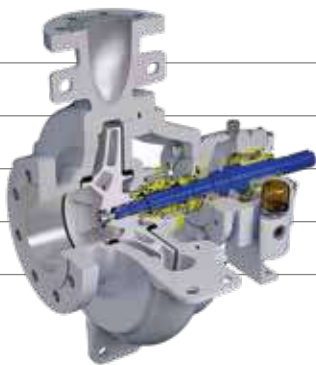


Wear-resistant  
vortex impeller



# AHLSTAR E range type EPP/T

## Operating data



|              |                           |
|--------------|---------------------------|
| Capacities   | 6'100 m³/h / 26'860 USgpm |
| Heads        | 160 m / 525 ft            |
| Temperatures | 210°C / 410°F             |
| Frequencies  | 50 or 60 Hz               |
| Pressures    | 25 bar / 360 psi          |

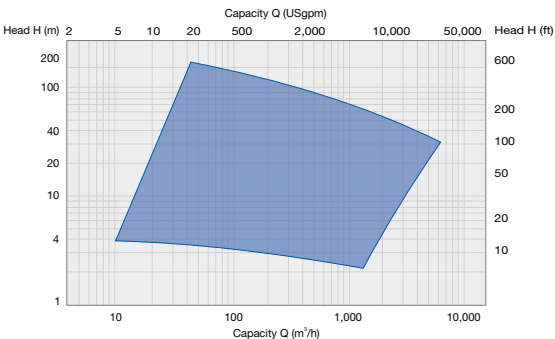
## Impeller options



Closed  
impeller



Open  
impeller

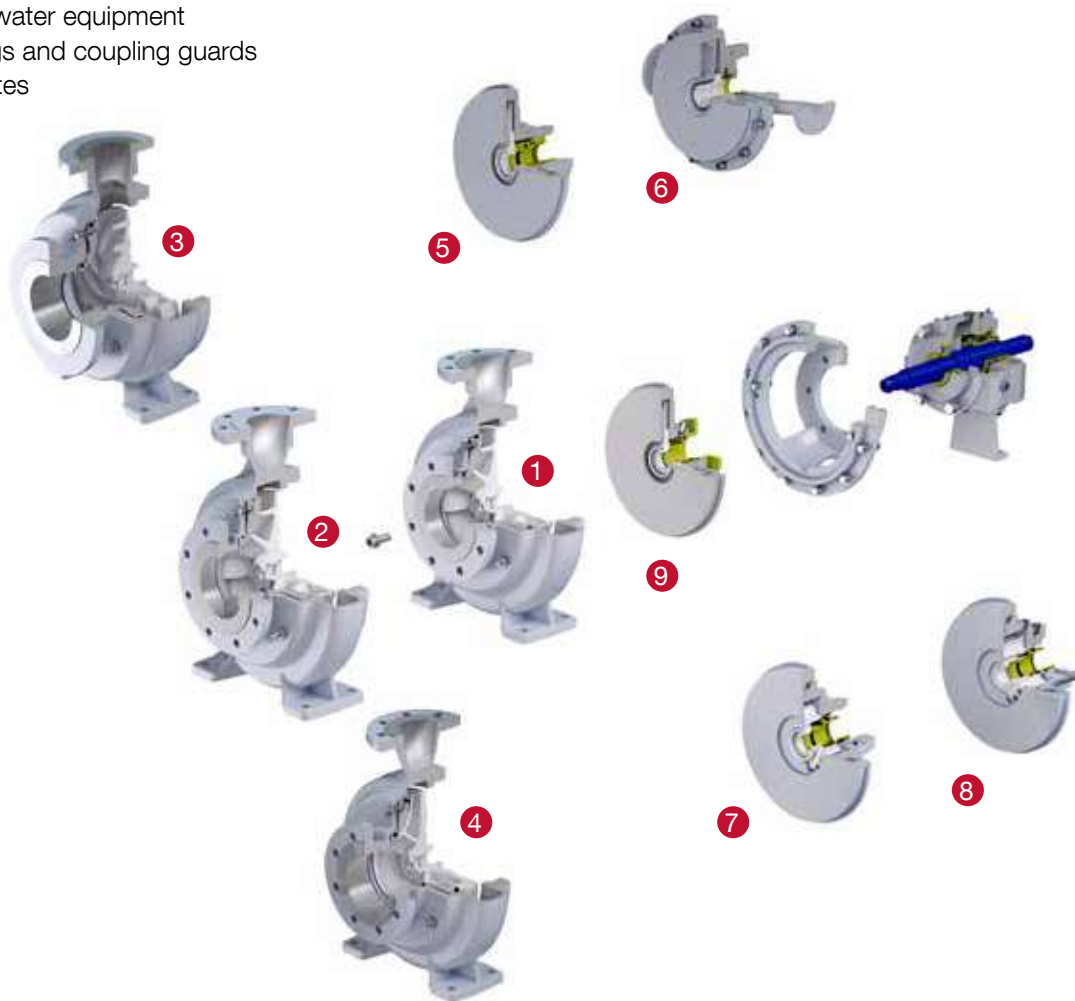


# Interchangeability

*All pumps in our AHLSTAR range have been standardized, using common modules and components, for maximum interchangeability and easy installation and maintenance. Fewer parts means lower inventory costs and greater process reliability.*

Common components and modules in AHLSTAR range types A, APP/T, EPP/T, NPP/T and WPP/T, with all options of gas separator GM, GS, R, self-priming LM and S, as well as CC designs are:

- 173 wet end sizes
- 24 sealing unit sizes with 7 common shaft seal sizes
- 7 common bearing units
- Common sealing water equipment
- Common couplings and coupling guards
- Common baseplates



**Lower spare part inventory and higher process reliability with high interchangeability of wet ends, sealing units and bearing units**

- |                                  |                                |
|----------------------------------|--------------------------------|
| ① A hydraulics                   | ⑥ R design air separating pump |
| ② APP/T hydraulics               | ⑦ LM design liquid ring pump   |
| ③ NPP/T hydraulics               | ⑧ S design liquid ring pump    |
| ④ WPP/T hydraulics               | ⑨ Versatile shaft seals        |
| ⑤ GM and GS design gas separator |                                |

# Materials

| Stainless steel design                                 |                              |                  | Nominal chemical composition %                          |           |           |           |           |                            |
|--|------------------------------|------------------|---|-----------|-----------|-----------|-----------|----------------------------|
|  |                              |                  | C   | Cr        | Ni        | Mo        | Cu        | N                          |
| Duplex   | ASTM A890 3A                 | 41               | 0.06 max.   | 24.0-27.0 | 4.0-6.0   | 1.75-2.5  | -         | 0.15-0.25                  |
|  | ASTM A890 1B                 | 4L, EH*          | 0.04 max.   | 24.5-26.5 | 4.7-6.0   | 1.7-2.3   | 2.7-3.3   | 0.10-0.25                  |
|  | ASTM A890 5A                 | 4T               | 0.03 max.   | 24.0-26.0 | 6.0-8.0   | 4.0-5.0   | -         | 0.10-0.30                  |
| Austenitic   | ASTM A743 CF-8               | 4C               | 0.08 max.   | 18.0-21.0 | 8.0-11.0  | -         | -         | -                          |
|  | AVESTA 654 SMO <sup>2)</sup> | 4U               | 0.025 max.  | 23.0-25.0 | 21.0-23.0 | 7.1-7.5   | 0.3-0.7   | 0.45-0.55                  |
| Martensitic  | ASTM A747 CB7Cu-2            | 4E               | 0.07 max.   | 14.0-15.5 | 4.5-5.5   | -         | 2.5-3.2   | -                          |
| Ferritic   | ASTM A743 CC50 (mod)         | ER**             | 0.25-0.35   | 29.0-30.0 | 1.50-3.00 | 1.50-3.00 | 1.00-1.50 | 0.10-0.20                  |
| Carbon steel, cast iron, titanium design <sup>3)</sup> |                              |                  | C   | Cr        | Ni        | Mo        | Cu        | Other                      |
| Cast iron <sup>3)</sup>                                | ASTM A48 CL 35 B             | 53               | -   | -         | -         | -         | -         | -                          |
| Chromium iron <sup>4)</sup>                            | ASTM A532 IIIA               | 5B               | 2.0-3.3   | 23.0-30.0 | 2.5 max.  | 3.0 max.  | 1.2 max.  | Si 1.5 max.                |
| Carbon steel   | ASTM A216 WCB                | 46 <sup>1)</sup> | 0.30 max.   | 0.50 max. | 0.50 max. | 0.20 max. | 0.30 max. | Mn 1.0 max.<br>Si 0.6 max. |
| Titanium   | ASTM B367 C-3                | 75 <sup>1)</sup> | -   | -         | -         | -         | -         | -                          |
| Material alternatives for other parts                  |                              |                  |   |           |           |           |           |                            |
| Gasket material  | Reinz AFM34                  | Y6               | Used in temperature range -50°C/-58°F...+250°C/+482°F   |           |           |           |           |                            |
|  | PTFE/Glass                   | 84               | Used in temperature range -190°C/-310°F...+240°C/+464°F |           |           |           |           |                            |
| O-ring material  | EPDM                         | 92               | Used in temperature range -50°C/-58°F...+150°C/+302°F   |           |           |           |           |                            |
|  | FKM                          | 93               | Used in temperature range -20°C/-4°F...+200°C/+392°F    |           |           |           |           |                            |

<sup>1)</sup> Currently available on limited sizes

<sup>2)</sup> AVESTA 654SMO is a trademark owned by Outokumpu Stainless which has granted Sulzer licence to produce this material

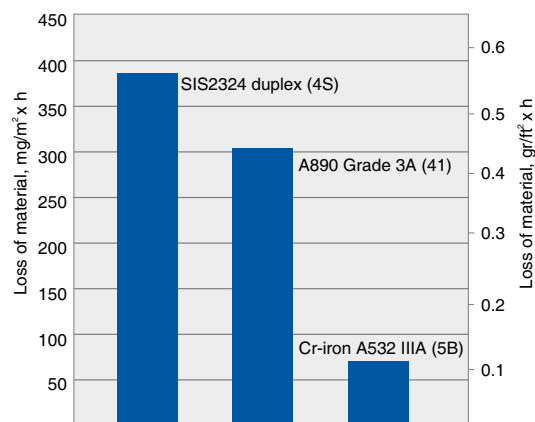
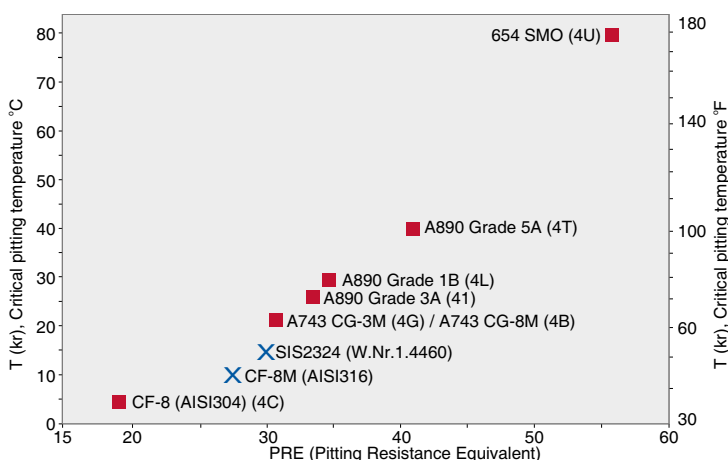
<sup>3)</sup> Type APP/T pumps

<sup>4)</sup> For W range (5B/4E) and full 5B

<sup>5)</sup> Other corrosion resistant cast steels available on request

\* EH precipitation hardened to c. 300HB

\*\* ER for W range impeller and sideplate



## Corrosion resistance

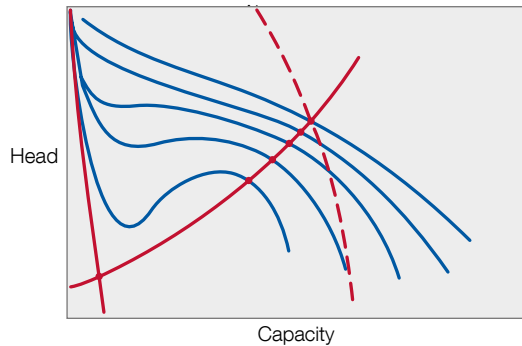
- Ferric chloride solution test; ASTM G-48
- X = typical other materials used in process industry (e.g. PPI)

## Wear resistance

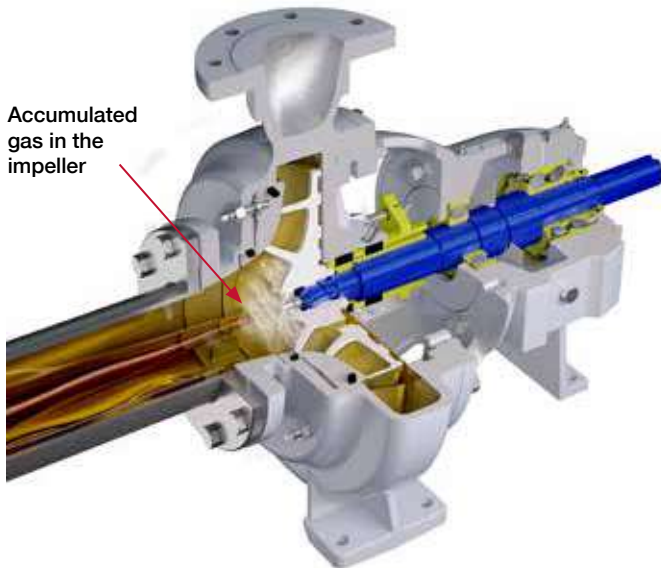
- Abrasion and corrosion test
- White liquor and lime mud +95°C / 203°F ±22°C / 40°F, 100 g/l / 0.835 lb/gal quartz sand (Stora Enso Pulp)
- Accuracy in the test ±21 mg/m² x h / 0.03 gr/ft² x h

# Degassing and self-priming units

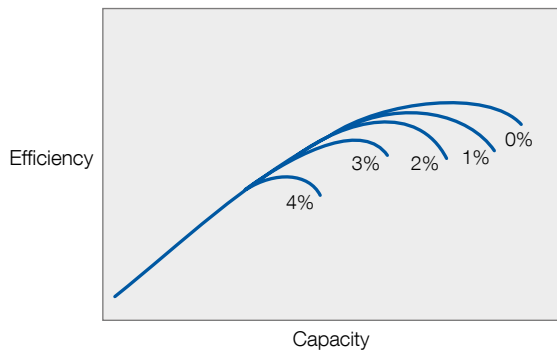
AHLSTAR pumps can be fitted with self-priming or degassing units, to enable the pump to be started with an empty inlet pipe and to allow it to pump liquids with high gas content.



Conventional centrifugal pumps, regardless of impeller type, can operate with a gas content of up to 4%. However, once the gas content exceeds 4%, bubbles start to accumulate in the impeller eye and impair operations. This reduces capacity and pumping becomes extremely unstable.



AHLSTAR degassing and self-priming units, such as the LM or S liquid ring pump and the GM, GS or R gas separator units, stabilize the pumping of liquids containing up to 40% weakly bonded gases or up to 70% strongly bonded gases using centrifugal pumps.



The difference in pressure between the pump inlet and the degassing unit outlet or the internal liquid ring pump eliminates gas bubbles from the impeller and thus stabilizes the system and significantly increases pump efficiency.



Liquid ring pump LM



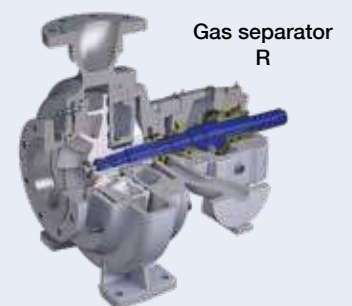
Liquid ring pump S



Gas separator GM



Gas separator GS



Gas separator R

# Degassing and self-priming solutions



## Positive inlet head

AHLSTAR pump with LM or S integrated liquid ring pump degassing unit

- For reliable pumping of gases containing liquids in unstable inlet head applications
- Single or double mechanical seal with recirculation flushing for clean liquids or with external flushing for fibrous and non-fibrous slurries and liquids containing large solids
- When the inlet head is stable, GS, GM and R gas separator degassing units provide reliability and efficiency



## Low or negative inlet head

AHLSTAR pump with LM or S integrated liquid ring pump

- Most reliable system for pumping gases containing liquids in low or negative inlet head applications
- Single mechanical seal with external flushing for clean, viscous, fibrous or non-fibrous slurries and liquids containing large solids
- Double mechanical seal for pumping liquids that are suitable for liquid ring flushing
- GM, GS or R gas separator degassing units without external vacuum pump cannot be used due to low or negative inlet head



### Replacing the barometric leg

AHLSTAR pump with a GM or R gas separator unit

- Simplifies expensive classic barometric leg pumping systems and ensures consistent and reliable operation
- Deep wells, high buildings and long pipes with vertical or submersible pumps and liquid level control systems can be avoided, thereby minimizing initial costs
- Single mechanical seal with recirculation flushing for clean liquids or with external flushing for fibrous or non-fibrous slurries
- Double mechanical seal for fibrous or non-fibrous slurries



### Self-priming pump applications

AHLSTAR pump with the LM or S integrated liquid ring pump degassing unit

- Ensures fast, reliable pump start-up and constant operation when starting with an empty inlet pipe
- Single mechanical seal with recirculation flushing for clean liquids, requires gooseneck inlet pipe
- Single mechanical seal with external flushing for fibrous or non-fibrous slurries and liquids containing large solids

# Shaft Seals

*Customized shaft seals for particular liquids and applications help reduce operational costs and minimize downtime.*

As Sulzer shaft seals require less or no water, they optimize operational and environmental cost reductions. Furthermore, our standardized, easy to understand designs shorten installation time, reduce maintenance costs and increase reliability.

Patented impeller balancing holes, together with the back vanes, improve liquid circulation and prevent clogging, creating ideal conditions behind the impeller and in the optimal seal chamber.

## Trusted sulzer dynamic seal

- Custom-designed for fibrous slurries, but also suitable for clean, viscous or non-fibrous slurries and liquids containing large solids
- No external sealing water required, and it does not leak
- Suitable for applications with positive pump inlet head and a temperature below boiling point in atmospheric pressure
- More than 50'000 dynamic seals have been installed since 1987, proving its popularity and reliability



## Self-venting throttled seal chamber Sulzer integrated single mechanical seal

- Ideal for clean liquid applications with a negative pump suction head with internal flushing
- High temperatures, up to 140°C / 285°F
- The impeller can be equipped with or without balancing holes
- Suitable also for non-fibrous slurries with external sealing liquid flushing preventing abrasive particles from penetrating the mechanical seal faces
- External flushing is mixed into the pumped liquids
- Temperatures of up to 180°C / 355°F



## Optimal bore Sulzer integrated single mechanical seal

- Custom-designed for fibrous slurries up to 8% consistency without flushing water, with positive pump suction head and specially designed patented impeller balancing holes
- Suitable for clean or viscous liquids and liquids containing large solids
- Liquid temperatures of 10°C / 20°F below boiling point in atmospheric pressure



## Optimal bore Sulzer integrated double mechanical seal

- Designed for all consistencies and concentrations of clean, viscous or fibrous slurries, non-fibrous slurries and liquids containing large solids
- Negative or positive pump suction head
- The impeller can be equipped with or without balancing holes
- In applications where abrasive non-fibrous and large solids containing liquids are pumped, the impeller typically does not have balancing holes
- Temperatures of up to 180°C / 355°F



### Ready-fitted mechanical seals

- Designed for standard stuffing box case cover
- More space in seal chamber because no shaft sleeve needed meaning lower cost
- Strong and solid design
- Single and double seal options
- Typical manufacturers: John Crane Safematic, EagleBurgmann, etc.



### Cartridge mechanical seals

- Originally, and usually, designed for the standard gland packing stuffing box
- Complex design due to the limited space of the standard gland packing stuffing box seal chamber
- Challenging installation due to the limited space around the seal
- Often requires extra installation adapter between the seal and the stuffing box cover
- Suitable for basic applications
- Can be designed in accordance with ISO 5199 or API 682 standards
- Single and double seal options
- Typical manufacturers: John Crane Safematic, EagleBurgmann, Chesterton, AES, etc.



### Standard element mechanical seals

- Designed for standard stuffing box case cover
- Requires shaft sleeve and seal housing
- Standard dimensions (L1K) for seals
- Suitable only for light-duty applications, e.g. clean liquids, low pressure, low temperature
- Single and double seal options
- Typical manufacturers: John Crane Safematic, EagleBurgmann, etc.



### Classic gland packing

- Designed in accordance with ISO dimension standards
- Classic standard stuffing box case cover
- Requires a sleeve to protect the shaft from corrosion and wear
- Reliable operation, but small (50 drops/minute) leakage required by seal/sleeve lubrication
- Requires regular supervision and maintenance
- Suitable only for light-duty applications, e.g. clean liquids, low pressure, low temperature
- Easy maintenance, without having to open the pump, due to a split gland design



# Sealing water equipment

*Sulzer sealing water equipment regulates the volume and pressure of external sealing water for optimum pump performance. The equipment is attached directly to the supply connection using a hose or pipe/tube.*

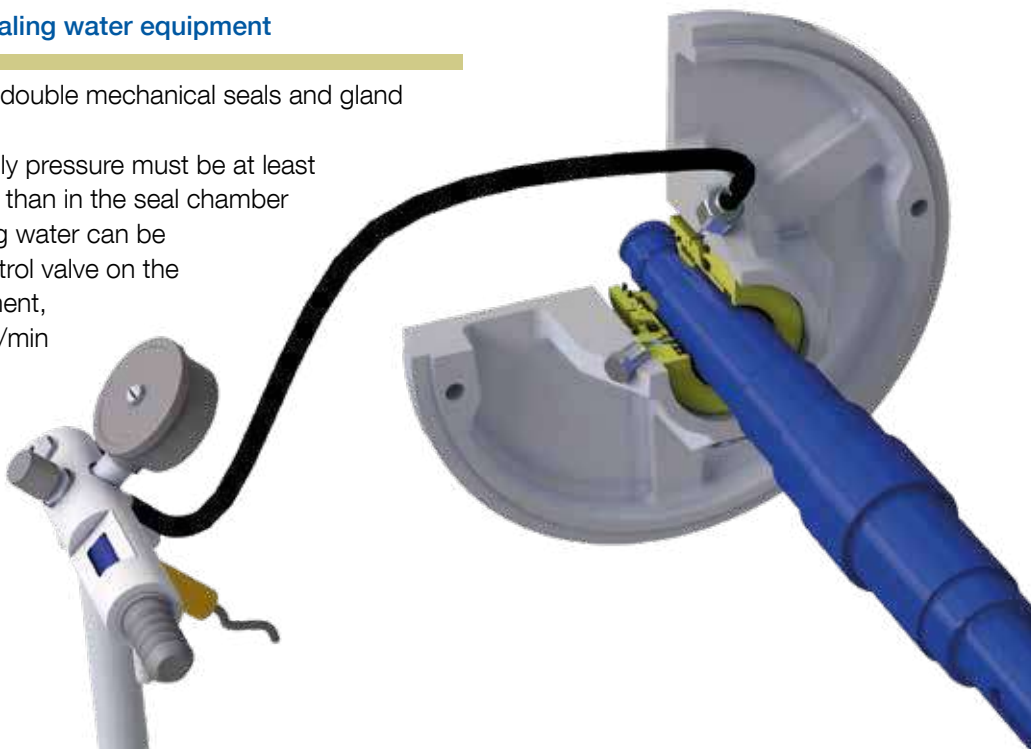
## Automatic constant flow sealing water equipment

- Suitable for single or double mechanical seals and gland packings
- Incoming water supply pressure must be at least 0.5 bar / 7 psi higher than in the seal chamber
- Automatically regulates the volume of sealing water to a constant 2 l/min / 0.5 USgpm



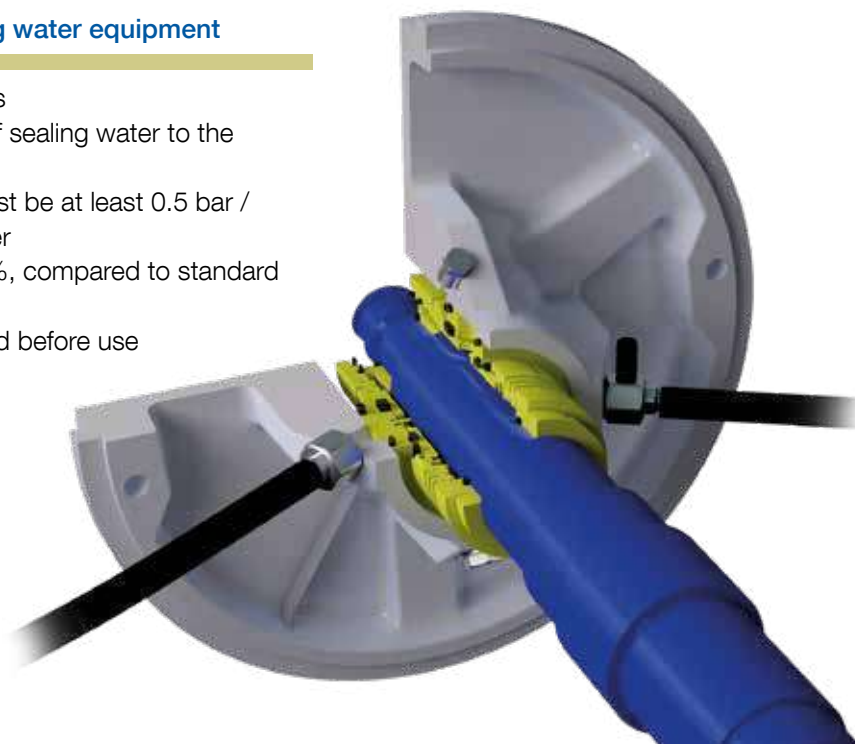
## Classic adjustable sealing water equipment

- Suitable for single or double mechanical seals and gland packings
- Incoming water supply pressure must be at least 0.5 bar / 7 psi higher than in the seal chamber
- The volume of sealing water can be regulated via the control valve on the sealing water equipment, typical value is 3 - 5 l/min / 0.8 - 1.3 USgpm



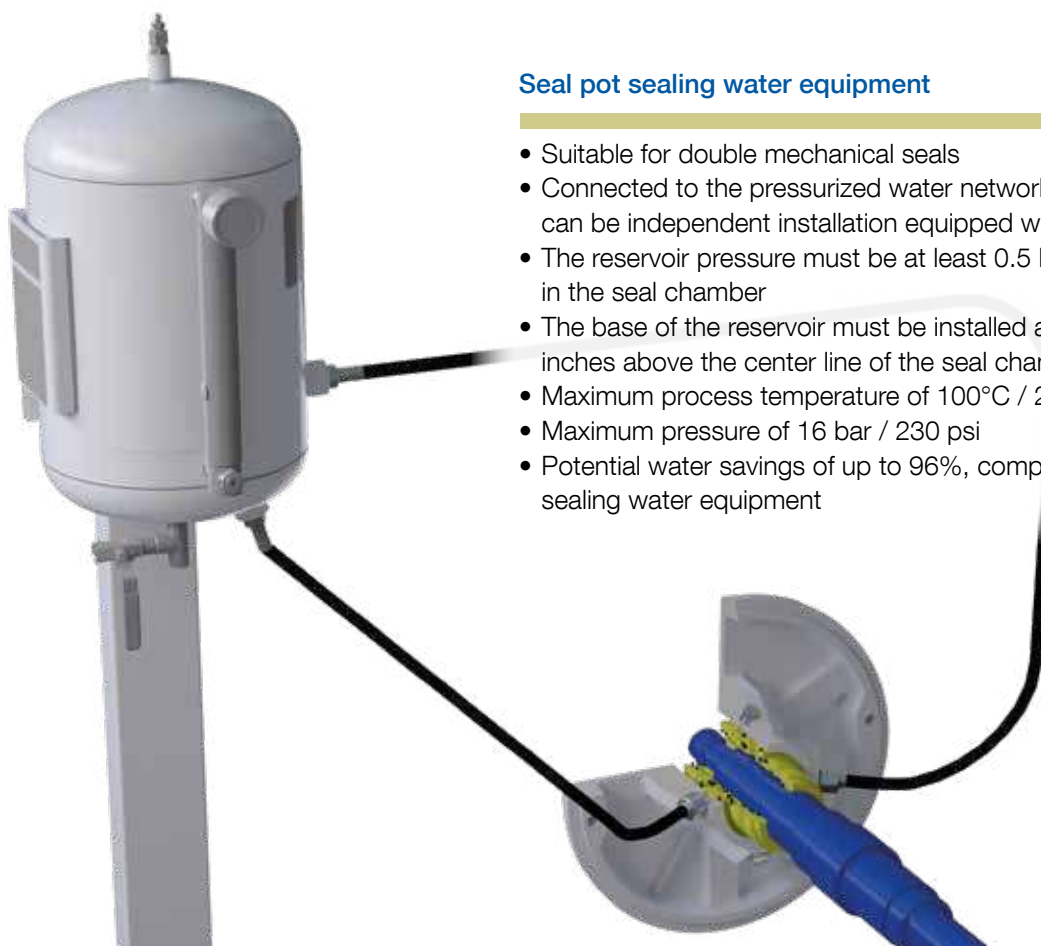
### Sulzer integrated smart flow sealing water equipment

- Suitable for double mechanical seals
- Automatically reduces the volume of sealing water to the minimum required
- Incoming water supply pressure must be at least 0.5 bar / 7 psi higher than in the seal chamber
- Potential water savings of up to 90%, compared to standard sealing water equipment
- The seal chamber must be ventilated before use



### Seal pot sealing water equipment

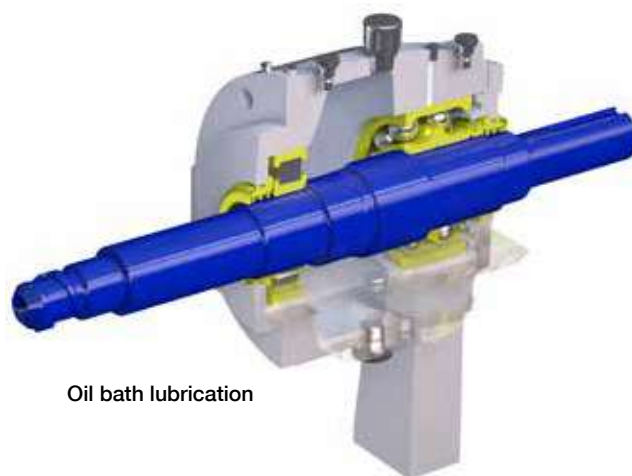
- Suitable for double mechanical seals
- Connected to the pressurized water network or gas network, or can be independent installation equipped with hand pump
- The reservoir pressure must be at least 0.5 bar / 7 psi higher than in the seal chamber
- The base of the reservoir must be installed at least 500 mm / 20 inches above the center line of the seal chamber
- Maximum process temperature of 100°C / 212°F
- Maximum pressure of 16 bar / 230 psi
- Potential water savings of up to 96%, compared to standard sealing water equipment



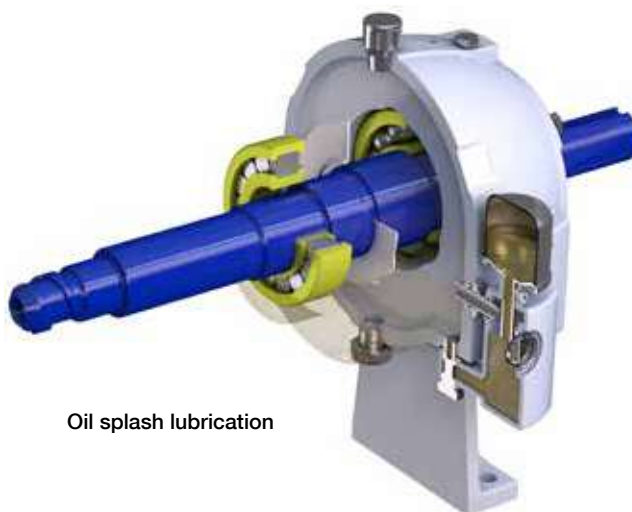
# Heavy-duty bearing units

*Sulzer's AHLSTAR bearing units are reliable, simplified and heavy-duty, resulting in minimized unexpected shutdowns and reduced downtime and maintenance costs.*

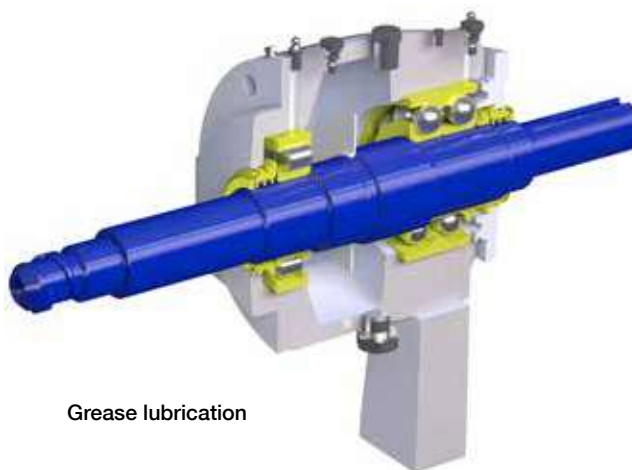
- Designed with the minimum number of components, making assembly fast and simple
- Heavy-duty shaft minimizes deflection at stuffing box < 0.05 mm / 0.002 in, thereby extending the life cycle of the shaft seal
- With oil bath, oil splash and grease lubrication for versatile applications, oil bath or oil splash lubrication for applications up to 180°C / 355°F and grease lubrication up to 120°C / 250°F
- The strong, over-sized bearing design far exceeds the ISO 5199 standard life cycle of 17,500 hours
- A sturdy support foot provides a solid base and prevents coupling alignment changes



Oil bath lubrication



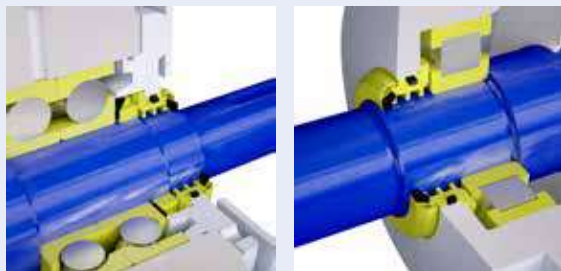
Oil splash lubrication



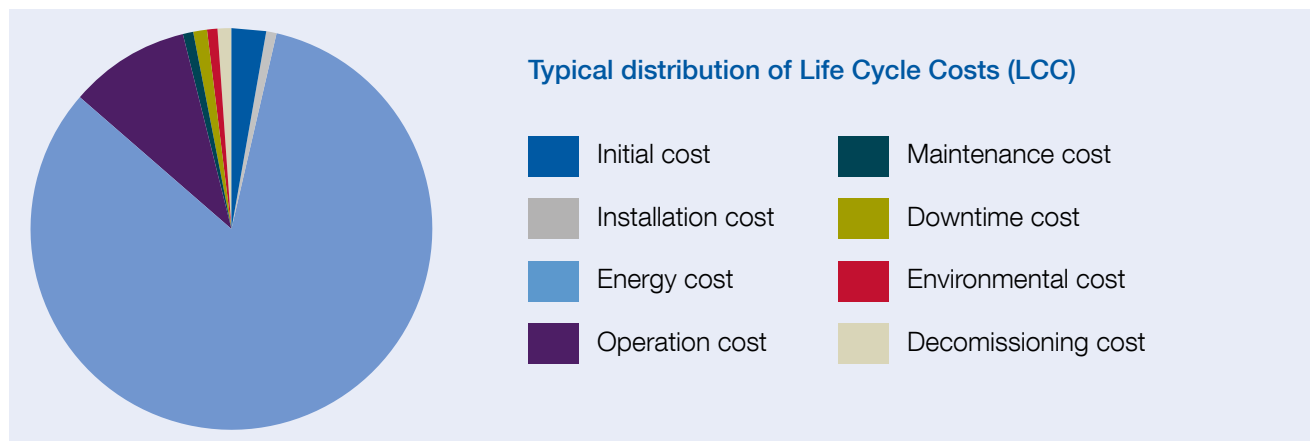
Grease lubrication

## Innovative bearing isolators

Sulzer's innovative, non-contacting bearing isolators at the both ends of the bearing house consist of three elements: a deflector, a lip seal and a labyrinth. This triple bearing protection prevents lubricant leaks from the bearing house and keeps contaminants out. No contact between the lip seal and shaft when the pump is rotating also means no wear, which extends the lifecycle of the unit.



## Superior design minimizes lifecycle costs



# Versatile installation options

## Fast and simple installation of Long Coupled (LC) pumps with T-frame baseplates

- The purpose of the baseplate is to facilitate installation of the pump-motor combination at the installation site
- The robust and rigid baseplate supports the substantial load of the piping and drive motor
- The baseplates have been designed to accommodate the next size of frame on the same baseplate
- Galvanized riser blocks as standard enable installation of the next size of drive motor frame, when required
- Stainless steel alignment blocks as standard facilitate fast and simple adjustment of the motor when aligning the coupling
- Alternative foundation bolts available, depending on application (welded, grouted or chemical anchors)



## Classic installation of Long Coupled (LC) pumps with grouted Sulzer ISO and API rectangular baseplates

- ISO and API standard rectangular baseplates are grouted into the concrete foundation
- Possible leaks are collected on the baseplate
- Galvanized riser blocks as standard enable installation of the next size of drive motor frame, when required
- Stainless steel alignment blocks as standard facilitate fast, simple adjustment of the motor when aligning the coupling
- Alternative foundation bolts available, depending on application (welded, grouted or chemical anchors)



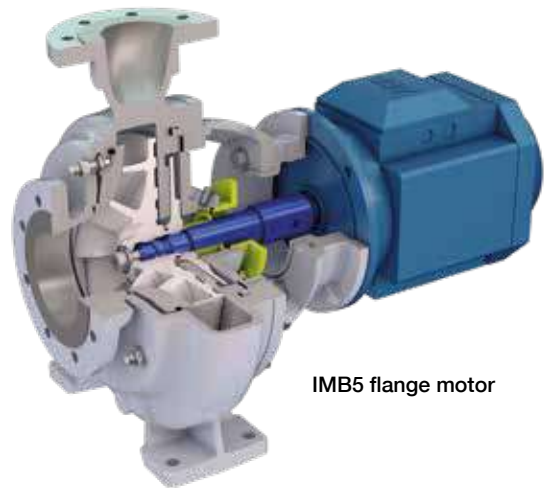
API rectangular baseplate



ISO rectangular baseplate

### Fast and simple and space-saving installation of Close Coupled (CC) pumps without baseplate

- Installation directly on the floor or installation rig without a baseplate is simpler, faster and more economical
- No need for coupling alignment, making the installation even faster, simpler and more economical
- Standard IEC dimensioned heavy-duty bearing motors in sizes IEC 90 to 280 as standard
- IMB5 flange motors for low-power applications and IMB35 flange/ feet motors for high-power applications
- AHLSTAR sizes 10, 11, 20, 21, 22, 23, 31, 32, 33 with all wet end and sealing unit options are available with the close coupled design



IMB5 flange motor



IMB35 flange/feet motor

## Surface treatment options

### Internal surface treatment

- Standard surface cleaning for normal applications
- Ground Ra 6.3 surfaces
- Cotton ball tested surfaces
- Hardening with plasma nitration
- Cleaning for peroxide applications
- Cleaning for drinking water applications

Special inside surface treatment on request.

### External surface treatment

- ISO 12944-2 C4 painting for normal applications
- ISO 12944-2 C4 painting for high temperatures >150°C /300°F applications
- ISO 12944-2 C5M painting for marine applications

Special external treatment available on request.



## Tests and certification options

### Performance tests

- Capacity, head, efficiency and NPSHr tests in accordance with ISO 9906:2012 / HI 14.6-2011
- Noise tests
- Vibration test in accordance with ISO 5199
- Mechanical tests in accordance with HI 14.6:2011
- Pressure pulsation test

### Material and NDT tests

- EN 10204.2.2 and 3.1
- Liquid penetration in accordance with ISO 1371-1 level 3
- Magnetic particle examination in accordance with ISO 1369 level 3
- PMI positive material identification

### Structural tests

- Balancing of impellers in accordance with ISO 1940 grade 6.3 and 2.5 static and dynamic
- Hydrostatic pressure test in accordance with ISO 5199:2002

### Inspection of assembly

- Dimensional checking of installation
- Dimensional checking of clearances
- Paint film thickness checking
- Final assembly checking

Customized tests available on request.

# Products and operation fullfill versatile international standards and directives

|                      |                                  |   |
|----------------------|----------------------------------|---|
| Legislation          | Directive 2006/42/EC             | Machinery directive   |
|                      | Directive 93/68/EEC              | CE Marking  |
|                      | Directive 94/9/EC                | Equipment and Protective systems intended for use in Potentially Explosive Atmospheres (ATEX)<br>Equipment categories II 2G and II 3G<br>Temperature classes T1-T4          |
| Product safety       | EN 809:1998 + A1:2009            | Pumps and pump units for liquids – Common safety requirements   |
|                      | EN ISO 12100:2010                | Safety of machinery<br>- General principles for design. Risk assessment and risk reduction  |
| Quality system       | EN ISO 9001:2008                 | Quality management systems. Requirements.   |
| Environmental system | EN ISO 14001:2004                | Environmental management systems<br>- Requirements with guidance for use  |
|                      | OHSAS 18001:2007                 | Occupational health and safety management systems. Requirements.  |
| Dimensions           | EN ISO 2858:2010                 | End-suction centrifugal pumps (rating 16 bar)<br>- Designation, nominal duty point and dimensions (up to size 44-200)<br>(not for EPP)<br>(only partly for CC-construction) |
| Design               | EN ISO 5199:2002                 | Technical specifications for centrifugal pumps – Class II   |
| Testing              | EN ISO 9906:2012<br>HI 14.6-2011 | Rotodynamic pumps – Hydraulic performance acceptance tests<br>- Grades 1E and 1B (Pump type A)<br>- Grade 2B (Pump type A, APP, NPP, WPP, EPP)                              |
|                      | EN 10204:2004                    | Metallic products – Types of inspection documents<br>- Inspection document type 2.2<br>- Inspection document type 3.1   |
|                      | EN 735:1995                      | Overall dimensions of rotodynamic pumps. Tolerances.  |
| Flange drilling      | ISO 7005-2:1988                  | Metallic flanges<br>- Part 2: Cast iron flanges<br>- PN10, PN16   |
|                      | ASME B16.1:2010                  | Grey Iron Pipe Flanges and Flanged Fittings<br>Class 25, 125, 250<br>- Class 125  |
|                      | ASME B16.5:2009                  | Pipe flanges and flanged fittings<br>NPS ½ Through NPS 24<br>- Class 150, 300   |
|                      | JIS B 2220:2012                  | Steel pipe flanges<br>- 10K, 16K, 20K, 30K  |
|                      | JIS B 2239:2004                  | Cast iron pipe flanges<br>- 10K, 16K  |
|                      | EN 1092-1:2007 + A1:2013         | Flanges and their joints<br>- Part 1: Steel flanges<br>- PN10, PN16, PN25   |
|                      | EN 1092-2:1997                   | Flanges and their joints<br>- Part 2: Cast iron flanges<br>- PN10, PN16   |



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