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**SULZER**

## HPT Multistage Barrel Casing Boiler Feed Pump



The **Heart**  
of Your  
Process

## Sulzer Pumps – Striving to Serve You Better

Sulzer Pumps combines more than 135 years of experience in pump development and manufacturing with a deep commitment to fully understand the needs of our customers.

Our detailed process and application knowledge has allowed us to develop innovative pumping solutions for our focus segments including tailor-made systems. Our active research and development supports the customer-oriented approach.

Sulzer Pumps has sales and service facilities in major markets of the world to provide fast and flexible response and support.



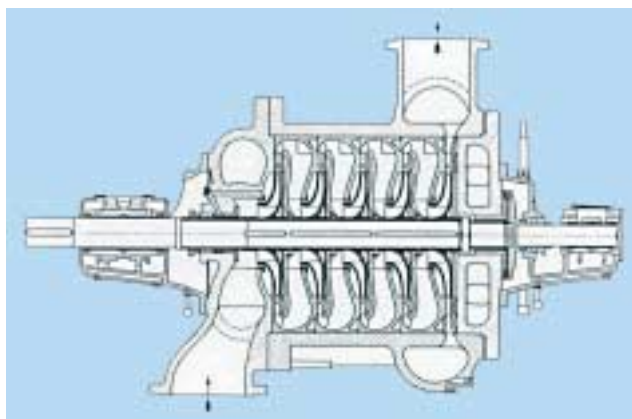
## HPT – Efficient and Reliable

HPT radially split barrel-casing pumps are specifically designed for boiler feed applications in thermal power stations. These pumps are optimized to provide high availability and high efficiency operation over an extended period of time, reducing operation and maintenance costs. Their robust construction and tolerance of changing conditions makes them particularly suitable for cyclic operation.

The pump's efficiency is a result of its advanced hydraulic design and so does not rely on the use of close internal clearances. This is also the case for the rotor-dynamic design, which ensures low vibration by providing a high degree of damping throughout the life of the pump, even with the clearances worn to their maximum values.

Although the HPT is a well-established design, with many years of reliable operation, it has been continually updated to take advantage of technological developments. These include developments in precision casting, sealing technology and materials as well as the application of FE analysis and state-of-the-art manufacturing techniques.

Drawing of original 1905 Sulzer boiler feed pump with a balance disc. Sulzer has the original patent for disc/counter-disc balancing systems.

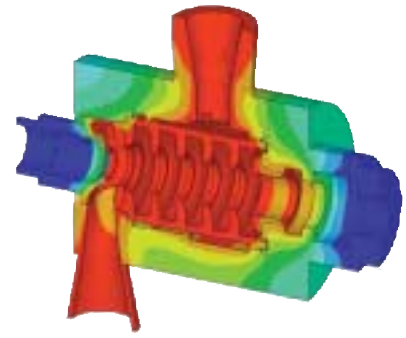


## Design Features

- Horizontal, multi-stage barrel casing based on EPRI contract developments
- Maximum safety due to double casing design
- Full cartridge pullout design for rapid changeover
- Inspection and overhaul without disconnection of main pipe work
- Single or double entry first stage impeller available
- Axial thrust compensated by balance piston
- Design features to eliminate the need for pre-warming on most applications

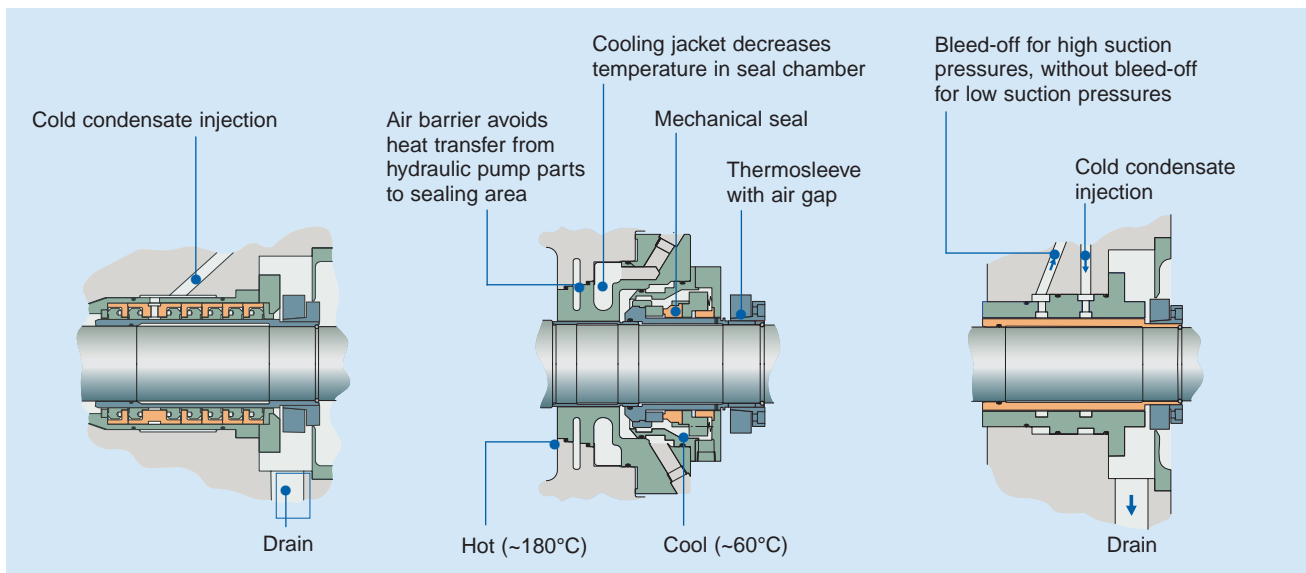
## Optimized Thermal Design

- The pump is designed to operate under cyclic conditions, without the need for pre-warming
- The design minimizes thermal distortion to avoid the reduction of internal clearances
- High strength materials are selected to accept thermal stresses
- Graphite stationary seals ensure secure sealing under all transient conditions



Computerized analysis to optimize temperature distribution under various conditions

## Shaft Seal Option



### With Floating Rings

- Moderate leakage

### Single Mechanical Seal

- Minimal leakage
- Low energy consumption

### Fixed Throttle Bushing

- Simple and reliable design
- Less sensitive to dirt and flashing

# HPT Design Features and Options

- Barrel design incorporates many design features resulting from Sulzer/EPRI research contract
- Maximum safety due to double casing design
- Pipework connections remain undisturbed during disassembly
- Barrel casing design provides maximum rigidity and accepts high pipe loads

Top or bottom facing nozzles welded or flanged; can be positioned to suit the planned installation layout

Full cartridge pull out for rapid changeover

- Axial thrust compensation by balancing piston to avoid damage during transient conditions
- Long operating life regardless of the operating mode

Design features to eliminate the need for prewarming in most installations

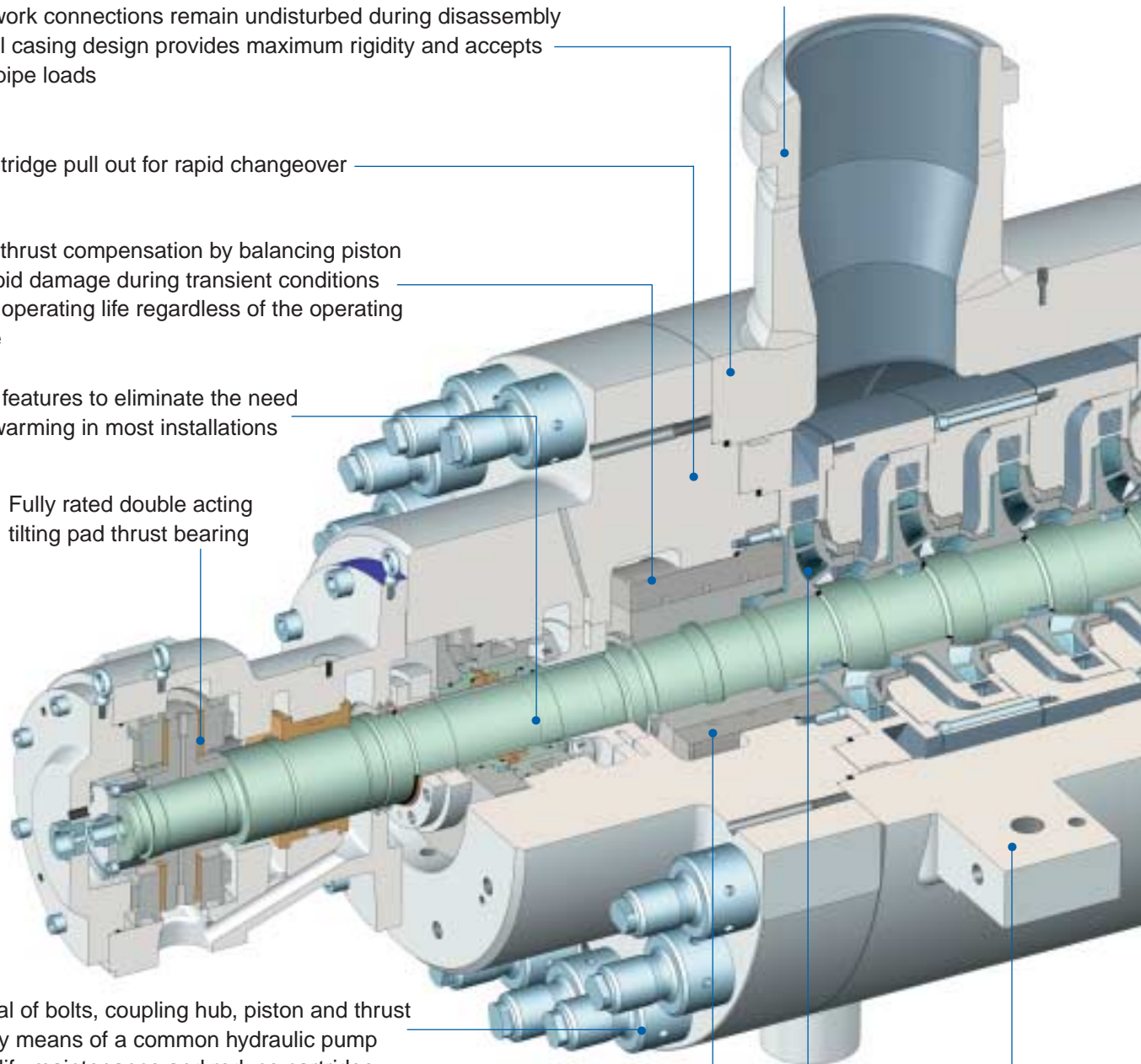
Fully rated double acting tilting pad thrust bearing

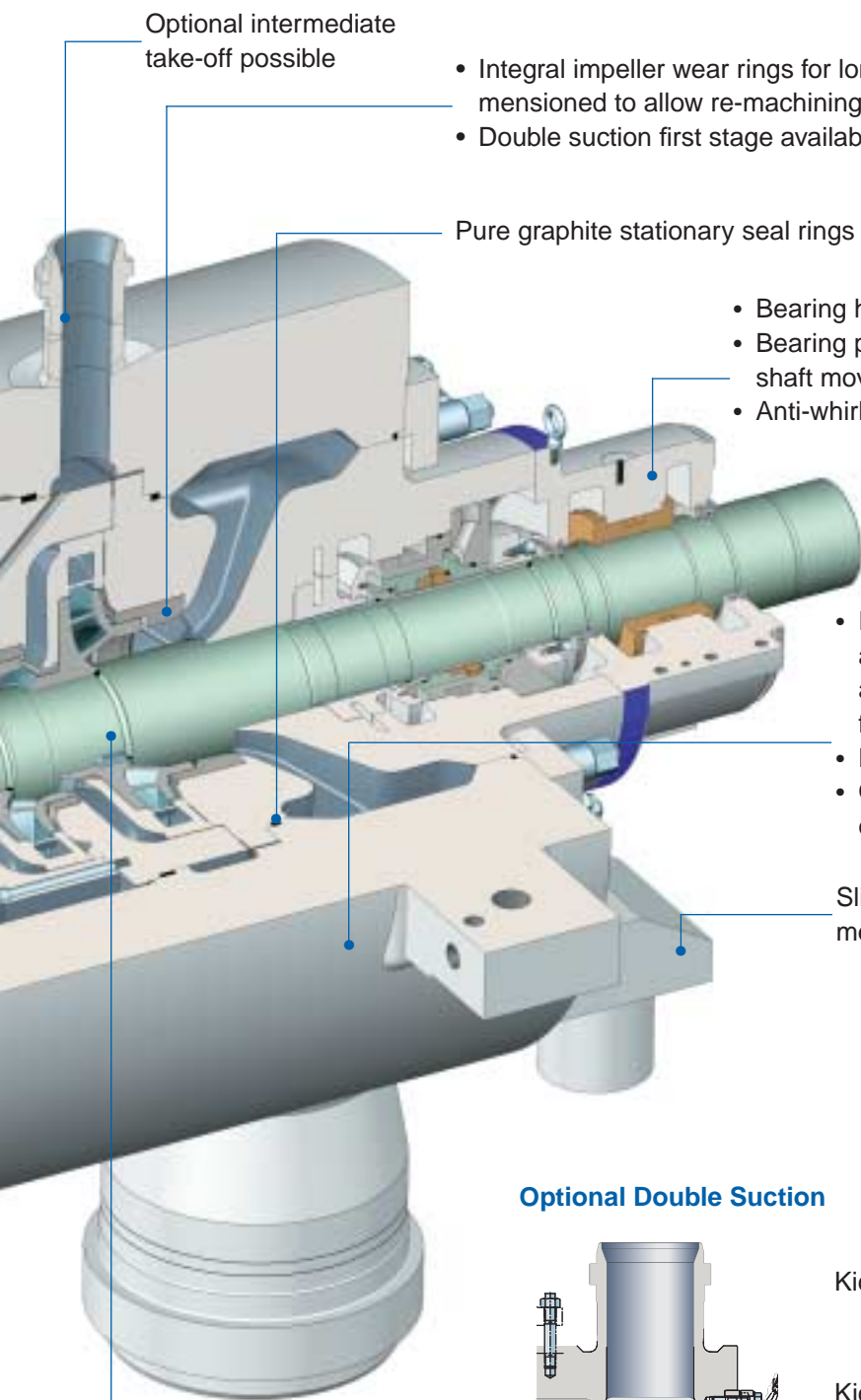
Removal of bolts, coupling hub, piston and thrust collar by means of a common hydraulic pump to simplify maintenance and reduce cartridge replacement time

- Design of close running clearances
- Optimized labyrinth—high efficiency and good rotor-dynamic behavior
- Radial grooves—increased radial stiffness, reduced effect on rotor tilting and good rotor dynamic behavior
- Swirl break at balancing piston to maintain rotor stability even when internal clearances are worn

Centerline mounting

- Precision casting in chrome nickel steel
- Optimization of hydraulic profiles
- Kicker stage available





Optional intermediate take-off possible

- Integral impeller wear rings for longer life dimensioned to allow re-machining several times
- Double suction first stage available

Pure graphite stationary seal rings used

- Bearing housing fixed to pump cartridge through 360°
- Bearing provides high stiffness and damping to minimize shaft movement
- Anti-whirl journal bearings

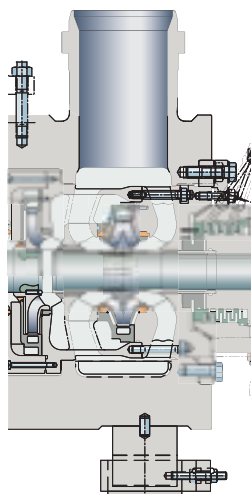
- Forged, low alloy steel barrel casing as standard; designed for long term cycling operation and to resist erosion-corrosion without the need for overlays
- High strength material to accept thermal shock
- Other materials possible to suit customer requirements

Sliding pads to maintain alignment during thermal movements

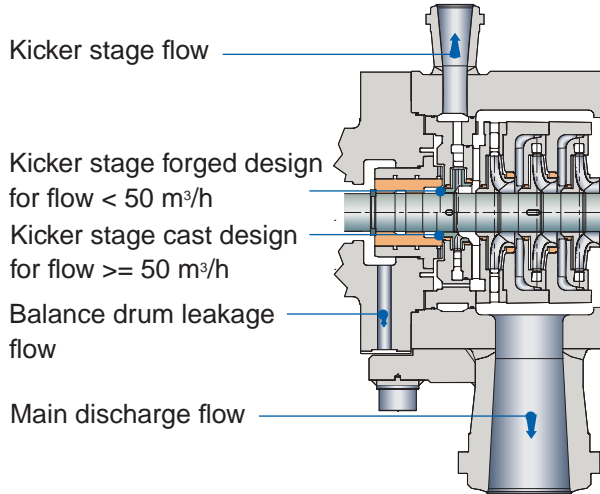
Shaft forged in chrome nickel steel

- Low L/D ratio
- Stable operation without critical speed problems
- Reduced vibration levels

**Optional Double Suction**



**Optional Kicker Stage**



Kicker stage flow

Kicker stage forged design for flow < 50 m³/h

Kicker stage cast design for flow ≥ 50 m³/h

Balance drum leakage flow

Main discharge flow

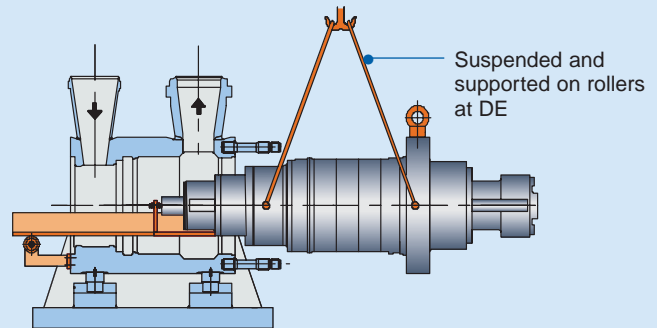
# HPT Features

## Integral Cartridge Design

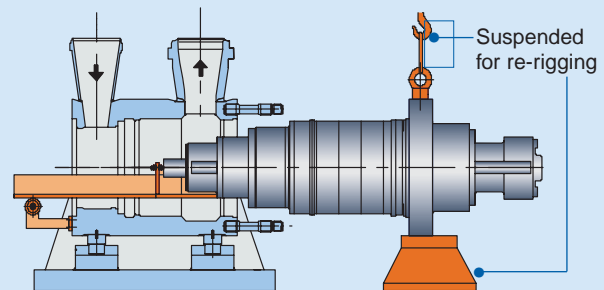
### Advantages

- The cartridge is completely assembled outside the barrel case
- Prior to installation of the cartridge, the mechanical seals are set, the rotor is radially and axially adjusted and the axial thrust bearing clearance is set
- Quick cartridge changes for increased productivity
- Cartridge support for increased safety
- Cartridge includes the shaft, coupling hub, static and dynamic hydraulic parts, shaft seals, radial bearings and thrust bearing, balancing system, suction and delivery cover

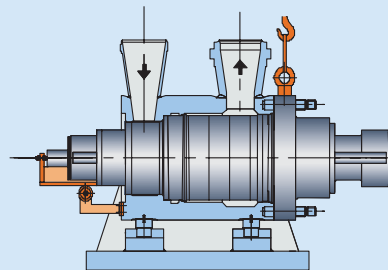
Step 1



Step 2



Step 3 Final Installation

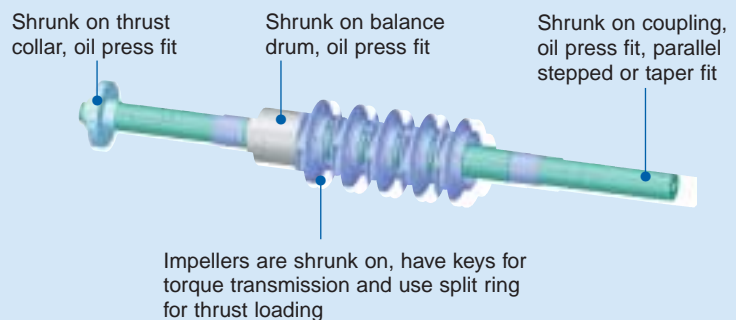


## Rotor Design

### Advantages

- Shrunk on parts allow for high rotor balancing quality
- Shrunk on parts avoid fretting corrosion and minimize stress concentrations
- Shrunk on parts avoid loose parts on shaft during operation and result in lower vibration

Rotor



## Diffuser and Impeller Design

### Advantages

Precision castings

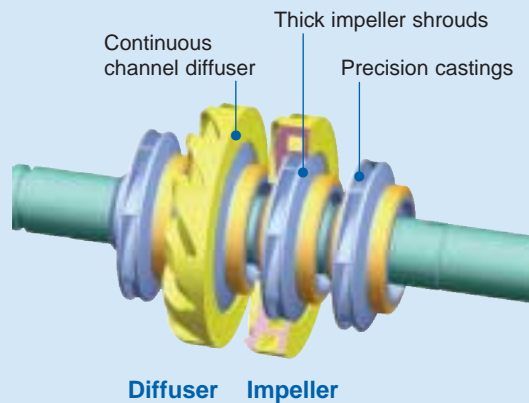
- High efficiency
- Small hydraulic unbalance

Thick impeller shrouds

- High strength for high head
- Natural frequency away from resonance, thus avoiding shroud breakage

Continuous channel diffuser

- High efficiency



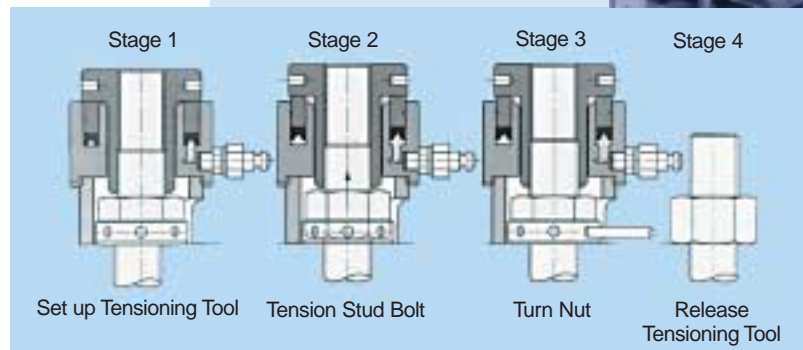
## Tightening System for Delivery Cover Studs

### Advantages

- Accurate tensioning to required pre-load
- Fast cartridge change

Hydraulic jacks

Air operated hydraulic oil pump



**Case Bolt Tensioning Tool**

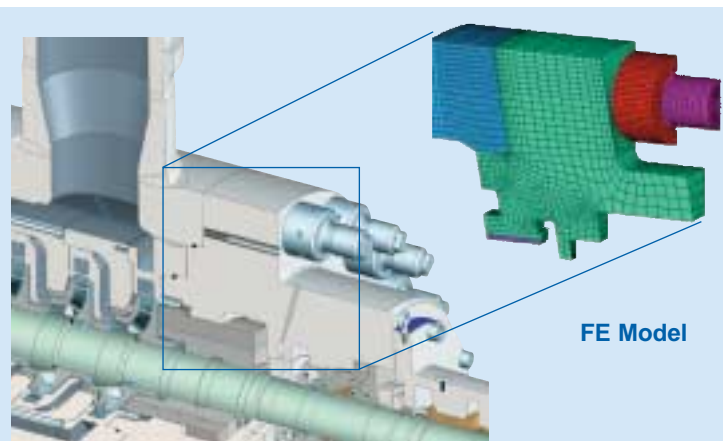
## Pressure Retaining Parts

### Advantages

- Hydro test ( $1.5 \times$  or  $1.3 \times p_D$ ) of each pressure casing provides high safety

**Analyzed with proven codes for high reliability:**

- German vessel code AD, standard
- ASME section VIII, Division 1, optional
- FE for selected cases



## Testing



### Sulzer Leeds, UK Test Facility

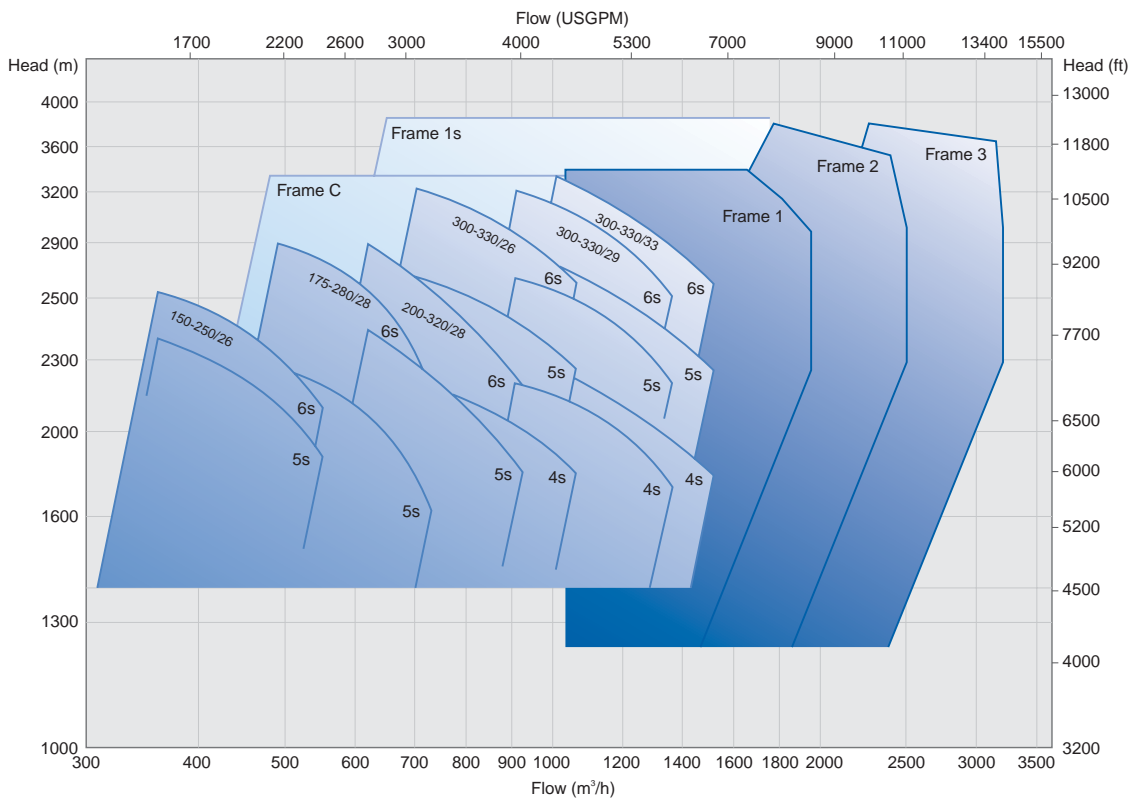
- 10 MW electric motor at full speed
- Electric capacity to 16 MW
- Speed increasing gearbox with multiple ratios
- 30 MW gas turbine drive
- 365000 gallon wet sump, 30 ft deep
- 50 ton crane capacity
- NPSH testing
- Hot or cold testing



## Materials

Part	DIN material	ASTM material	Advantage
Barrel casing	10 Cr Mo 9 10, forged	A 182 Gr F22	• High erosion resistance
Delivery cover	10 Cr Mo 9 10, forged	A 182 Gr F22	• Good thermal transient properties
Impeller	G-X 5 Cr Ni 13 4	A 743 Gr CA-6MN	• High erosion resistance
Diffuser	G-X 5 Cr Ni 13 4	A 743 Gr CA-6MN	• Good cavitation resistance
Stage casing	G 17 Cr Mo 9 10	G-X 5 Cr Ni 13 4	
Suction casing	A 217 Gr WC 9	A 743 Gr CA-6MN	
Shaft	X 4 Cr Ni 13 4	A 182 Gr F6MN	• High strength • High fatigue resistance
Balance drum	X 20 Cr Ni 17 2	A 276 Type 431	• At least 50 HB hardness difference
Stationary wear parts	X 20 Cr Ni 17 2	A 276 Type 431	• High erosion resistance
Stud		36 Ni Cr Mo 16	• High strength
Static seals		Pure graphite	• Good pressure / thermal resilience

# Performance Range



Note: The range chart and the data table show the normal operating range. However, for special cases, the HPT can be adapted in design to cover duties outside of this range.

# Operating Data

HPT Pump		
Pump sizes	From 150-260 to 400-482	
Units	Metric units	U.S. units
Capacities	up to 4000 m³/h	up to 17613 US gpm
Heads	up to 4200 m	up to 13778 ft
Horsepower	up to 27800 kW	up to 37280 hp
Temperatures	up to 220°C	up to 430°F
Speeds	up to 7300 rpm	

# References



Lippendorf—the most modern lignite-fired power plant in the world, located in central Germany’s Saxony region. The new plant is a 2 x 920 MW lignite-fired power plant (2 x 875 MW net electrical power output), commissioned in 1999. Lippendorf delivers 230 MW of district heating to the city of Leipzig. The once-through type boilers have a steam output

of 2,420 t/h (supercritical), 267 bar (8932 ft) and 554° C (1029° F). The electrical efficiency is 42.6%, which is at present the world’s highest efficiency for a lignite-fired plant. Much of the design efforts of the Lippendorf plant have been concentrated on reducing environmental impact in accordance with new European Union directives.

### Lippendorf, Germany

HPT 400-482 / 6 stage  
3468 m<sup>3</sup>/h (15259 US gpm)  
@ 3909 m (12821 ft)  
36661 KW (49160 hp) @ 4721 rpm



### Boxberg, Germany

HPT 350-440 / 5 Stage  
3353 m<sup>3</sup>/h (14753 US gpm)  
@ 4035 m (13234 ft)  
36258 KW (48620 hp) @ 5797 rpm



### Pulau Seraya Power Station, Singapore

HPT 150-260/1d / 5 Stage  
441 m<sup>3</sup>/h (1941 US gpm)  
@ 2154 m<sup>3</sup>/h (7067 ft)  
2890 kW (3875 hp) @ 6364 rpm



### Almeria II Power Station, Spain

HPT 300-330 / 5 Stage  
1202 m<sup>3</sup>/h (5291 US gpm)  
@ 2333 m (7654 ft)  
7900 kW (10600 hp) @ 6200 rpm



### West Thurrock, UK

HPT 230-305 / 3 Stage  
876 m<sup>3</sup>/h (3859 US gpm)  
@ 1953 m (6408 ft)  
4671 kW (6265 hp) @ 7200 rpm



### Shajiao “C” Power Station, China

HPT 300-330 / 4 Stage  
1327 m<sup>3</sup>/h (5843 US gpm)  
@ 2369 m (7771 ft)  
9172 kW (12300 hp) @ 6358 rpm



### Schwarze Pumpe, Germany

HPT 350-440 / 5 stage  
3165 m<sup>3</sup>/h (13926 US gpm)  
@ 4100 m (13448 ft)  
35833 KW (48050 hp) @ 5795 rpm

# Your Global Partner

## Worldwide Test Facilities

Sulzer operates over 20 test facilities world-wide, suitable for horizontal or vertical, open pit, high flow rate/high-energy and multiphase testing. We have the ability to perform tests at 50 and 60Hz and, depending on the site, are able to operate using diesel engines, gas engines and gas turbines in addition to conventional electric motors. A specialty of Sulzer is the ability to fully string test large high-energy pumps to prove the pump package as a whole to our customers.

This ability is particularly important for critical offshore applications where on-site correction is both expensive and time consuming.

Our gas turbine test stand allows full load string testing of pumps or compressors without having to build the sets at third party sites. We are the only pump manufacturer in the world able to undertake in-house tests of machines generating over 30 MW.

## Customer Support Services

Global businesses require local services. Sulzer Pumps is committed to providing local support through our worldwide network of over 50 service facilities.

## Retrofit of Existing Barrel Type Boiler Feed Pumps

Applying our unique experience and expertise, we are able to deliver consistently high quality, value-added support. In addition to supplying parts and service for Sulzer equipment, our in-house re-engineering specialists can modernize and retrofit existing boiler feed pumps with the following capabilities and benefits:

- Repair and re-machining of existing pump barrel casings
- Integration of a new Sulzer designed internal cartridge
- Increasing pump efficiencies
- Main piping, foundation and pump drive remain unchanged
- Pumps compatible with existing oil supply system

Reference installations and retrofits:

- Janschwalde Power Station, Germany (12 units)
- Mosenergo Power, Russia (19 units)
- Novochoerkasskaja Power, Russia (9 units)
- BHEL, India (12 units)
- Dunamenti Power, Hungary (6 units)
- Ratcliffe, United Kingdom (2 units)

Using root-cause failure analysis, system investigation and materials assessment, retrofit specialists modify installations to meet new duty conditions or to improve operating efficiency. Beyond optimizing performance, retrofitting existing installations results in increased component life and reduced energy consumption. We provide a full range of services for pumps and other associated equipment with local customer service available 24 hours a day, 7 days a week, backed by our service group support teams.



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