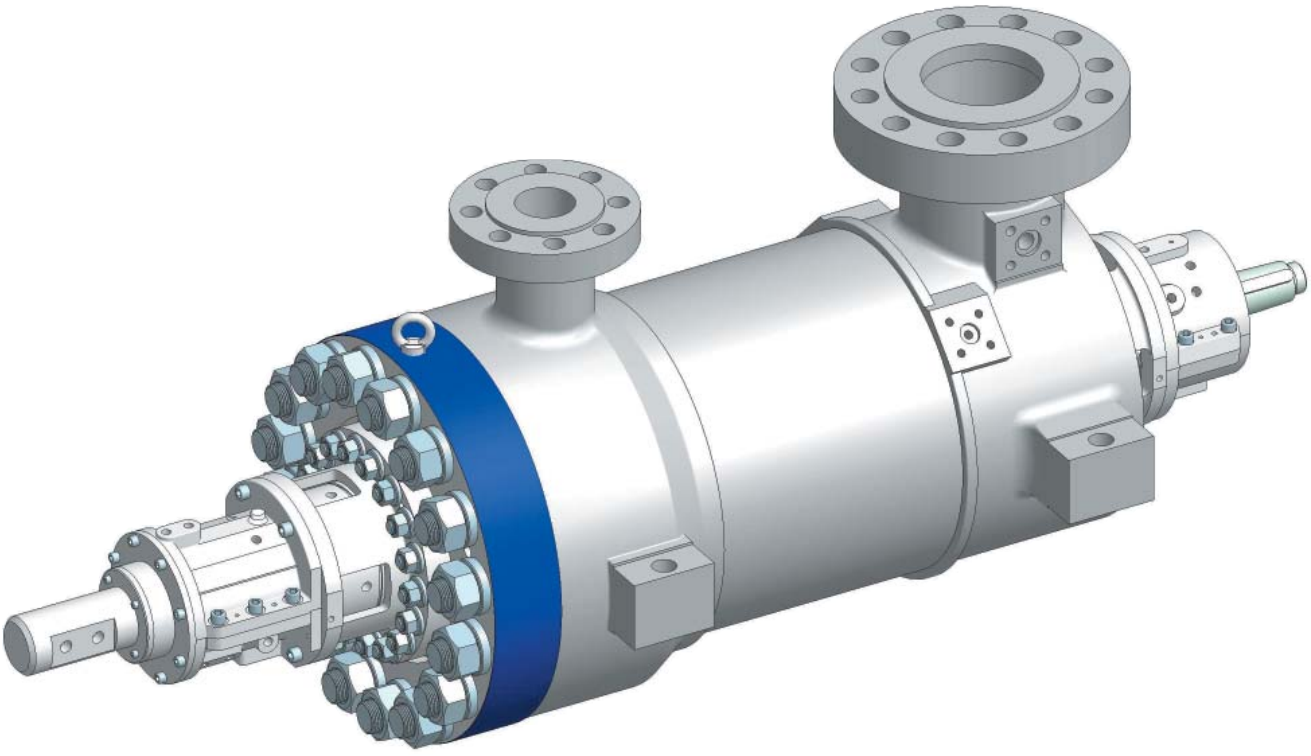
SULZER

GSG Diffuser Style Barrel Pump
ISO 13709 (API 610) Type BB5



The Heart of Your Process

Sulzer Pumps

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 if required. Our active research & development supports the customer oriented approach.

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

Extensive Product Range

Sulzer Pumps has a long history of providing innovative pumping solutions to business partners in the following industries:

- Oil & Gas
- Hydrocarbon Processing
- Pulp and Paper
- Power Generation
- Food, Metals & Fertilizers
- Water and Wastewater

Hydrocarbon Processing

Hydrocarbon extraction plants, refineries, petrochemical plants and gas plants operate sophisticated production processes requiring reliable pumping solutions. Continuous product innovations such as our improved line of hermetically sealed, horizontal and vertical process pumps, are helping the industry improve its operational efficiency.

Sulzer Pumps, with its high-quality product line, is known for being able to consistently meet these expectations. All our pumps are engineered in line with the latest standards issued by API, ISO and ANSI in order to ensure reliable and safe operation at your site. The Hydrocarbon Processing Industry is one of the core business segments within Sulzer Pumps. Following industry practice, we further subdivide the segment into:

- Synfuels
- Refining
- Gas Processing
- Petrochemicals
- Nitrogenous Fertilizer

The market - and therefore our customers - requires specialty applications for each subsegment.

Product Development

Sulzer Pumps provides a broad range of ISO 13709 (API 610) centrifugal pumps for the demanding applications of the petroleum industry. Our vast experience in supplying multistage barrel pumps to over 40 MW, and our proven experience in supplying inline or opposed impeller diffuser, or dual volute barrel pumps, add to the reliability of the GSG.

Application Range

Thousands of GSG pumps are installed around the world. They are found in:

- Power Plants
- Refineries
- Petrochemical Plants
- Gas Processing Plants
- Onshore and offshore water injection services
- Onshore and offshore crude shipping service
- Onshore crude oil, refined product and LPG pipeline services

High pressure and high or low temperatures are GSG services.

Design

The GSG is built to the latest edition of ISO 13709 (API 610). It is a type BB5, horizontal, radially split, diffuser type, multistage barrel pump. The rotor stack can be either inline (all the impellers facing towards the driver) or back-to-back. On the smaller pumps, the inboard seal chamber and bearing housing must be removed for cartridge removal. On larger pumps, the entire cartridge can be removed as an assembly to speed overhaul or re-rate turnaround time.

The barrel is available as either a casting or forging with a variety of flange ratings to meet individual specifications. It is normally centerline supported for thermal stability and maximum nozzle load capacity. The barrel closure is either the traditional flanged head-studs and nuts, flanged head-Supernuts™, or Sulzer's patented Twistlock closure for speedy removal and assembly.

The inner cartridge consists of stacked diffuser/impeller sets. A double suction first stage impeller is available on all but the smallest sizes. Axial thrust is compensated by a balance drum for inline stacked rotors. The diffusers hydraulically balance radial forces. For those services where intermediate pressure takeoff is needed, higher flow diffuser/impeller sets can be utilized up to the takeoff stage, and then lower flow sets are used after the takeoff stage to optimize efficiency and performance. When design conditions change, re-rates are similarly achieved using different diffuser/impeller combinations, or blank stages—all in the same barrel.

For applications on light gravity fluids with many stages, a back-to-back rotor stack is utilized to allow direct drive at normal motor speeds and provide improved rotordynamics. In such rotors, the opposed impellers cancel most of the axial thrust. The center bushing and throttle bushings take most of the residual axial thrust, so the thrust bearing loads are minimal. The back-to-back design allows the use of a 7300 series ball thrust bearing—and saves the substantial cost and maintenance components associated with lube oil systems. For high pressure and high energy levels, inline, or back-to-back stack, high speed, semi-stiff rotor designs are available.

Depending upon pump size, power, and rotor design, the pumps can be supplied with ring oil or oil mist lubricated antifriction bearings, ring oil lubricated sleeve radial—ball thrust bearings, or pressure lubricated sleeve radial—tilting pad thrust bearings.

Materials

All common ISO 13709 (API 610) material combinations are available.

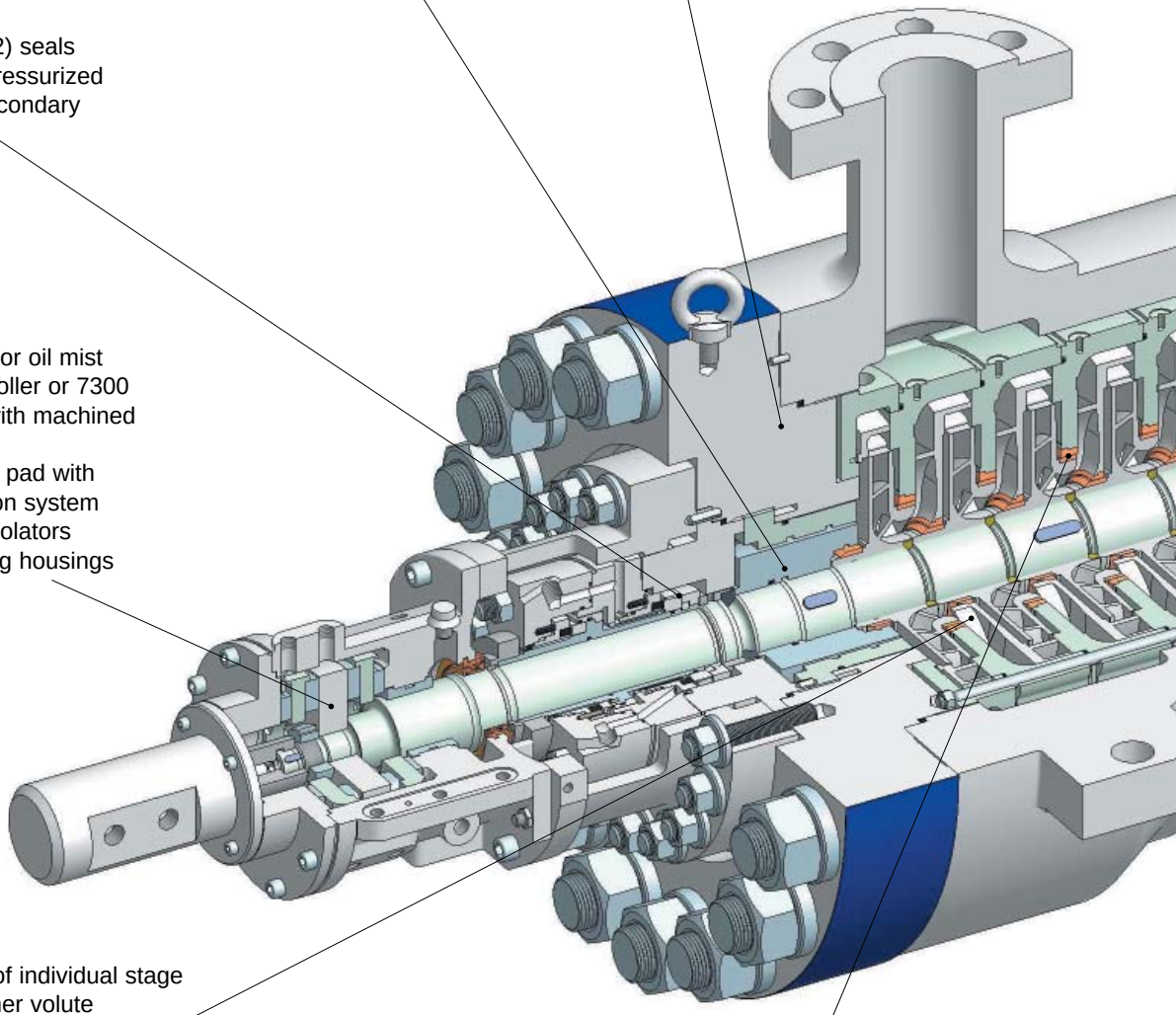
GSG Inline Design Features and Benefits

Casing Cover
- Flanged head, studs/nuts
- Flanged head, Supernuts™
- O-ring or spiral wound gasket

Axial Thrust Balance
- Balance drum
- Swirl break technology

Mechanical Seals
- ISO 21049 (API 682) seals
- Single, dual, dual pressurized
- Non-contact gas secondary

Thrust Bearing
- Fan cooled ring oil, or oil mist lubricated tapered roller or 7300 series double ball with machined brass cages, or
- Double acting tilting pad with force feed lubrication system
- INPRO™ bearing isolators
- Carbon steel bearing housings with 360° support



Diffusers/Impellers
- Allow replacement of individual stage pieces vs. entire inner volute
- O-ring or metal-to-metal stage casing fits
- Key driven enclosed impellers
- For HPI applications shrink fit, axially secured impellers, and stepped shaft at each stage
- Blank stages can be supplied for future conditions

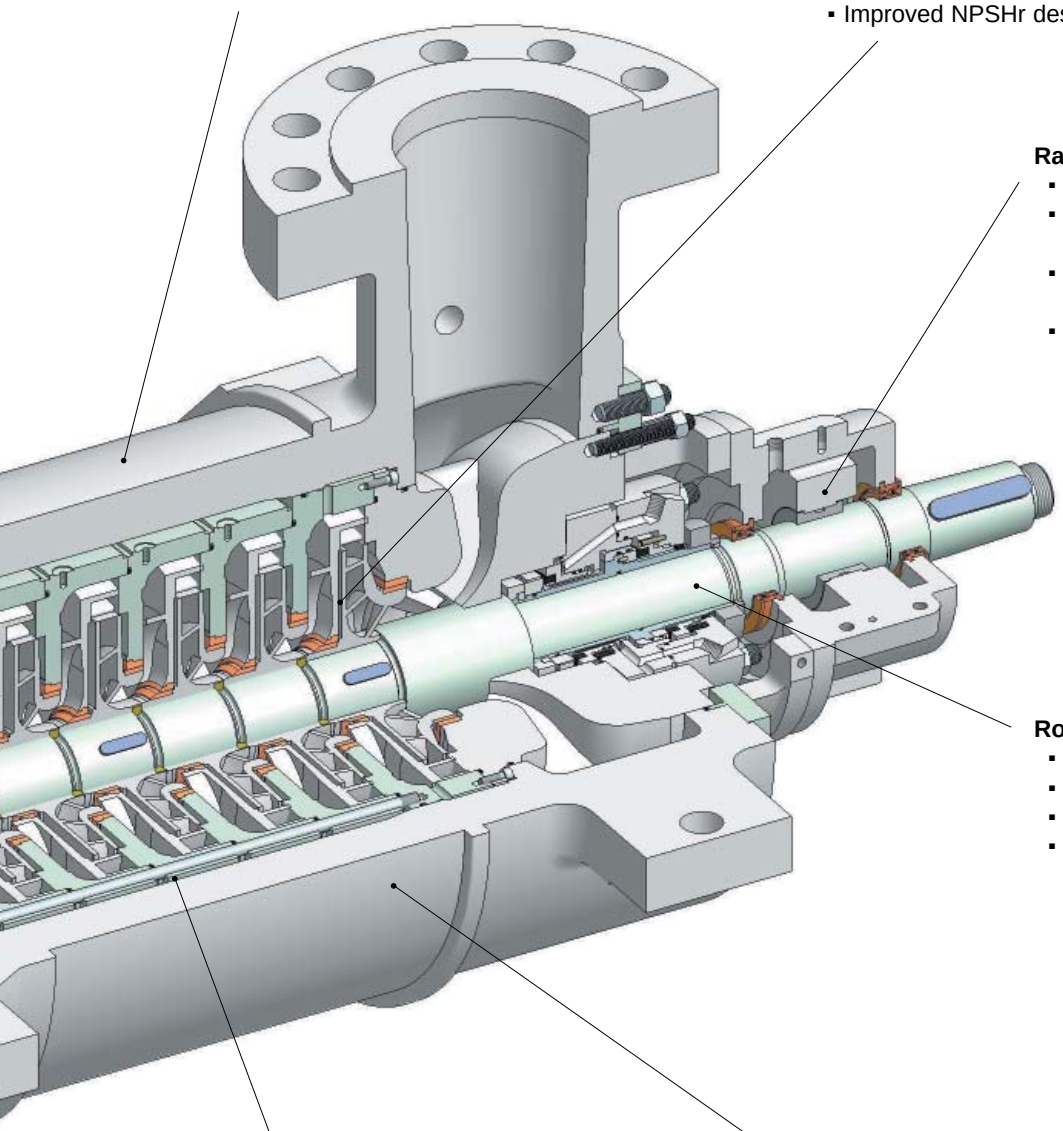
Wear Parts
- Wear parts offered are the result of a year of wear testing by Sulzer
- Variety of materials, hardness, and hard coatings available depending on pump material and application
- PEEK with reduced clearances available on clean fluids for enhanced efficiency

Interstage Takeoff

- Partial flow takeoff from intermediate stage
- Able to stack high capacity and low capacity diffusers/impellers on same rotor for optimized stage takeoff
- Common on boiler feed pumps
- Available on recycle process applications
- Saves cost of additional pump

First Stage Impeller

- Low Nss design is standard
- Double suction available on all but smallest sizes
- Improved NPSHr designs available



Radial Bearings

- Inpro™ bearing isolator
- Carbon steel bearing housing with 360° support
- Ring oil or oil mist lubricated roller or ball bearing with C-3 clearance
- Ring oil or force feed lubricated sleeve bearings available

Robust Shaft and Rotor

- Designed for low stress level
- Fully machined
- Dynamically balanced
- Straight bore, tapered bore, or hydraulic fit under coupling available per ISO 13709 (API 610)

Barrel

- Centerline mounted for thermal stability and maximum nozzle load capability
- Cast with nozzles and flanges
- Forged barrel with NDE of nozzle welds
- Warm-up flow through discharge drain not required below 260° C (500° F). Warm-up flow required for higher temperatures
- Pin-and-key-slot thermal expansion system
- Jacketing, insulation or noise blankets available

Pump Inner Cartridge Assembly

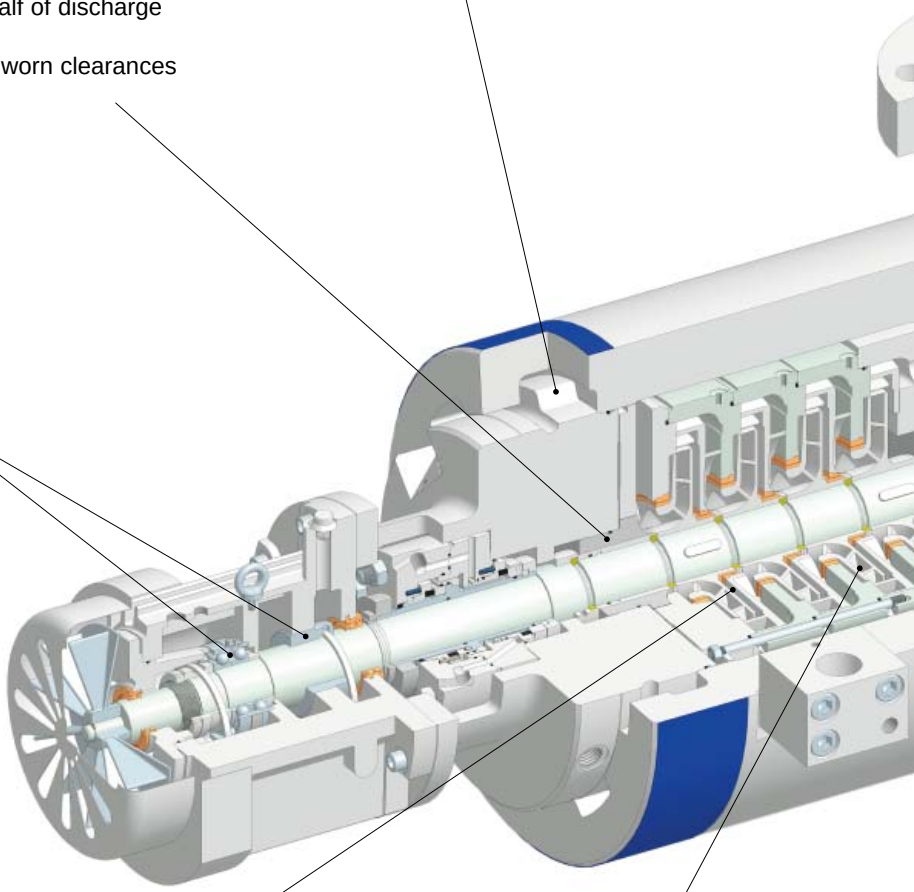
- Stage casings sealed by discharge pressure
- Free to expand towards discharge cover during warm-up
- Inner tie bolts for assembly/disassembly
- Coupling hub, inboard radial bearing and inboard seal chamber removal required on small pumps to remove cartridge
- Larger pumps have barrel bore diameters larger than bearing housing which allows cartridge to be removed with those parts assembled

GSG Back-to-Back Design Features and Benefits

Casing Cover
- Flanged head, studs/nuts
- Flanged head, Supernuts™
- Sulzer's patented Twistlock head
- O-ring or spiral wound gasket

Axial Thrust Balance
- Opposed impellers absorb thrust
- Center and throttle bushing absorb residual thrust and only breakdown half of discharge pressure at each fit
- Axial thrust stable even with worn clearances
- Low thrust bearing loads

Bearings
- Inpro™ bearing isolators
- Carbon steel bearing housings with 360° support
- Ring oil or oil mist lubricated roller or ball bearing with C-3 clearance
- Ring oil or force feed lubricated sleeve bearing
- Fan cooled 7300 series ball thrust bearing has low loads and long life
- Tilting pad thrust bearing and lube system available on larger sizes

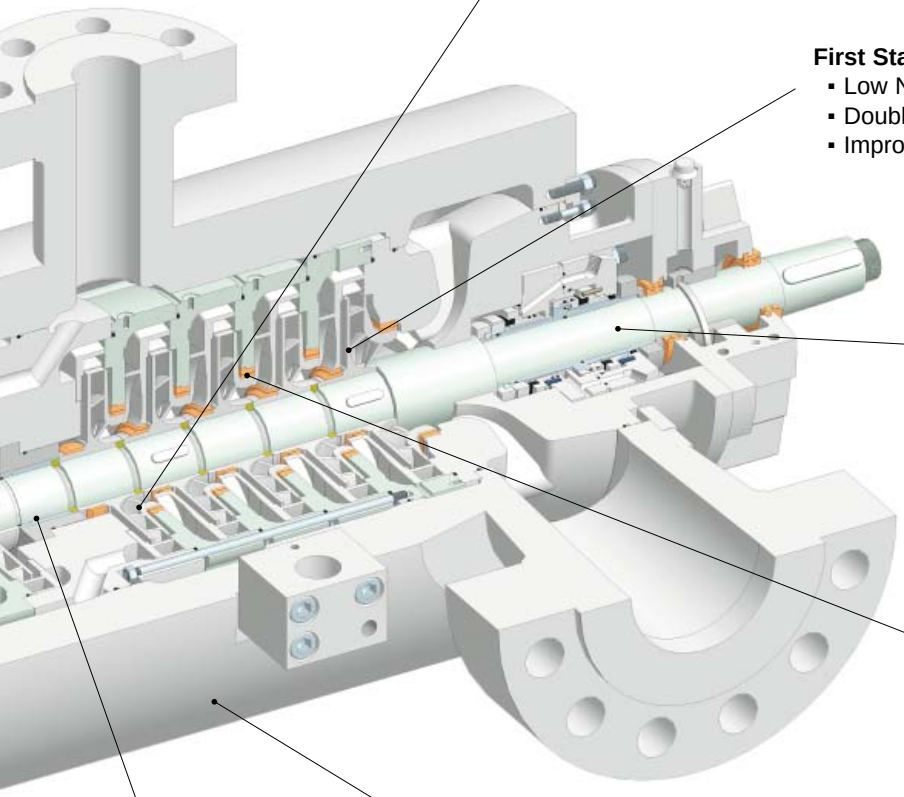


Diffusers/Impellers
- Allow replacement of individual stage pieces vs. inner volute
- Milled diffusers on small sizes for hydraulic accuracy and efficiency
- O-ring or metal-to-metal diffuser fits
- Key driven enclosed impellers
- For HPI applications shrink fit and axially secured impellers and stepped shaft at each stage
- Blank stages can be supplied for future conditions

Pump Inner Cartridge Assembly
- Joints sealed by discharge pressure
- Free to expand towards discharge cover during warm-up
- Inner tie bolts for assembly/disassembly
- Coupling hub, inboard radial bearing and inboard seal chamber removal required on small pumps to remove cartridge
- Larger pumps have barrel bore diameters which allows cartridge to be removed with those parts assembled

Back-To-Back Design

- For many stages and/or light gravity fluids, or remote applications where lube oil systems are not desired
- Dramatically improves rotordynamics—even with worn clearances on light hydrocarbons
- Allows more stages at direct drive motor speeds; high speed with lube system may not be required—substantial first cost and maintenance savings



First Stage Impeller

- Low Nss design is standard
- Double suction available on all but smallest sizes
- Improved NPSHr designs available

Robust Shaft and Rotor

- Designed for low stress level
- Fully machined
- Dynamically balanced
- Straight bore, tapered bore or hydraulic fit under coupling available per ISO 13709 (API 610)

Wear Rings

- Replaceable stationary and rotating wear rings

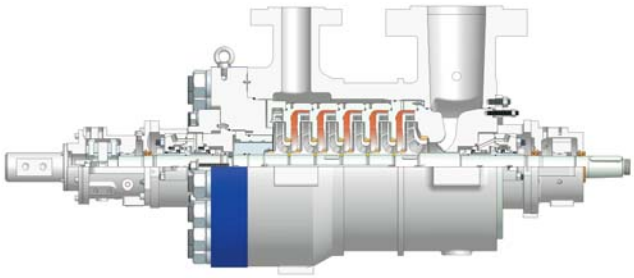
Barrel

- Centerline mounted on hot services
- Foot mounting available
- Cast with nozzles and flanges
- Forged barrel with NDE of nozzle welds—side, top and other nozzle configurations available to prevent flange interference or simplify piping

Center and Throttle Bushings

- Excellent rotor dynamic behavior
- Reduced wear
- Axial thrust balance even with worn clearances

GSG: Inline and Back-to-Back Design Features and Benefits

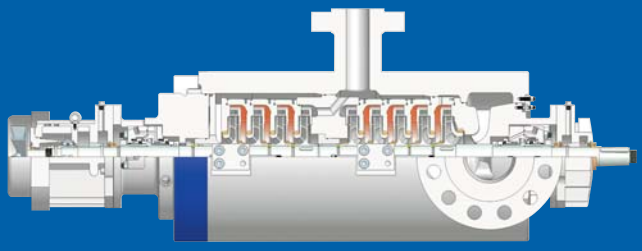


GSG Inline

- Fulfills the majority of requirements for BB5 pumps with either cast or forged barrels to meet customer specifications.
- Multivane diffusers balance radial loads. Balancing drum takes the majority of axial thrust load. Heavy duty bearings support the rotor and carry residual thrust loads.
- Smaller size pumps fitted with ring oil lubricated antifriction bearings. Oil mist lubrication optional
- All but smallest sizes may be fitted with pressure lubricated sleeve radial, double acting tilting pad thrust bearings, lube oil systems, bearing RTD's, X-Y vibration probes and Keyphasor, etc.
- Maximum number of interchangeable stage pieces minimizes spares parts inventory
- In direct drive applications, clearly the best selection up to stage limits. If still more head is needed, first consider GSG back-to-back and direct drive. If that does not meet head requirement, then consider GSG inline with higher Speed—using gear box or VFD.
- For very high head and high energy levels beyond GSG back-to-back direct drive capabilities, GSG with semi-stiff rotor design (like Sulzer's HPcp, HPT pumps) can be offered. Could justify stand-alone, single unit—no standby. Discussion recommended.

GSG Back-to-Back

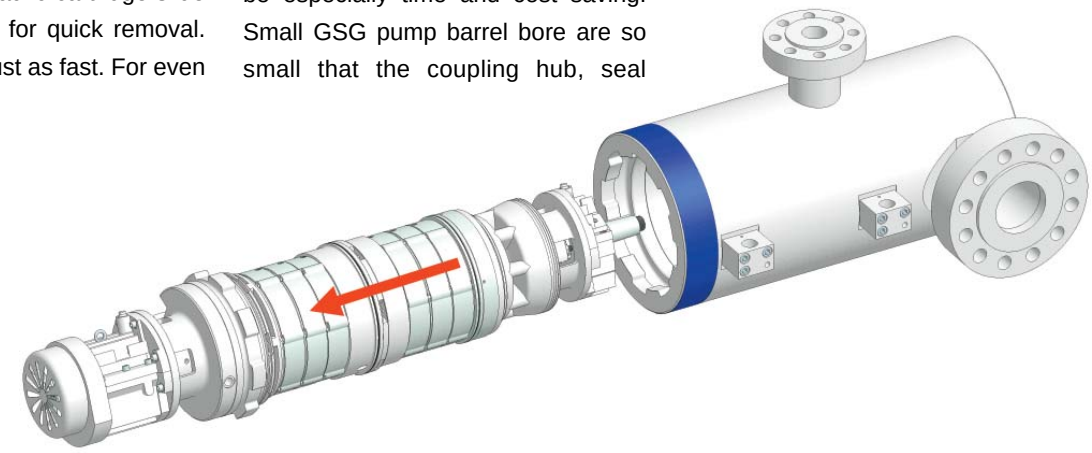
- With up to 16 stages available, fulfills direct drive applications that require more head than is available from direct drive inline GSG
- Multivane diffusers balance radial loads. Opposed impellers balance majority of axial thrust. Center bushing and throttle bushing take nearly all the residual axial thrust. Even when clearances are worn, axial and radial loads remain balanced.
- Fan cooled, ring oil lubricated, sleeve / ball thrust bearing without lube systems are common up to ISO 13709 (API 610) Table 9 limits, or Sulzer limits depending upon application. Significantly reduces installed cost and provides simple, reliable pumps.



- When even high speed GSG with semi-stiff inline rotor does not meet head requirements, or cannot meet rotordynamic requirements a GSG with semi-stiff back-to-back rotor can be offered.

Rapid pump dismantling

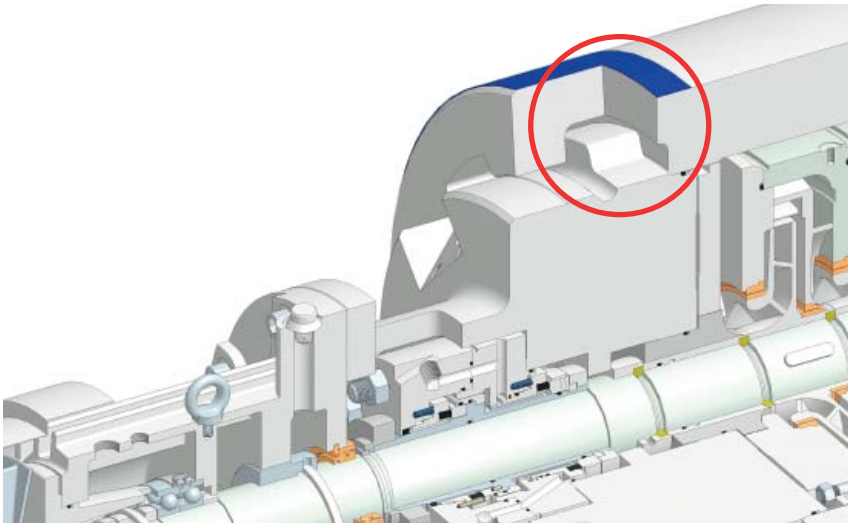
To speed the repair of a GSG pump, larger sizes are designed using that cartridge concept. The pump coupling hub, inboard bearing housing, seal chamber and hydraulic cartridge slide through the barrel for quick removal. Re-installation is just as fast. For even faster turnaround, the Sulzer patented Twistlock design puts an end to hours of torquing the barrel cover nuts. For remote locations or offshore this can be especially time and cost saving. Small GSG pump barrel bore are so small that the coupling hub, seal chamber and bearing housing will not fit through. Those parts have to be removed on those pumps before the cartridge is pulled.



The assembled cartridge can be removed as one piece on larger pumps.

Sulzer’s patented Twistlock

The innovative Sulzer Twistlock barrel cover design provides effective sealing and eliminates the usual requirements of torquing many fasteners to very high values—taking hours. The Twistlock also reduces the end cover flange area required thus reducing weight—an added bonus for offshore installations.



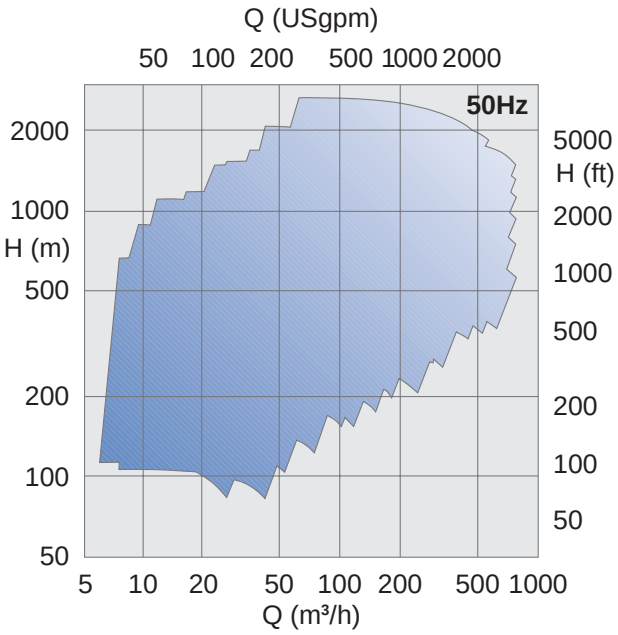
Installation sequence:

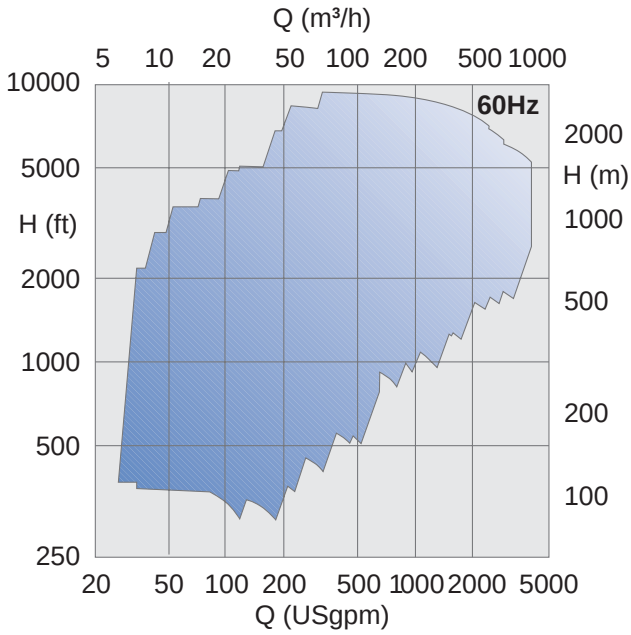
Cover in place

Cover introduced and partially rotated

Cover locked and secured

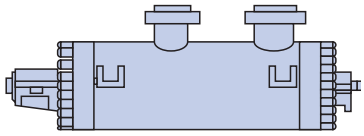
Performance Range

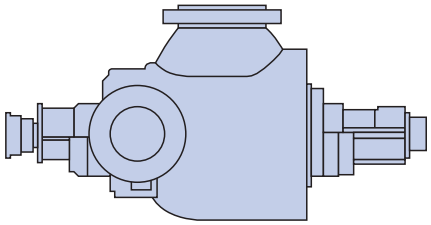


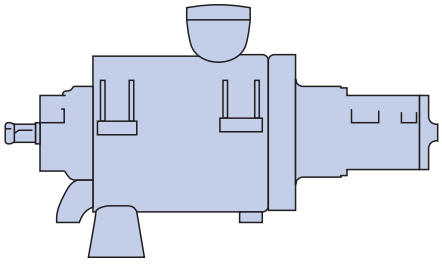


Operating Data

	GSG	
Pump Sizes	40 to 200 mm	1.5 to 8 inches
Capacities	up to 850 m3/h	up to 3,700 usgpm
Heads	up to 2,450 m	up to 8,000 feet
Pressures	up to 275 bar	up to 4,000 psi
Temperatures	-30° C to +425° C	-20° F to +800° F







Other Sulzer Barrel Pump Models

When preferred or for erosive, sandy services, Sulzer's CP opposed impeller, dual volute barrel pumps are proven performers. Heads to 6,700 m (22,000 ft)

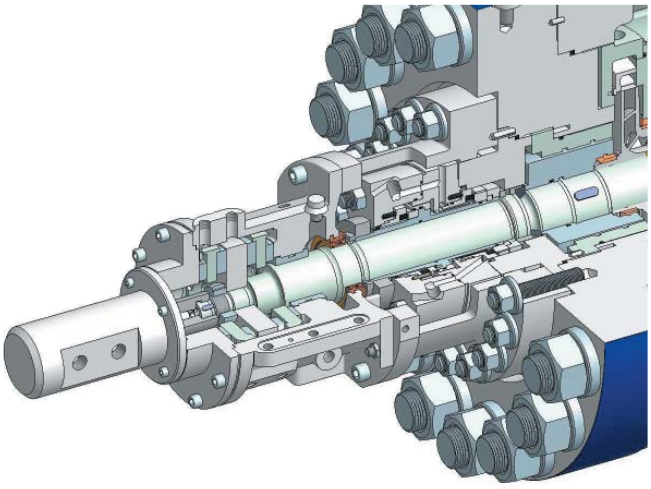
Sulzer's HPcp (inline or back-to-back) is the global leader in large water injection services from 5 MW to 30 MW. Heads to 6,500 m (21,000 ft)

Sulzer's HPT boiler feed pumps are renowned for their reliability. Sizes to over 40 MW (55,000 hp) cover the majority of power plant needs.

GSG Options

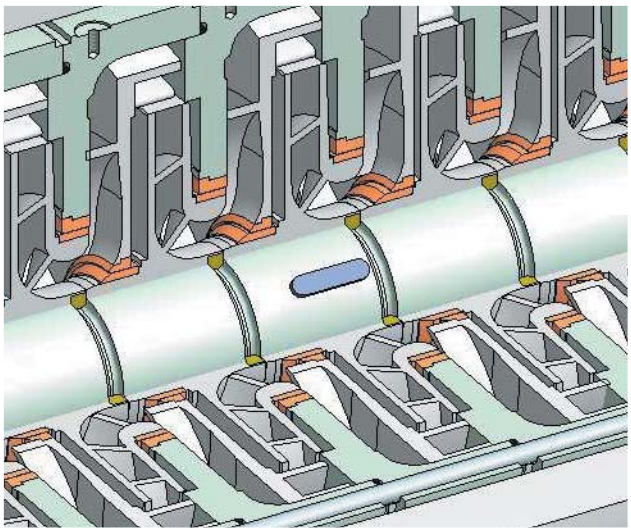
Bearing options

- Fan cooled ring oil, or oil mist lubricated antifriction bearings, or
- Ring oil lubricated sleeve radial bearings with antifriction thrust bearing, or
- Force feed lubricated sleeve radial bearing and double acting tilting pad thrust bearing
- A variety of bearing instrumentation is available to meet specifications



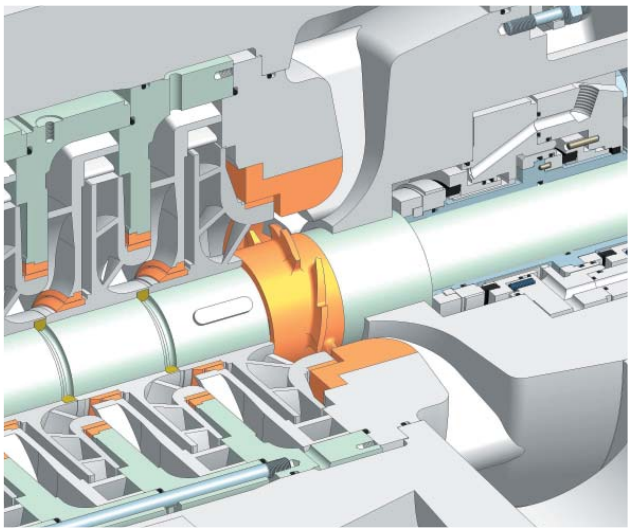
Rotor and Impeller options

- For ISO 13709 (API 610) applications, impellers are individually axially secured and are shrink fit to the shaft—which is stepped under each impeller for ease of assembly
- For other applications a slip-fit impeller stack is available
- Straight bore, tapered bore, or hydraulic fit coupling hub is available per ISO 13709 (API 610)
- GSG “inline” or “back-to-back” rotor design.
- Double Suction first stage impeller for lower NPSHr.



High temperatures and options for bottoms / residues

- Proven coke crusher available for services with coke particles
- Pump warm-up not required below 260° C (500° F). Warm-up flow required for higher temperatures
- Pin-and-block thermal expansion system provided on hot services
- Jacketing, insulation or noise blankets available



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