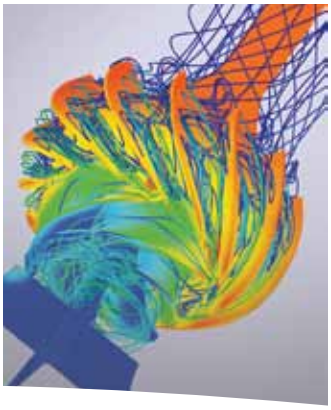
FLOWSERVE

Pleuger Azimuthing Thrusters

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
- 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

Lawrence Pumps®

Niigata Worthington™ Pumps

Pacific® Pumps

Pleuger® Pumps

Scienco™ Pumps

Sier-Bath® Rotary Pumps

TKL™ Pumps

United Centrifugal® Pumps

Western Land Roller™ Irrigation Pumps

Wilson-Snyder® Pumps

Worthington® Pumps

Worthington Simpson™ Pumps

Flowserve has expanded its reputation as the global leader in innovative pumping solutions by producing high-performing, heavy-duty thrusters for offshore applications under its Pleuger heritage name.

Experts in Offshore Propulsion Systems

Reflecting decades of applications expertise behind its rugged and versatile thruster design, the Flowserve Pleuger azimuthing thruster is built to excel in the harshest and most difficult environments of the world's oceans. Structural system components, such as bearings, couplings, gearing, torque transmitting elements, seals and auxiliaries are robustly engineered to provide long operating life and fail-safe performance in a multitude of applications, including:

- Semi-submersible rigs
- Floating production, storage and offloading (FPSO) vessels
- Drill ships
- Crane and pipelay vessels
- Research and other offshore ships

Custom Engineered Thrusters

The Flowserve Pleuger Thruster is a tough, adaptable, custom-fabricated propulsion unit for ship and offshore applications. The WFS (dry dock detachable) and WFSD (underwater detachable) thrusters are each optimized for uncompromising performance using duty-specific subassemblies designed for their individual applications. Flowserve has the knowledge and experience required when it comes to designing, manufacturing and delivering the world's highest-availability, azimuthing thrusters.

Application Versatility

The versatile Flowserve Pleuger Thruster boasts an extensive list of available features to meet the needs of multiple offshore industries. Among the numerous possible configurations, the thrusters can be specified with:

- Pulling or pushing propellers
- Thruster for offshore application with 97° coaxial tilt of propeller shaft and nozzle to minimize propeller tip clearance
- Thruster for ships application with 90° coaxial tilt of propeller shaft and nozzle to minimize propeller tip clearance
- Underwater detachability
- L- or Z-drive power train
- Ducted or open fixed pitch propellers
- Capsule- or column-retractable designs
- ICE-class upgrade, up to the highest ice breaker class

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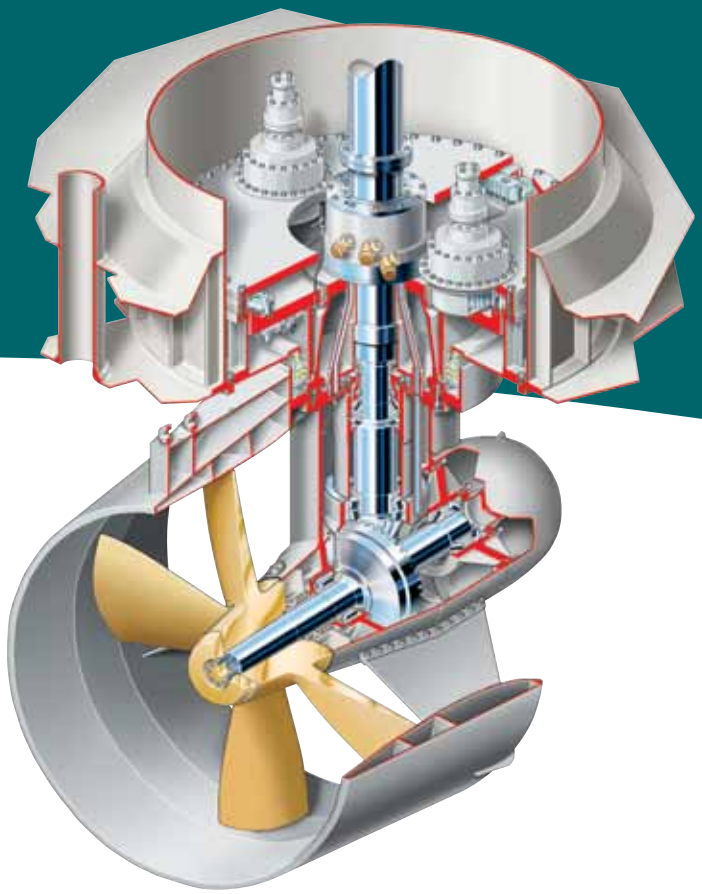
Pleuger Azimuthing Thrusters



The Flowserve Pleuger azimuthing thruster is designed with the flexibility to apply thrust in any direction. Its proven, robust construction performs both propulsion and steering duties for many offshore applications. The Flowserve design team has focused on providing the ultimate in versatility, reliability and durability, to ensure maximum availability of the thruster system. As a result, long operational life cycles and remarkable performance are key attributes.

Operating Parameters

- Power ratings to 9000 kW (12 000 hp)
- Propeller diameters to 6.0 m (19.7 ft)

Features and Benefits

Four- or Five-bladed Propellers are available with fixed pitch, in ducted or un-ducted configurations.

Advanced Computational Fluid Dynamics (CFD) Tools are used to analyze thruster behaviors under a full range of operating conditions, optimizing thrust output and efficiency.

Precision Bevel Gears provide the highest reliability. Pinion and gear are rough-machined, case-hardened and then finished with HPG precision hard-cut technology.

97° Tilted Propeller Axis and Nozzle deliver increased thrust of up to 25% compared to 90° axis arrangements. Propellers and nozzles are custom-designed for each application.

Power Transmission Components are designed with industry-leading service ratings and safety factors. Design loading is based on continuous running in dynamic positioning condition. Duplex bearings accommodate thrust in either direction and allow windmilling of the propeller at any speed.

Innovative Hydraulic Mounting System and self-aligning curved tooth couplings significantly shorten installation time and associated maintenance costs.

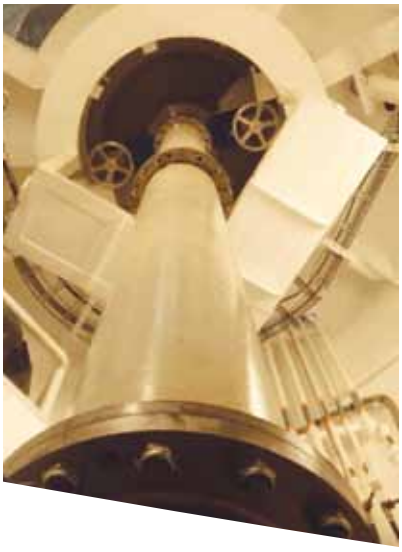
Pressure Compensation System for semi-submersible vessel automatically adjusts the internal pressure of the thruster's outboard unit to ensure maximum shaft seal life and greatly diminish the risk of water ingress. The fully flooded gear housing provides optimum lubrication.

Propeller Shaft Sealing is a four-piece lip seal arrangement running on a ceramic coated liner providing ultra-reliable sealing of the thrust unit.

Azimuth Column-sealing is a four-piece lip seal arrangement running against a duplex chrome steel liner assuring ultra-long seal life.

Standard Hydraulic Steering System features redundant closed-loop drives. Electric-drive systems are available.

Minimum Five-year Service Interval minimizes operating costs and increases thruster uptime.



Robust Thrust Unit

The streamlined gear housing of the thrust unit is made of high-grade steel to provide long-lasting performance. The nozzle and propeller designs are reviewed and certified by an independent research institute to ensure that the highest performance and trouble-free service are achieved.

Reliable Azimuth Drive

The reliable Flowserve Pleuger azimuth drive is engineered for minimum downtime during service. The azimuth drive design features a large diameter slewing gear mated to a rugged hydraulic or electric driver, both with standard failsafe brakes. The hull insert (receptacle) and redundant seawater seals ensure watertight construction.

Coaxial Tilted Propeller Shaft and Nozzle Increase Efficiency

To eliminate the majority of typical propulsion losses, the Flowserve Pleuger Offshore thruster incorporates a 97° angle propeller shaft. By tilting the propeller axis downward slightly, severe thrust reductions caused by the propulsion stream contacting the hull (Coanda Effect) can be greatly reduced. As a further benefit, thruster-thruster interaction losses are controlled, enhancing overall vessel dynamic positioning capability.

Simplified Motor Alignment

The Flowserve Pleuger azimuth thruster features an L-Drive mounting receptacle that includes a built-in support structure for the main drive motor. This design not only reduces hull dead weight, it also eliminates the motor alignment procedure, making for fast and easy change out of major components.

Service Features Reduce Maintenance Costs

The Flowserve Pleuger WFSD thruster is designed so that the thrust unit and azimuth drive are removable while the vessel is afloat. The azimuth drive seal is readily accessible, allowing for easy change-out. This underwater detachable configuration eliminates the need for dry docking procedures, reducing both maintenance costs and downtime. Flowserve also offers a watertight cover for this arrangement, providing optimum installation and maintenance flexibility, even in the open ocean.

Shaft Design Helps Facilitate Installation

The drive shaft comes equipped with self-aligning couplings that require no adjustment during installation. Also, the connection between the underwater detachable thrust unit and azimuth drive is established with a simple and reliable hydraulic press fit connection. Both features help to ease installation and maintenance tasks.

Differential Pressure Compensation System

The Flowserve Pleuger azimuthing thruster employs a differential pressure compensation system (DPCS) for semisubmersible vessels. This system balances pressure within the thruster unit to that of the submerged depth, relieving pressure on the propeller shaft seals, enhancing their life expectancy and protecting against water intrusion.

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Thruster Configurations

Thruster for Offshore Applications

In difficult offshore environments, drilling platforms must be maneuvered and stabilized against not only wind and wave action but also counter the torque of the drilling drive unit. The Flowserve Pleuger thruster for offshore applications has been developed specifically for semisubmersible rigs and drill ships as a main propulsion system as well as to enhance dynamic positioning operations.

Thruster for Ship Applications

The Flowserve Pleuger azimuthing thruster for ships has been developed especially for main propulsion systems, maneuvering in port, or enhanced dynamic positioning. This makes it well suited for use in such applications as wind turbine installation, platform supply and any vessel requiring a high degree of maneuverability. Optional upgrades for ice class design (up to ice breaker class) or Z-drive are available.

Retractable Azimuth Thruster

For ship applications where maximum efficiency is desired while underway, the Flowserve Pleuger azimuthing thruster can be upgraded to a containerized retractable design. This configuration allows the thruster to be hydraulically retracted into the hull while not in use, reducing drag and saving on fuel costs. The retractable design is also beneficial in situations where the vessel may encounter shallow drafts or underwater obstacles that could damage an otherwise unprotected thruster unit. Available with input powers up to 6000 kW (8000 hp), this configuration can also be ugraded to underwater detachable configuration.

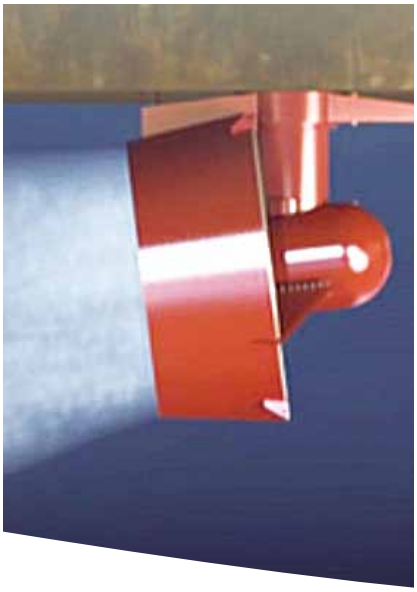
Ice Class Azimuth Thruster

The Flowserve Pleuger azimuth thruster for both offshore and ship applications can also be upgraded to ice class requirements. Flowserve has a long history of involvement with all the major classification societies and their ice class regulations. Designs can be supplied up to ice breaker class with ducted or un-ducted propellers.

Custom Designed Auxiliary Propulsion

In addition to their more typical thruster designs, Flowserve has also produced a number of custom auxiliary propulsion units over the years. An example of this are thruster designs that meet the extreme shock and signature requirements of Navy vessels such as nuclear and conventional submarines as well as aircraft carriers. From submersible motors to diesel engine drives, Flowserve has the solution for just about any propulsion need.

Thruster Controls and Display Panels



Thruster Controls

Together with its rugged and reliable thruster units, Flowserve also offers a full range of instrumentation and controls to operate and monitor them. Solutions include:

- Basic interface controls (single sensor systems)
- Local and emergency override controls
- Full thruster control system, linked directly with the main vessel control system
- Custom control units to fit any application requirements
- Junction boxes for direct control by vessel systems
- Local control cabinets with interface to vessel systems
- Condition monitoring system

Bridge Panels

Complementing its full line of thruster controls, Flowserve offers several configurations of bridge display panels and operator screens. The panels and screens are fully customizable to the end user's requirements.

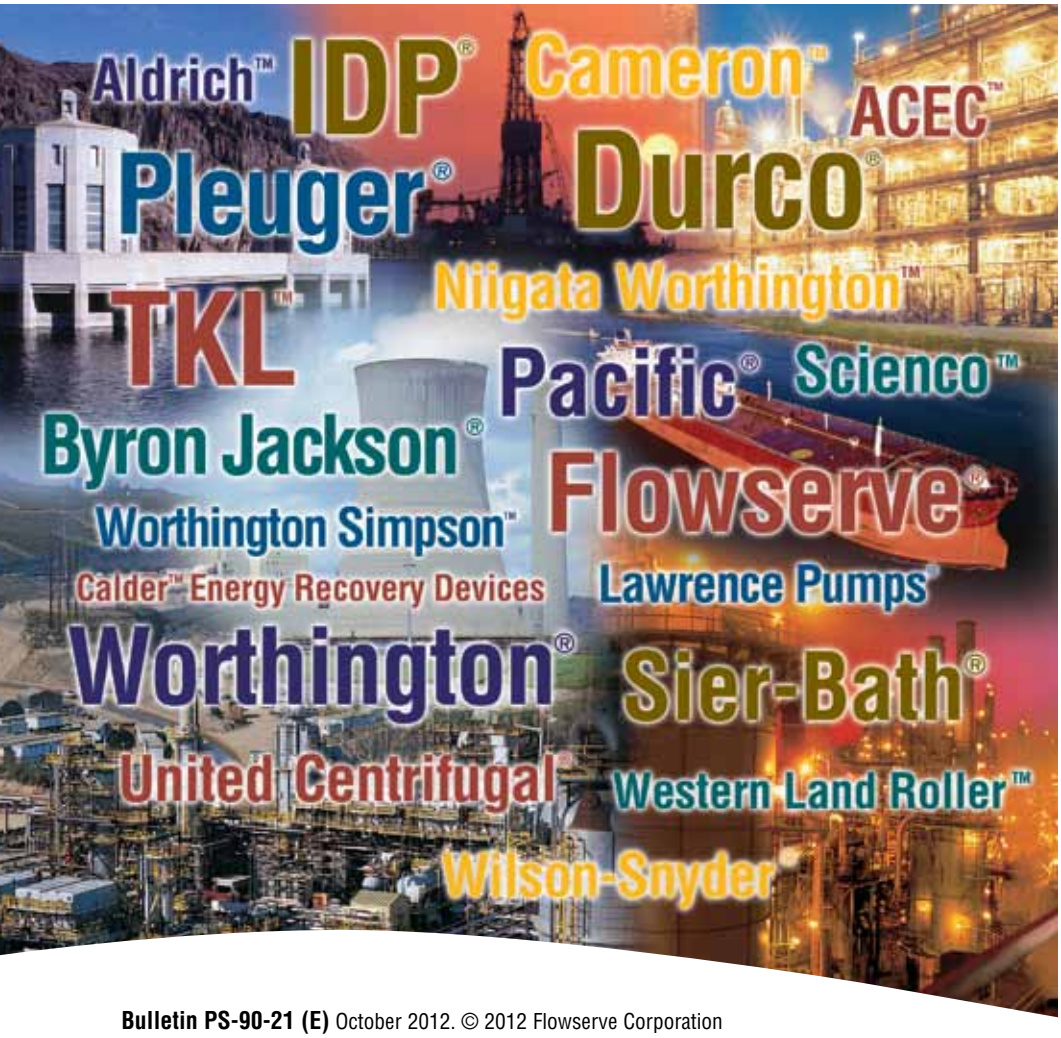
The typical azimuth thruster screen provides information regarding:

- Operating mode of each main propulsor
- Drive speed
- Motor load
- Feedback
- Alarms

Service

Service Stations and Quick Response Centers are available to provide Pleuger Thruster users with spare parts and technical support.

Aftermarket support for thruster spares, repairs and upgrades can be directed to: thruster@flowserve.com.



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