Pleuger Propulsion Systems

Since 1929 Pleuger Industries GmbH is in the forefront of virtually every significant advancement in pumping technology to meet water-handling challenges. In the early 1950’s Pleuger started to develop ship propulsion systems from it’s knowledge in submersible motors and axial flow pump technology.
Experience in Propulsion Systems

Since the early 1950’s Pleuger has led the development and production of different thruster designs. In 1955, Pleuger patented the world’s first electric pod propulsion system, which was a further development of the “Active Rudder” (AR), an auxiliary propulsion drive integrated into a vessel’s rudder.

Since that time more than 2000 thrusters of different construction have been manufactured. Examples include transverse tunnel thrusters, active rudder thrusters, retractable thrusters, containerized, controllable and fixed-pitch thrusters, and most recent designs of underwater mountable thrusters.

In the past 20 years Pleuger concentrated its design and production on custom engineered solutions for underwater mountable geared thrust units and tunnel thruster.
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 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 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 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. This configuration can also be upgraded to underwater detachable configuration.

Ice Class Azimuth Thruster
The Pleuger azimuth thruster for both offshore and ship applications can also be upgraded to ice class requirements. Pleuger 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, Pleuger 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, Pleuger has the solution for just about any propulsion need.
Azimuth Thruster for Offshore Applications

Experts in Offshore Propulsions Systems
Reflecting decades of applications expertise behind its rugged and versatile thruster design, the 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 Vessels
- Crane Vessels
- Multi Purpose Offshore Vessels
- Research Vessels
- Supply Vessels

Application Versatility
The versatile 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° angle gear.
- Underwater detachability
- L- or Z-drive power train
- Electric drive motor or Diesel engine direct driven
- Ducted or open fixed pitch propellers
- Capsule- or column-retractable designs
- ICE-class upgrade, up to the highest ice breaker class

Custom Engineered Thrusters
The 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. Pleuger has the knowledge and experience required when it comes to designing, manufacturing, testing and delivering the world’s highest-availability, azimuthing thrusters.
Azimuth Thruster for Offshore Applications

Robust Thrust Unit
The streamlined gear housing of the thrust unit is made of welded high strength ship building 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 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 Pleuger Offshore thruster for semisubmersible vessels 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 Pleuger azimuth thruster WFSD 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 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. Pleuger 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 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.
Pleuger Under Water Mountable Type – WFSD

Features and Benefits

Four- or Five-bladed Propellers
are available with fixed pitch, in ducted or un-ducted configurations. Controllable pitch propeller design on request.

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 (if specified)
deliver increased thrust of up to 25% compared to 90° axis arrangements. Propellers and nozzles are custom-designed for each application. Gear Housing and nozzle made from welded high strength ship building steal provides perfect strength and weight effectiveness.

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.

Oil 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.
Pleuger looks back on a long history of design and manufacturing of containerized thruster solutions. Many of such systems were built for semisubmersible drilling units already in the 1970’s. The containers included the majority of equipment to operate the thruster, such as lube oil system, steering hydraulics, cooling water pumps and prime mover. In recent years Pleuger delivered a containerized system with retraction mechanism (WFSK).

**Containerized, Retractable and Under Water Mountable (WFSDK)**

Pleuger developed a system where the standard WFSD underwater mountable thruster is build into a retractable container solution. The vertical retraction/elevation mechanism is hydraulic driven. The HPU for this operation is located inside the container and provides the hydraulic power for the locking mechanism as well. Hence, the container includes all drive units to operate the thruster, elevation and locking process.

**Simple Hull Interface**

The container is build square shaped to fit best to the vessel hull structure. The thruster well in which the container moves is kept fairly simple. Machining work is limited to locking locations. There is no requirement of machining along the elevation rails, thus reducing alignment work to a minimum.
Engineered Ice Class Upgrade
The Pleuger Engineering Team is capable to build the standard thruster range with Ice Class strengthening upon request. As reference, 4 Azimuth Thrusters with Ice Class Arc 4 (RMRS) were designed and delivered to Russian supply vessels. The units were configured as Z-Drive for 5400kW input power with Ø4.2m Propeller.

Flexibility in the design phase
Pleuger is highly flexible to design a thruster to the needs and requirements of the customer. The requirements for Ice Classification are demanding but can be incorporated in most of the thruster designs. Specific propulsion solutions have always been the key competency of the Pleuger Engineering Team.

5400kW Arc 4 Ice Class Thruster
5400kW Arc 4 Ice Class Brake / Input Shaft
5400kW Arc 4 Ice Class Top Bevel Gear
Ring Gear after Full Torque Test

Pleuger Ice Class Thruster – Special Applications
Flexible Hull Interface

Pleuger is flexible in the hull interface and aligns the receptacle to the hull design.

Flexible design of Auxiliaries

The design and manufacturing of the auxiliary hydraulics, such as steering HPU and Lube Units can be adopted to the requirements of the project. Often these skids are subject to alignment with the limits of available space inside the machinery room. The Pleuger Engineering Team is flexible to adopt the equipment to the given space.

Machined Thruster – Hull Interface

Pleuger has tools, capabilities and high experience to perform the machining of the receptacle after hull integration. Thruster and tools are designed to perform this machining work even while the vessel is afloat.

Installation of Azimuth Drive afloat

For the under water mountable thruster type WFSD the equipment is designed in such a way that the installation and also repair work on the Azimuth Drive can be performed while the vessel is afloat. This feature provides an advantage during vessel construction and repair work. The Pleuger Commissioning Team is available to support this process whenever the schedule of the yard requires attendance.

Simplified Motor Alignment

The 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.
FAT – Factory Acceptance Tests

Pleuger performs a number of extensive testing methods to the thruster equipment in order to verify continuous high quality of the propulsion equipment. A few of the many quality proofs each Pleuger azimuth thruster has to pass are explained in the following.

**Full Load Torque Test**
A full load torque test is applied to each Pleuger azimuth thruster to verify the correct adjustment of gear set and bearings. Prior to testing, the gear set is colored with special paint. Under load the gear teeth of pinion and bull gear have contact, creating a contact pattern on the paint. The shape and location of this contact pattern is crucial for a long and trouble free operation of the thruster. The full load torque test incorporates simulation of the propeller thrust to apply most realistic operation conditions.

**Bearing Clearance and Back Lash**
As standard procedure the bearing clearance and gear back lash are measured. Pleuger even measures the gear back lash while taking into account the propeller thrust. Hence, the major operation influences are simulated when performing this critical quality check.

**Azimuth Sealing Test**
The azimuth sealing is an integral part of the thruster system. It seals the vessel hull from surrounding seawater at the steering column. Specifically thrust units built into semisubmersible rigs are subjected to high water pressure due to operation draught. The Pleuger azimuth sealing consists of 4 lip sealings. Each of the sealing chambers is tested individually to ensure each sealing has proper effectiveness.

**Propeller Shaft Sealing Test**
Gear Housing, Propeller Shaft Sealing and Input Shaft Sealing are tested multiple times during manufacturing process.
Customized Thrust Calculation

In House Propeller Design
At Pleuger the propeller is designed in house. For each project a detailed and informative propeller calculation is performed, resulting in comprehensive propeller curves provided to the customer. The propeller pitch and shape is adjusted to meet the exact requirements of the customers application. The Pleuger engineering department uses conservative analytical methods as well as advanced CFD technology to perform thruster performance calculations.

Independent Performance Verification
Pleuger is keeping close relationship to hydraulic institutes. In certain cases Pleuger uses independent 3rd parties to verify the predicted thruster performance.
Thruster Controls & Auxiliaries

Thruster Controls
Together with its rugged and reliable thruster units, Pleuger 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
- Local control cabinets with interface to vessel systems
- Condition monitoring system

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

Steering Power Pack
The Pleuger steering HPU is build as closed loop system with easy accessible pumps and motors. Alternatively, Pleuger can provide electric motor driven steering systems.

Lube Oil Units
Pleuger lube oil systems contain redundant pumps and filters. Optional a fine filter with water separation capabilities can be incorporated into the system. A Header Tank provides positive pressure to the thruster gear box. For semi sub vessels this pressure is dynamically controlled.
### Standard Azimuth Thruster Ranges

#### 97° - WFSD / Under Water Mountable Thruster Sizes

<table>
<thead>
<tr>
<th>Unit</th>
<th>Dim.</th>
<th>Power (max) kW (hp)</th>
<th>2610 (3500)</th>
<th>3500 (4700)</th>
<th>3000 (4020)</th>
<th>4000 (5360)</th>
<th>3500 (4700)</th>
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<tr>
<td>Power (max)</td>
<td>mm</td>
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<td>3400</td>
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<td>4000</td>
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#### Dimensions

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#### Max Power - Range

<table>
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<th>Dim.</th>
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<th>3000 (4020)</th>
<th>3500 (4700)</th>
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<tbody>
<tr>
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<td>2800</td>
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<td>3500</td>
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<td>4400</td>
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<td>Propeller Diameter</td>
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<td>720</td>
<td>600</td>
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<tr>
<td>Input Speed</td>
<td>rpm</td>
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<td></td>
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#### Dimensions

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<td>1750</td>
<td>1800</td>
<td>1960</td>
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## Tunnel Thruster

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<tr>
<td></td>
<td></td>
<td>1000 (1340)</td>
</tr>
<tr>
<td>Power (max) kW (hp)</td>
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</tr>
<tr>
<td>Propeller Diameter mm</td>
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<tr>
<td>Input Speed (50Hz/60Hz) rpm</td>
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<tr>
<td>Thrust (approx.) kN</td>
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<td>139</td>
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### Dimensions

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<tr>
<th>Unit</th>
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<td>3500 (4690)</td>
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<tr>
<td>Power (max) kW (hp)</td>
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<td>Propeller Diameter mm</td>
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<tr>
<td>Input Speed (50Hz/60Hz) rpm</td>
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<td>600/720</td>
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<tr>
<td>Thrust (approx.) kN</td>
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<td>491</td>
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</table>

| Tunnel Diameter mm          | DK   | 2040        | 2342        | 2646        | 2948        | 3252        | 3554        |
| Tunnel Length mm            | LT   | 1800        | 2000        | 2300        | 2600        | 2900        | 3200        |
| Propeller CL to Motor mm    | H    | 1630        | 1920        | 2130        | 2380        | 2620        | 2870        |
| Thrust Unit mm              | C    | 640         | 720         | 920         | 1020        | 1130        | 1230        |

*Pleuger has delivered more than 1500 tunnel thruster for almost every propulsion application. The thruster can be configured as FP (fixed pitch) or CPP (controllable pitch) type. The motor arrangement is typically vertical L-Drive, but customized configurations are possible.*
## Recent Azimuth Thruster References

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<th>Project Name</th>
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<th>Power [kW]</th>
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WFSD: Fixed Pitch Underwater Detachable Azimuth Thruster
WFSDZ: Fixed Pitch Underwater Detachable Azimuth Thruster - Z-Drive  *under construction
WFSDKE: Capsule Retractable Underwater Detachable Azimuth Thruster
Pleuger Thruster Service

Dedicated to Flexibility
The Pleuger Thruster Service Team is dedicated to mobilize wherever needed worldwide. The team performs perfectly timed and planned thruster offshore mounting and dismounting operations with remarkable efficiency. Due to the long history in thruster service Pleuger can support thruster overhauls in any part of the world. Furthermore, Pleuger has service capabilities at the Hamburg manufacturing site.

Pleuger Genuine Spare Parts
Pleuger supplies genuine spare parts to any thruster equipment built under brand name Pleuger Thruster.

All the right Tools
Pleuger holds offshore container with all the right tools to perform thruster service operations at shipyards or offshore. The container is usually shipped prior to mobilization of the team to ensure availability when the team arrives at the service site.
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www.pleugerindustries.com

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