



TECHNOLOGY INFORMATION

STEERPROP PROPULSION BASIC FEATURES

ELECTRIC STEERING

Steerprop Azimuth Propulsors are equipped with robust electric steering gear. Electric motors controlled by frequency converters produce the azimuthing torque.

Electrical steering has several advantages. It is accurate and has constant steering speed. It is energy-efficient as it uses power only when actively turning. For this reason, electrical steering also produces significantly less noise than hydraulic steering systems.

The steering gear requires little service due to its mechanically simple but high quality construction. In the event that service becomes necessary, this simplicity makes service operations quicker and easier.

PRESSURIZED LUBRICATION SYSTEM

Smaller Steerprop Azimuth Propulsors utilize both pressurized and immersion lubrication. The gears and bearings in the upper gearbox are lubricated with pressurized oil jets, while the components in the lower gearbox are immersed in oil.

Larger Steerprop Azimuth Propulsors are pressure lubricated in both gear sets. As the superfluous oil from the gearboxes is moved into the oil tank, no extra energy is consumed by oil churning by the gear wheels.

Utilizing pressure lubrication in both gearboxes also reduces the amount of lubrication oil the propulsor requires.

OPTIMIZED STEEL STRUCTURE

Fabricated steel is used to manufacture the housings for smaller Steerprop Propulsors. The qualities of high-precision fabricated steel make it particularly suitable for producing durable propulsor bodies.

However, in the event that larger propulsor sizes and stringent ice-classification are required, cast steel is used for even greater durability.

TRIPLE STEERING SEALS

The steering tube is equipped with three lip seals installed against a machined stainless steel liner. The outermost seal is turned downwards to minimize the accumulation of dirt that may cause wear on the seals.

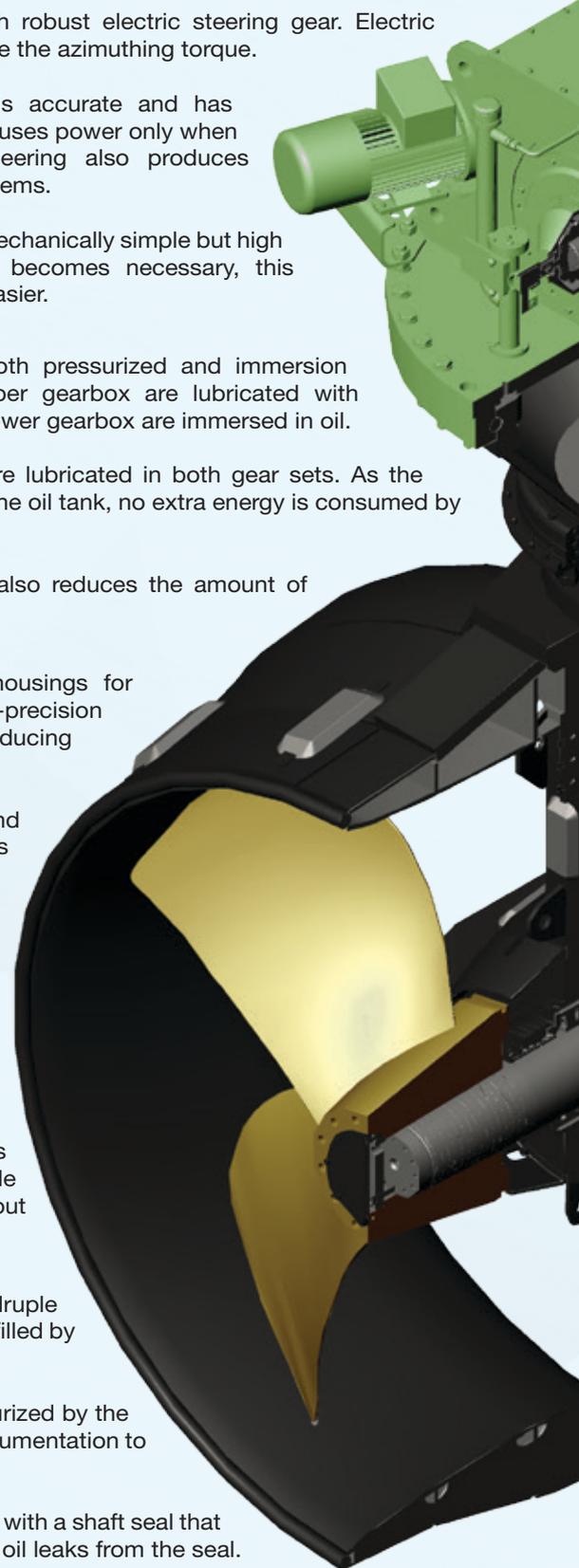
The three lip seals form two chambers filled with pressurized oil in the steering seal. The chambers are connected to the propeller shaft seal and enable the entire seal system to be bled and flushed without removing the lower part or the unit.

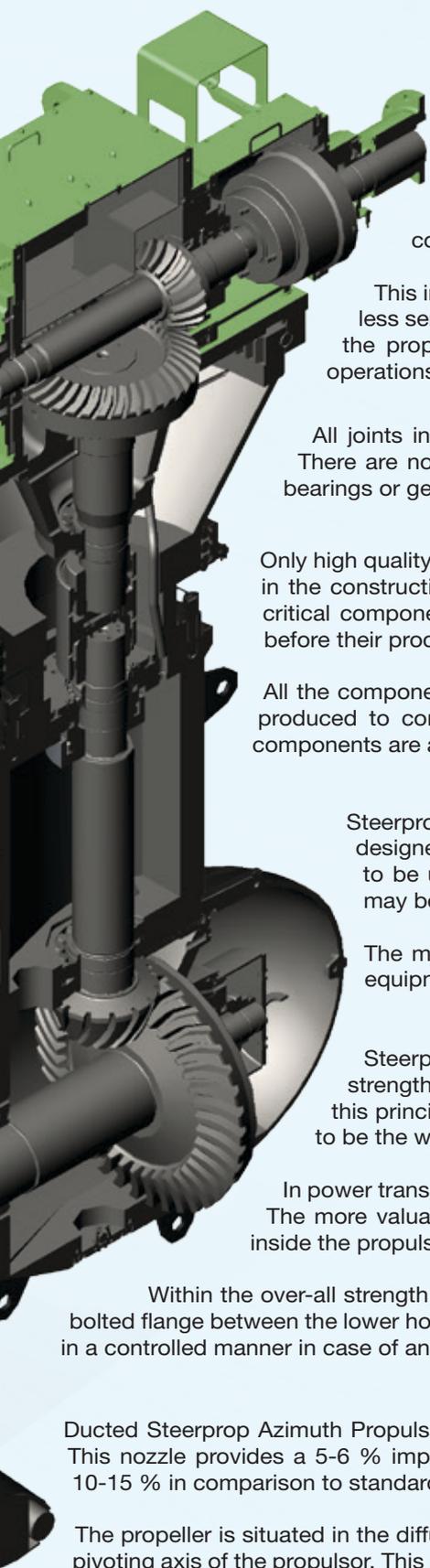
FLUSHFLUID SHAFT SEALS

The propeller shaft seal is sealed using quadruple ring-type lip seals. The space between the seals is filled by oil lines from the steering seals.

The oil chambers on the propeller shaft are pressurized by the seal oil tank. The seal oil tank is equipped with instrumentation to monitor the condition of the seal system.

Larger Steerprop Azimuth Propulsors are equipped with a shaft seal that uses pressurized air to eliminate even the smallest oil leaks from the seal.





Steerprop Azimuth Propulsors have a robust, mechanically simple construction. The design is kept as simple as possible to maximize the propulsors' reliability by minimizing the amount of components that may wear in use.

This improved reliability means that Steerprop Azimuth Propulsors need less service and result in less downtime for service. However, in the event the propulsors do require service, mechanical simplicity makes service operations quicker and require less spare parts.

All joints in the power train are either conical or cylindrical shrink-fit joints. There are no keyways to deteriorate the integrity of the power train's shafts, bearings or gears.

Only high quality components from well-known, reputable manufacturers are used in the construction of Steerprop Azimuth Propulsors. Manufacturers of the most critical components are carefully scrutinized with personal visits from Steerprop before their products are accepted for use in the design.

All the components used in the power train of Steerprop Azimuth propulsors are produced to conform to the highest standards of quality and reliability. These components are always classified with established classification societies.

Steerprop Azimuth Propulsors and their auxiliary equipment have been designed to be as compact as possible. This enables azimuth propulsors to be used in vessels with low main decks or on vessels where space may be a critical factor for other reasons.

The modular nature of the propulsors' auxiliary equipment enables the equipment to be fitted even in smaller propulsion rooms.

Steerprop Azimuth Propulsors are engineered with a fail-safe sequential strength security principle for both the power train and the housings. With this principle, the cheapest and most easily replaceable parts are designed to be the weakest.

In power transmission, the weakest components are the blades of the propellers. The more valuable and harder to service parts of the power train are protected inside the propulsor body in case of accidents.

Within the over-all strength of the housing structures special attention is given to safety. The bolted flange between the lower housing and the upper parts of the propulsor is designed to break off in a controlled manner in case of an overwhelming impact, e.g. hard grounding.

Ducted Steerprop Azimuth Propulsors use the HJ3 high performance nozzle, designed by Steerprop. This nozzle provides a 5-6 % improvement to bollard pull and improves free running efficiency by 10-15 % in comparison to standard nozzles.

The propeller is situated in the diffusor part of the nozzle, enabling the nozzle to be installed near the pivoting axis of the propulsor. This reduces the required steering torque and thus the amount of power needed to steer the vessel.

ROBUST MECHANICAL CONSTRUCTION

KEYLESS SHRINK-FIT JOINTS

HIGH QUALITY COMPONENTS

COMPACT PROPULSOR SIZE

SEQUENTIAL STRENGTH

HIGH PERFORMANCE NOZZLE

STEERPROP PUSH-PULL CONTRA-ROTATING PROPELLERS (CRP)

STEERPROP DUAL-END CRP

Steerprop CRP propulsors combine the advantages of a pulling propeller with the benefits of dual-end push-pull CRP technology. In Steerprop dual-end CRP technology, the propulsive load is divided between independent pulling and pushing propellers located on opposite ends of the propulsor body. This load distribution allows the propulsors to use larger and slower propellers to greatly enhance the propulsors' efficiency.

Dividing the propulsive torque this way also has other benefits. This load distribution allows the propulsor to be reinforced against ice or other debris without compromising propulsive efficiency. As each component is subjected to lesser load, the components' mechanical reliability is also enhanced.

The propulsor body is hydrodynamically optimized to further improve efficiency. The pulling propeller's slipstream interacts beneficially with the bulbous front of the propulsor body. This interaction effectively cancels out the drag caused by the propulsor's body.

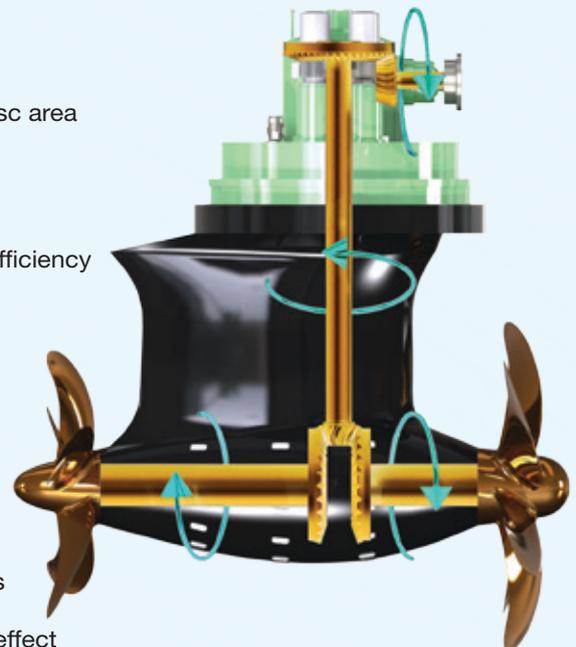
In addition, the rear propeller recovers a major part of the rotational energy from the pulling propeller's slipstream. This swirl recovery further improves the propulsor's efficiency. It also changes the nature of the propulsor's total slipstream. This unique intensified slipstream has been noted to be particularly beneficial in ice-management operations.

By combining all these efficiency enhancing solutions into one propulsor with simple mechanical construction, Steerprop is able to produce propulsors that offer unsurpassed propulsive efficiency and robust reliability in even the most demanding operating conditions.



FEATURES AND ADVANTAGES

- Pulling and pushing propeller
 - Benefits of the pulling propeller
 - Two propellers almost double propeller disc area
- Optimal power distribution:
 - 60 % pulling, 40 % pushing propeller
 - Lower mechanical load on components
 - Ice-classification without compromising efficiency
- Larger, slower propellers
 - Improved efficiency
 - Low noise
 - Low cavitation
- Hydrodynamic optimization
 - Positive hydrodynamic interaction between the front propeller and the propulsor body
 - Rear propeller clear of the front propeller's tip vortex
 - Rotational energy recovery with the CRP effect



STEERPROP CONTROL SYSTEM

The Steerprop Control System is built with carefully selected widely-available components that represent the latest and most advanced industrial automation technology. These components are then optimized to use with the Steerprop Control System with advanced programming by Steerprop Automation Design.

MODERN AUTOMATION SYSTEM

Steerprop has deliberately avoided proprietary components in the control system. Standard components were chosen to ensure their availability for both current and future service operations and control system upgrades.

The Control System is equipped with several layers of back-ups and redundancies to ensure that control of the vessel is never lost. In case of failure in the main controls, the system alerts the operator to manually switch to the back-up controls.

The Steerprop Control System features the latest monitoring and remote service systems. The monitoring systems record various pertinent data, e.g. running hours, load distribution, steering operations, etc. The current and recorded information can be accessed in real-time from the Steerprop Service Display.



STEERPROP SERVICE DISPLAY

The remote service system allows Steerprop Service Engineers, in co-operation with the vessel's technical crew, to remotely service and troubleshoot the control system.

The Steerprop Control System is designed to be as flexible as possible. It can be seamlessly interfaced with any known control system, ranging from dynamic positioning systems to autopilots to satellite uplink systems. The control system can also be seamlessly interfaced with any kind of prime mover - from electrical drives control by frequency converters to direct diesel drives.

TAILORED SYSTEM STRUCTURE



This flexibility in the control system structure makes it possible to tailor the control system according to:

- The vessel's type and operation profile
- The prime mover type
- Dynamic positioning and integrated bridge systems
- Other control, monitoring and automation systems on the vessel

The operator interface is the main source of information for the vessel's crew. Steerprop has focused on making this interface as easy to use and as informative as possible. The different indications are kept simple and easy to give the operating crew the information they need in normal and abnormal operational situations.

SIMPLE AND INFORMATIVE

The Steerprop Control System utilizes the latest control lever technology. These new levers feature accurate and comfortable steering with possibilities for new kinds of steering feedback to the operator, such as tactile feedback.

The Steerprop Direction Indication display is an innovative feature of the Control System. This one single display can keep the operating crew informed of all the important steering information from the Control System, such as propulsor angle, rpm, steering power and more.



STEERPROP DIRECTION INDICATION

STEERPROP FACTORY ACCEPTANCE TEST (FAT)

FACTORY ACCEPTANCE TEST

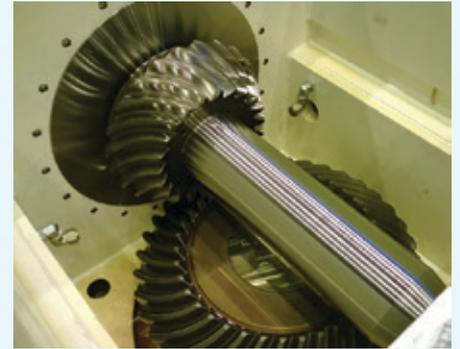
Every Steerprop Azimuth Propulsion is subjected to a full Factory Acceptance Test at the Steerprop testing facility prior to delivery to the customer. In this test, the entire propulsor is tested together with its own control system to ensure that they function flawlessly together.

TORQUE TEST

In the full torque test the propulsor is subjected to its full operational torque. The tooth contact patterns in the gear sets are carefully inspected to ensure optimal power transmission between the gear wheels.

By carefully optimizing the contact patterns and power transmission in the gear wheels, the propulsor's mechanical reliability and service life are both assured.

The torque test also ensures that all components of the powertrain - the gear wheels, shafting, bearings - are in accordance with Steerprop's high standards.



RUNNING TEST

The propulsor's control system is linked to the propulsor at the start of the test. All steering and other control functions are tested and calibrated. The propulsors are then run at full speed until the testing temperature is reached. The propulsors are run at operating speeds for the rest of the test.

During this test, the propulsors are closely monitored for the following parameters and the results are carefully recorded in the FAT record:

- Heating times
- Pressures
- Temperatures

If any deviations are discovered during the running test, the test is immediately stopped. The cause for the deviation is located and repaired and the test is restarted. This will be repeated until the propulsor meets Steerprop's high standards for quality and efficiency.



CONTROL SYSTEM TEST

The control system is connected to the propulsor in accordance with the project's cable diagrams. The control system is always tested together with its individual propulsor to ensure they work perfectly in unison. During this test, main remote controls, back-up remote controls, local controls and local back-up controls are tested and calibrated, and the control system's software is adjusted if necessary.

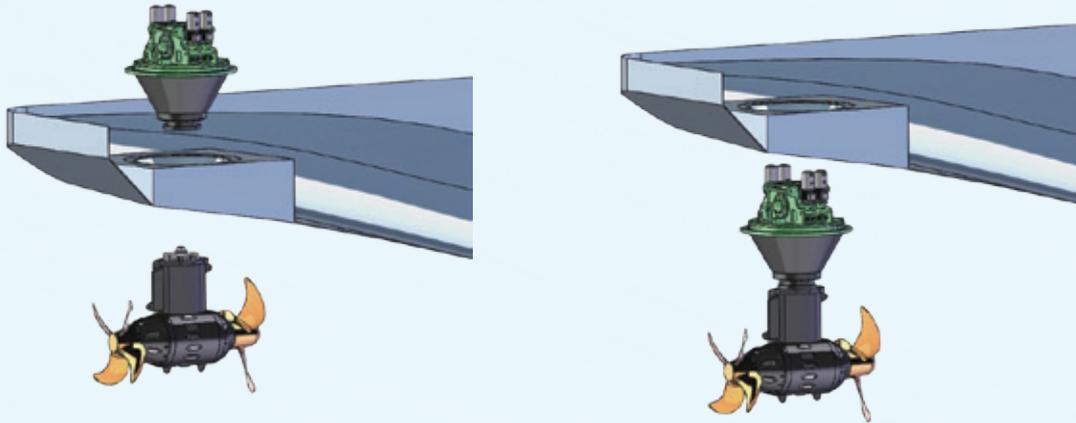
Reaction times, steering ramp times etc. are carefully monitored and recorded as the control system is tested. All the alarms and other fault indicators are carefully tested to ensure their proper function.

This comprehensive test ensures that the total control system, both hardware and software, works perfectly with its own propulsors and that all cabling diagrams are correct.

STEERPROP AZIMUTH PROPULSOR INSTALLATION

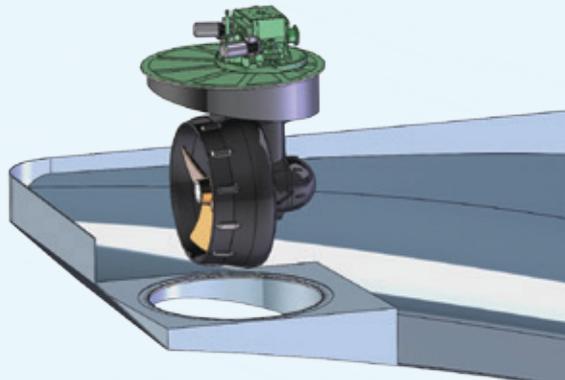
Steerprop Azimuth Propulsors are designed to be easy to install into any vessel, regardless of vessel type. These installation options are not fixed and may be altered to suit the needs of the shipyard and the owner. Each propulsor is tailored to each individual vessel, the propulsor's installation method is tailored to fit the client's needs and facilities.

INSTALLATION OPTIONS



The small bolt-in mounting arrangement is the lightest installation configuration. With this installation configuration, the propulsor can be installed in two pieces from above and below or in one piece from below.

STANDARD BOLT-IN MOUNTING



The large bolt-in mounting arrangement allows the entire propulsor to be installed in one piece from above as a single unit. This unit usually includes all of the propulsor's auxiliary systems such as lubrication. This single propulsor unit is bolted in place to ensure that the entire assembly can be removed for service.

LARGE BOLT-IN MOUNTING

In case of repairs or maintenance, the entire propulsor can be removed or replaced in one piece. This enables comprehensive maintenance to be carried out on the propulsor without drydocking the vessel.

With larger propulsors, the sheer size and weight of the propulsor limits the installation options available. Frequently, the facilities at the shipyard - lifting capacities and the size of the dry dock pool - also limit how the propulsor can be installed into place.

LARGER PROPULSOR INSTALLATION

Because of this, Steerprop has designed the larger propulsors so that they can be installed in a variety of different ways - such as in two pieces from above and below or from below in one piece.

Particularly with larger propulsors, it is important for Steerprop to work together with the shipyard and the owner to find the optimal installation method.



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