

LIPS

FP PROPELLERS

Fixed pitch propeller solutions



Propulsion solutions with fixed pitch propellers

Wärtsilä is able to solve all your needs with regard to fixed pitch propeller installations:

- Total system solutions under one responsibility
- Easy assembly and easy maintenance
- Durable construction
- Optimum efficiency through tailor-made design
- Worldwide service and maintenance.

Lips fixed pitch propellers

All LIPS[®] propellers are custom designed and made for each application. The propellers vary in diameter from 1 to 12 metres and from several hundreds of kilos to more than 100 tonnes.

Given the complex geometry of modern propellers, the casting process is monitored from start to finish to ensure a high-quality casting.

Each ship's hull has its own characteristics. To achieve the highest possible total efficiency of the vessel, the propeller must be a perfect match with the engine and the hull. A fixed pitch (FP) propeller is the choice when optimum efficiency, reliability and robustness are required.

FP propellers are usually applied in ocean sailing vessels like containership, tankers, bulk carriers and dry cargo

vessels. Wärtsilä has produced roughly 9000 FP propellers so far.

Lips FP propellers for all ship types guarantee maximum efficiency and minimum noise and vibration levels thanks to their tailor-made design and use of the latest available technology.

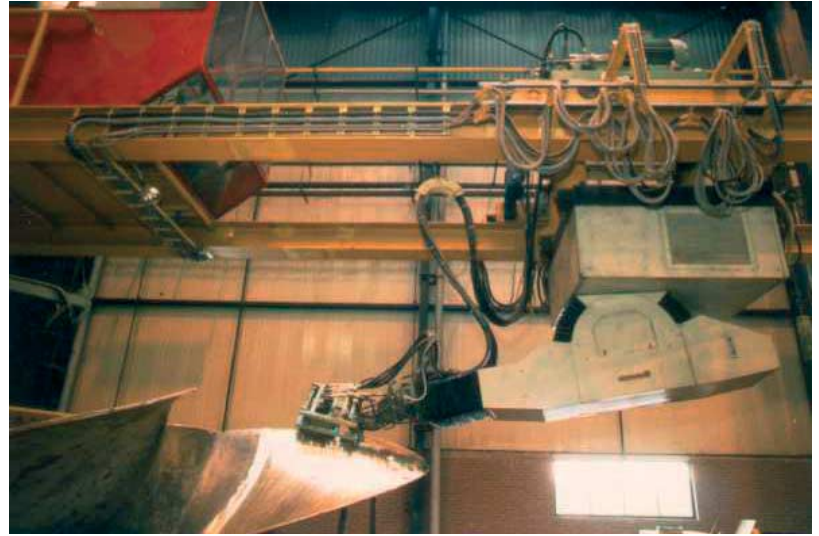
Lips patented Cunial[®] material provides excellent casting, machining and fatigue properties. An additional advantage is that they are easy to repair.

Lips FP propellers can be produced with any required blade number and size from 3.5 m upwards. For the smaller sizes mostly used in ships for coastal and inland waterways, we have a special product group called Lips Coastal and Inland Propulsion Systems (CIPS), which supplies propulsion systems for both these markets and for luxury motor yachts.

The production process

Of the more than 25 different bronze alloys developed by Wärtsilä for marine propellers, Cunial bronze is the most used and therefore the best-known material. Cunial bronze, which stands for an alloy composed of copper, nickel and aluminium, has unparalleled durability and reliability. The high quality of the alloys is the result of





The production process of fixed pitch propeller.

| The mechanical properties of Cunial: | |
|-----------------------------------------------------|---------------------------------------|
| Mass density | 7650 kg/m ³ |
| E-modulus (at 20° C) | 121000 N/mm ² |
| Poisson's ratio | 0.33 |
| Yield stress | min. 250 N/mm ² * |
| Tensile strength | min. 650 N/mm ² |
| Elongation (longitudinal) | min. 18% |
| Coefficient of thermal expansion (from 20 to 100°C) | 16 · 10 ⁻⁶ K ⁻¹ |

*At request the yield stress of the material can be increased up to 270 N/mm²

years of research. Monitoring is carried out throughout the melting process to check that the various elements are present in the correct composition.

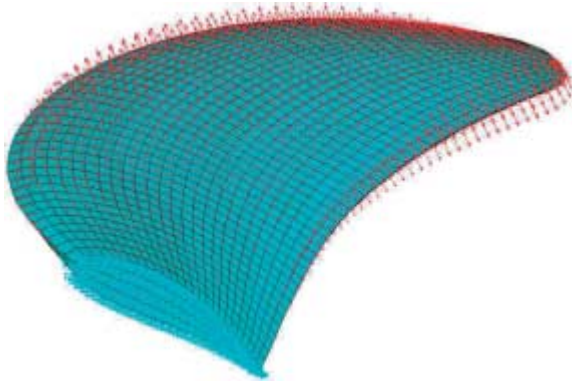
Having complete control over the production process provides us with valuable information such as the fatigue strength in seawater. This information in turn allows our hydrodynamic designers to design the propellers to the limit, thus minimizing propeller weight.

Casting the form of a marine propeller is an extremely complex procedure. To predict the casting process, we use solidification simulation software for difficult propeller

geometries. Accurate control of the process allows us to use a minimum casting allowance.

Today, Lips FP propellers are increasingly being worked mechanically with the aid of grinding robots. However, the expertise and eye for detail of the finisher is still critical to give the propeller that essential finishing touch.

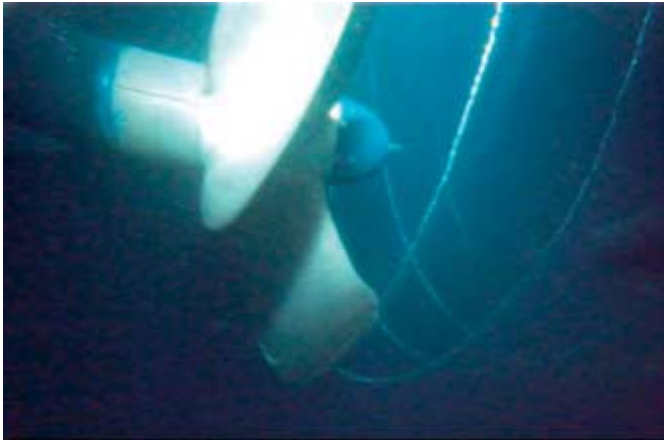




FP propeller FEM mesh.



FP propeller in hold of vessel during transport.



Full scale cavitation observation.



Lips Efficiency Rudder.

Design philosophy

The main targets when designing an FP propeller are:

- Efficiency (related to speed)
- Cavitation behaviour (related to noise)
- Pressure pulses on the hull (related to vibrations)
- Meeting the strength requirements.

Lips FP propellers meet these demands for a wide variation in speed and power densities and for any type of ship. Our design experience covers many types of ships, including high-powered fast containerships, to tankers, bulk carriers and cruise liners.

We have extensive hydrodynamic knowledge and we have developed our design tools based upon long experience with calculations, model test results and full-scale measurements. Our research and development efforts are dedicated to continuously improving the hydrodynamic design of our propellers. To achieve this goal, we co-operate with research institutes and universities in joint research projects. Our aim is to improve our knowledge and experience at full scale and to improve our design and analysis methods, including Computational Fluid Dynamics (CFD).

Product portfolio

Wärtsilä is able to supply fixed pitch propellers with a maximum finished weight of over 100 tonnes. We also supply a wide array of propulsion equipment such as shaftlines, shaftline accessories and rudders.

We produce our monobloc fixed pitch propellers as standard with a keyless bore. This allows the propeller to be hydraulically press-fit onto the propeller shaft, a method that offers two advantages. First, it avoids the stress concentrations that develop when installing the propeller with keys and keyways. And second, hydraulic mounting and dismounting is a relatively simple installation procedure. Keyed propellers can also be supplied on request.

Fixed pitch propeller (monobloc)

Wärtsilä can supply fixed pitch propellers with any number of blades. The most common are 4-, 5- and 6-bladed propellers, but we have also supplied propellers with up to 9 blades. The maximum propeller diameter supplied so far has a diameter of 11.64 m and the heaviest propeller a finished weight of over 100 tonnes.



Built-up propeller hub.



Bearing.



Seal.

Built-up propellers

Our standard built-up propellers are mounted to the flange of the tail shaft and the blades are de-mountable, even underwater. The hub is designed for strength and robustness with the minimum number of parts. The blades on the hub are slightly adjustable.

The main reasons for applying Wärtsilä built-up propellers are:

- Regular occurrence of blade damage by collision with ice or other objects
- Easy transport in case of damage
- The possibility to slightly adjust the pitch for other sailing conditions or fouling of the hull.

We supply built-up propellers with minimum 3 and maximum 6 blades for hub diameters ranging from 600 mm to 2945 mm.

Shaftline

Each ship shaftline has its own design and requirements. The propeller shaft installation has a proven basic design, which enables easy installation in the ship:

- Hydraulic toolsets
- Hydraulic nut
- Hydraulic ring
- Propeller and intermediate shafts
- Hydraulic coupling flange
- Hydraulic sleeve coupling.

Shaftline accessories

- Sterntubes with or without bearings
- Seals and bearings
- Thrust bearings
- Torque measurement device
- Turning device
- Shaft grounding device
- Shaft locking device
- Shaft brake.

Nozzles

The advantage of using a nozzle is in the additional amount of thrust it develops. Various types of nozzles such as the 19A, 37 and the Lips HR high-efficiency nozzle can be supplied.

Efficiency Rudder

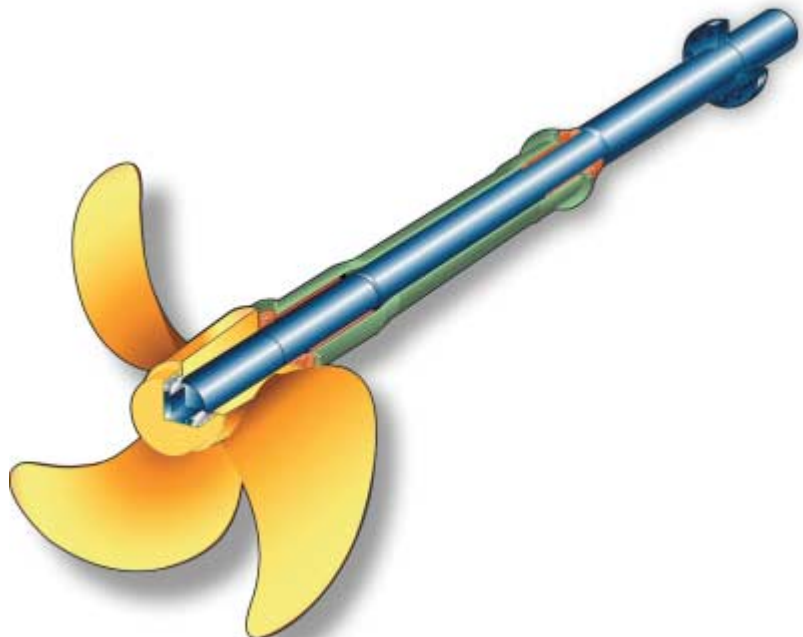
Lips Efficiency Rudder increases the ship's propulsive efficiency by 3-5% compared with a conventional system, as well as reducing propeller-induced vibrations by 30-40% and noise by 3-5 dB(A)).

The rudder performance is at least equal to that of a conventional rudder.

Consultancy

On request we also assist in questions regarding propeller and shaftline design. In the case of damaged propellers, for instance, we are often contacted for a second opinion regarding propeller performance, propeller strength and material quality.

Our laboratory and metallurgical team is perfectly equipped to answer all questions related to material quality, failure and repair possibilities.





Propeller storage in Drunen, the Netherlands.

Replacement of fixed pitch propellers

Over the years shipowners and yards have often approached us for solutions to modernization and replacement of a fixed pitch propeller.

The main reasons for replacement are:

- The propeller has too much damage and cannot be repaired
- Upgrading of the propeller design to modern standards
- Improved efficiency
- Lower propeller induced pressure pulses
- Change in mission profile
- Poor initial design.

Improving propeller design

Wärtsilä has conducted considerable research into improving propeller designs in close co-operation with model test institutes and universities. The new techniques we have developed enable us to design propellers with higher efficiency without increasing the levels of vibration and noise on board. This results immediately in lower fuel consumption. In general, the following four options are available for increasing efficiency through a new propeller design, assuming that the geometry of the new propeller should lie within the geometry of the old propeller:

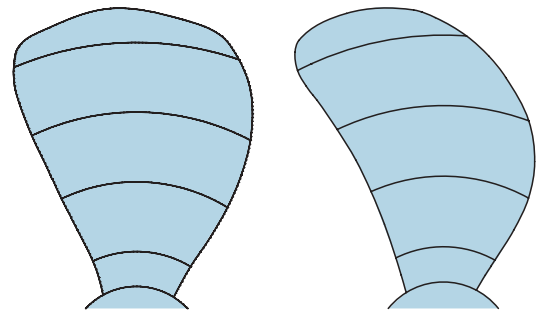
- Reduce the blade area
- Change the blade contour
- Modify the radial pitch distribution
- Apply the Wärtsilä Tip-rake concept.

Reducing the blade area

Reduction of the blade area could be possible in cases where the calculated power density of the propeller is relatively low compared to Wärtsilä standards. Reducing the blade area of an FP propeller and optimizing the power density to an acceptable Wärtsilä value can increase efficiency by more than 3%.

Changing the blade contour

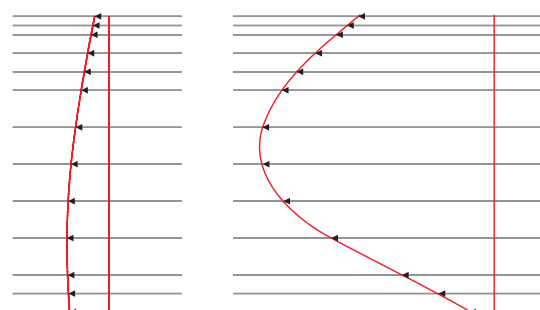
When it is not possible or desirable to reduce the blade area, changing the blade contour can increase the efficiency of the FP propeller instead. Recent projects show that efficiency improvements of 3-4% can be achieved.



Blade contour.

Modifying the radial pitch distribution

In past designs it was usual to apply some kind of constant radial pitch distribution with a constant load at all radii. However, this distribution can lead to intensive tip and hub vortex cavitation, which may damage the rudder and generate high-pressure pulses. For this reason FPP design today favours a variable pitch distribution with better cavitation behaviour and low pressure pulses (Fig.). However, if the pressure pulses are kept on the same level as the old design, reduction of the blade area is possible and efficiency will increase.

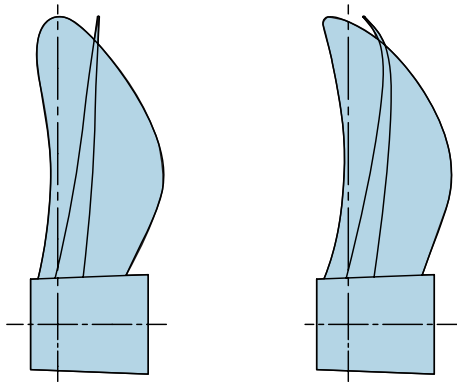


Radial pitch distribution.

Applying the tip-rake concept

The tip-rake concept can be applied to achieve better efficiency, resulting in fuel savings and/or higher ship speed. Relative efficiency improvements of 2-3 % compared to normal propellers have been measured so far. Tip-rake also leads to lower pressure pulse levels and a quieter propeller, and therefore more comfort for the crew. When considering replacement or modernization of the existing propeller, it is worth investigating to what extent a new, state-of-the-art propeller design could reduce fuel consumption and/or pressure pulses, thereby increasing crew comfort.

We are an experienced partner ready to assist you.



The tip-rake concept.

Worldwide service and maintenance

We offer you a worldwide service network that ensures reliable and efficient support and the quickest possible solution to any propulsion problem during the full operational lifetime of the vessel.



Underwater repair of propeller.

Our service activities include:

- Retrofits and upgrades
- Metallurgical repairs
- Modifications to heavy running propellers
- Underwater services and survey
- Original Lips spare parts
- Personnel training programmes
- Helpdesk
- Worldwide field service
- In-house overhaul/repair.

Wärtsilä service: around the world, around the clock.



Wärtsilä is The Ship Power Supplier for builders, owners and operators of vessels and offshore installations. Our own global service network takes complete care of customers' ship machinery at every lifecycle stage.

Wärtsilä is a leading provider of power plants, operation and lifetime care services in decentralized power generation.

For more information visit www.wartsila.com

WÄRTSILÄ® and LIPS® are registered trademarks. Copyright © 2005 Wärtsilä Corporation.

Wärtsilä Propulsion Netherlands B.V.

Lipsstraat 52, P.O. Box 6
5150 BB Drunen, The Netherlands

Tel: +31 416 388115
Fax: +31 416 373162

