

LIPS

CIPS

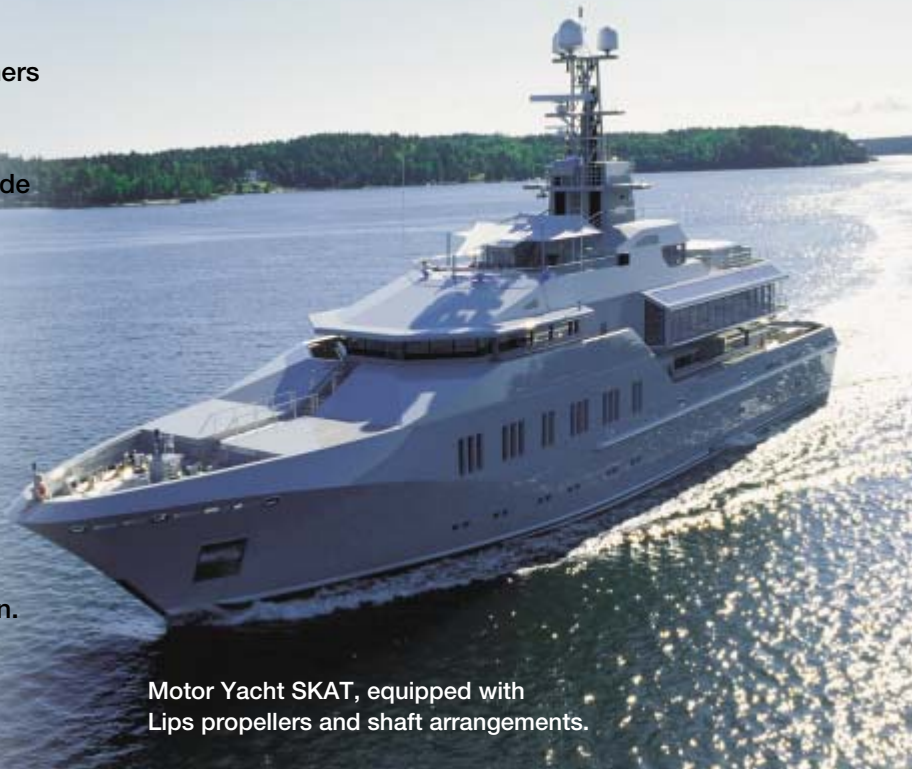
Lips Coastal and Inland Propulsion Systems



Wärtsilä is dedicated to providing its customers with products and support that fulfil their requirements. This approach enables us to target the needs of each customer and provide optimum solutions that meet their support, delivery and technical requirements. We use state-of-the-art design methods, the latest technologies and optimized products to find the best solution.

Our approach offers:

- Total system solutions under one responsibility
- Durable constructions
- Environmentally safe solutions
- Optimum efficiency through tailored design.



Motor Yacht SKAT, equipped with Lips propellers and shaft arrangements.

Lips Coastal and Inland Propulsion Systems

LIPS® Coastal and Inland Propulsion Systems (CIPS) specializes in propulsion systems for vessels operating on local waterways – coastal and fishing vessels, and also the large fleets of river vessels especially common in the Netherlands, Belgium and Germany. We are also experts in designing propulsion systems for large, fast luxury yachts and government-owned ships with propeller diameters up to 3500 mm as well as a variety of special vessels, all with their own original characteristics. Market for Lips CIPS are fixed pitch propellers, nozzles and propeller shaft assemblies complete with sterntube, couplings and DSS Manebar and JMT Sternguard seals and bearings.

Technical know-how

Wärtsilä operates in close co-operation with its customers in order to optimize product performance to demands and opportunities. And since each ship is different, we will always deliver a tailored propulsion solution offering maximum performance with minimum vibration and noise levels.

Inland waterways

Shipping in coastal waters and inland waterways puts high demands on propulsion systems because conditions in this sector vary enormously. For instance, the draft of the vessels changes because the water level varies due to the effects of rain or dryness. Often, there is also limited

information about the resistance or wakefield of the vessels. All these aspects have to be taken into consideration, which is not an easy task. Nevertheless, Wärtsilä is capable of designing an optimum propulsion system for each vessel in its specific environment. Our engineers are specially trained to deal with these extreme circumstances. They are able to call on more than 75 years of experience in combination with modern computer equipment, which enables them to simulate the cavitation behaviour and pressure pulses of the propeller under various conditions.

CIPS market segments

- Coasters and inland navigation ships
- Fishing vessels
- Push and tug boats
- Special applications (yachts, ferries, dredges, research vessels)

Market requirements

- Fit for use installations
- Cost-efficient solutions
- High efficiency (HR-nozzle)
- High bollard pull (HR-nozzle)
- Durable construction
- Short delivery times
- Good manoeuvrability performance
- Good service and repair facilities
- Low noise and vibration
- Hydrodynamic consultancy input



Staten Island double ended ferry, equipped with Lips propellers and shaft arrangements.



Fishing vessel HD 31, equipped with a Lips propeller, HR nozzle and shaftline.



Tug Nehir, equipped with Lips propellers, HR nozzles and shaftlines.



Container Casanova, equipped with a Lips propeller and HR nozzle.

Design philosophy, features and benefits

Philosophy

Wärtsilä considers reliability and durability to be the key issues when designing propulsion installations.

The main targets for CIPS design are:

- Efficiency (related to speed, bollard pull or fuel saving),
- Cavitation behaviour (related to noise)
- Pressure pulses on the hull (related to vibrations).

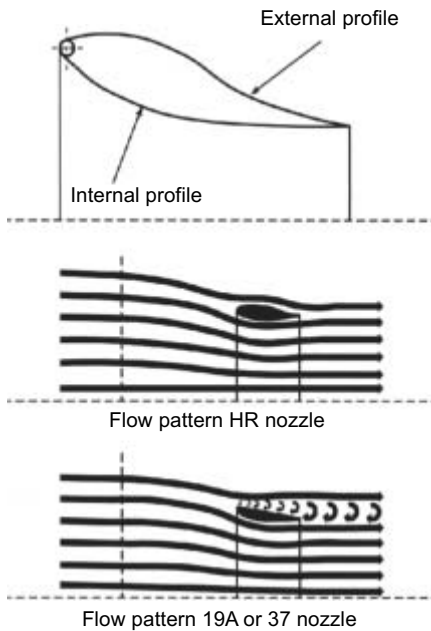
Wärtsilä propellers meet these demands over a wide range of speed and power densities for any type of ship. Our research and development efforts are dedicated to continuously improving the hydrodynamic design. We also co-operate with research institutes and universities in joint research projects to improve our knowledge of fundamental physics, to extend our knowledge and experience at full scale and to improve our design and

analysis methods, including Computational Fluid Dynamics (CFD).

Our design experience covers many types of ships ranging from high-powered river push and tug boats, to fishery vessels, coasters, inland navigation ships and yachts.

Features & benefits

- Custom-designed to order in ISO Tolerance classes 2, 1, and S
- Extensive hydrodynamic know-how and experience in a wide range of propulsion applications
- Own development of material and casting technology (Cunial®)
- Optimum propeller design in terms of efficiency noise, vibration and durability.

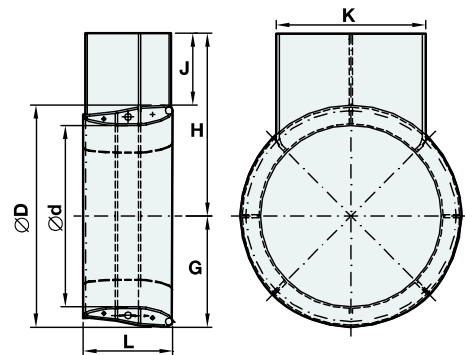


Flow comparison HR nozzle (top) versus 19A and 37 nozzle (bottom). 19A and 37 type nozzles show flow separation at higher speeds.

Nozzle	Ød	ØD	G	H	J	K	L
HR 1000	1010	1238	619*	1019*	400*	840*	500
HR 1050	1060	1300	650*	1050*	400*	900*	525
HR 1100	1110	1360	680*	1080*	400*	970*	550
HR 1150	1160	1422	711*	1111*	400*	960*	575
HR 1200	1210	1483	742*	1142*	400*	1200*	600
HR 1250	1260	1545	772*	1172*	400*	1012*	625
HR 1300	1310	1606	803*	1203*	400*	1064*	650
HR 1350	1360	1667	834*	1234*	400*	1104*	675
HR 1400	1410	1730	865*	1265*	400*	1144*	700
HR 1450	1460	1790	895*	1295*	400*	1186*	725
HR 1500	1510	1852	926*	1326*	400*	1226*	750
HR 1550	1560	1913	957*	1357*	400*	1264*	775
HR 1600	1610	1974	987*	1387*	400*	1306*	800
HR 1650	1660	2032	1016*	1416*	400*	1344*	825
HR 1700	1710	2098	1049*	1449*	400*	1380*	850
HR 1750	1760	2158	1079*	1479*	400*	1420*	875
HR 1800	1810	2220	1110*	1510*	400*	1680*	900
HR 1850	1860	2282	1141*	1541*	400*	1502*	925
HR 1900	1910	2342	1171*	1571*	400*	1542*	950
HR 1950	1960	2404	1202*	1602*	400*	1582*	975
HR 2000	2010	2465	1233*	1633*	400*	1620*	1000

* = Dimensions can be adjusted according to ship's hull.

Overall dimensions HR nozzles.



Lips HR nozzle, 10% more efficiency

Design philosophy

The Lips HR nozzle (which takes its name from the Dutch Hoog Rendement = High Efficiency) operates like an aircraft wing. A sectional view of the nozzle shows this aerofoil section. Flow around the section causes thrust (lift) in both horizontal and vertical directions. An aeroplane requires vertical lift, of course, whereas the nozzle generates horizontal thrust that provides the propulsive force in the direction of travel. The propulsive effect of the nozzle is caused by the water flowing around the nozzle section. The faster the water flows around the section, the more thrust is produced.

The maximum water flow rate depends on the shape of the section. Once the water can no longer follow the section, separation occurs, causing strong turbulence and a significant increase in drag. Any object drawn through water is subject to normal resistance. The same applies to the nozzle, so maximum thrust must be produced without causing flow separation. At the same time, the drag caused by the profile must be kept to the minimum.

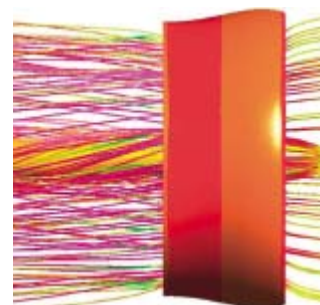
The increase in thrust performance is also called the efficiency improvement of the nozzle.

This hydrodynamic profile offers two important advantages compared to other nozzles. The drag caused by the section is small. Even more important, the maximum water speed around the section is higher, without causing

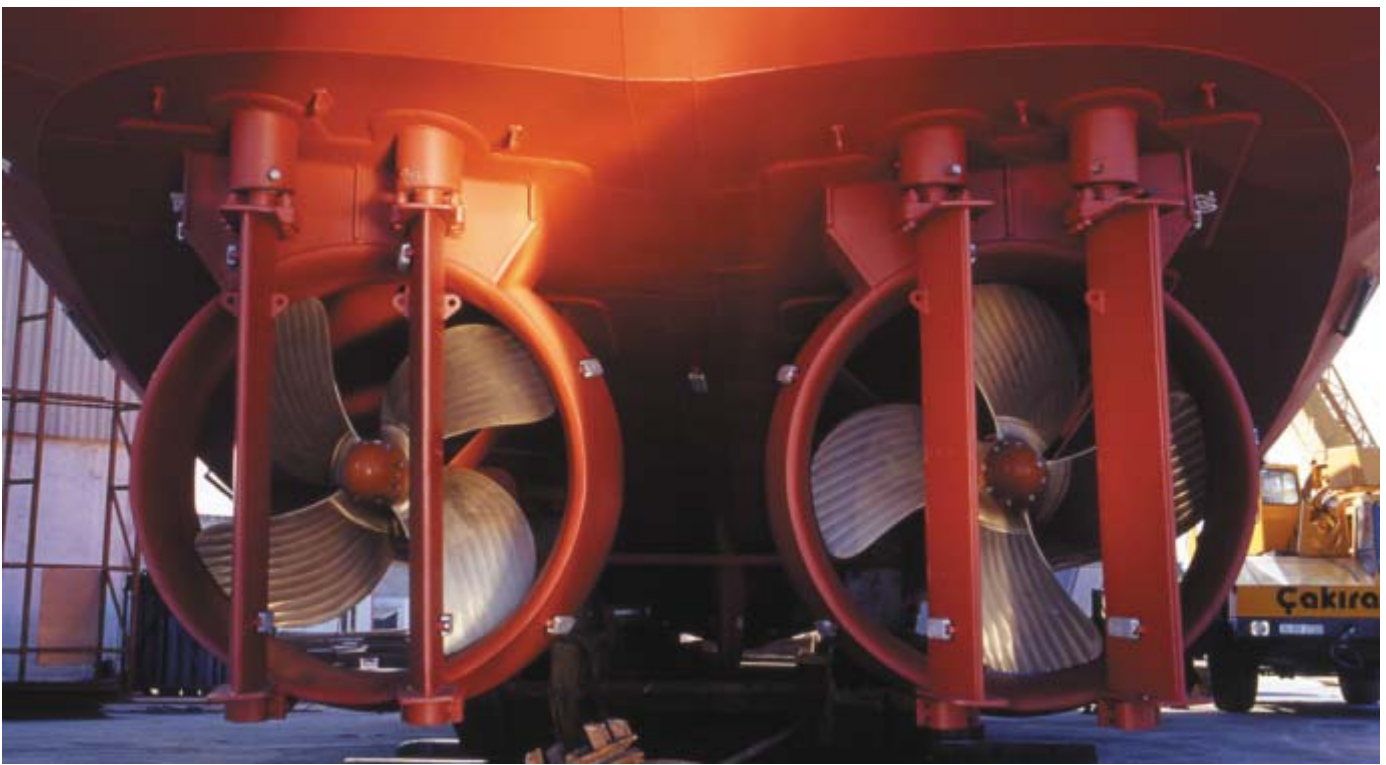
flow separation. As a result, the HR nozzle develops significantly higher thrust than comparable nozzles. *The HR nozzle section ensures that the total thrust is 10% higher than that of any other available nozzle. This performance increase leads to a corresponding reduction in fuel consumption, higher bollard pull or faster sailing.*

The investment in the nozzle can therefore pay for itself in 1 to 1.5 years.

An additional advantage is that the combination of a Lips HR nozzle with a Lips propeller design results in reduced noise and vibration levels.



HR nozzle designed with the aid of Computational Fluid Dynamics (CFD) techniques.



Two Lips FP propellers in HR nozzles.

Features & benefits

- 10% more efficiency with HR concept or 8% more bollard pull.
- An integrated headbox for easy mounting into ship.
- Choice of fully stainless steel inner sides or stainless inner ring.
- Conventional nozzles type 19A and 37 also available.
- Variable nozzle height, the bottom side can be flattened to suit ship construction.
- The combination of Lips HR nozzle and a Lips propeller offers an optimum solution with regard to efficiency and noise and vibration.

Methods of fixing the propeller onto the propeller shaft

Wärtsilä offers two methods for fixing a propeller onto a propeller shaft: a keyed joint or a key-less joint.

The key-less assembly has the advantage that the propeller does not have to be heated during installation or dismantling, which avoids shrinkage stress in the shaft and propeller. Also the propeller shaft can be smaller since no key seat is required in the propeller.

For newbuild projects we normally recommend keyless joints. For replacement propellers we also have keyed propeller designs available.

Number of propeller blades

The choice of number of propeller blades depends, among other factors, on the load on the propeller relative to speed. Other factors are the number of cylinders in the engine, the engine type (V-type or in-line) and the gear ratio. In order to avoid resonance effects, the frequency of the propeller blades must not coincide with the combustion frequency of the engine. The number of propeller blades is also a factor when calculating and determining the critical speed.

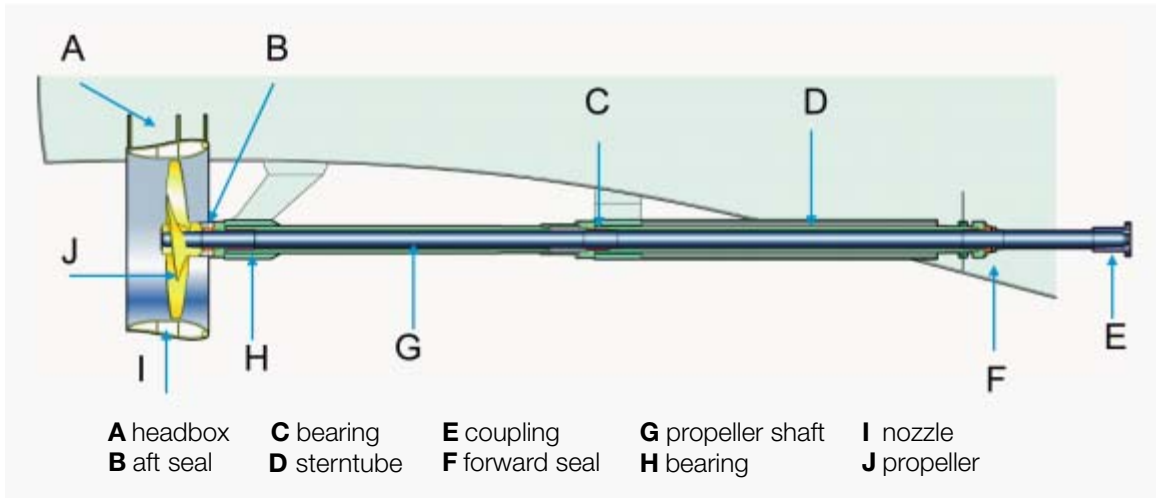
Brief propeller material comparison

Material

Lips patented Cunial® material provides excellent casting, machining and fatigue properties. Additional advantages are the good reparability, high wear and corrosion-resistant, low specific weight and the tensile strength, which is 40% higher than that of commonly used manganese bronze material. CIPS propellers can be produced with any required blade number and size till 3.5 m.

Material comparison

	Tensile strength	Corrosion fatigue	Reparability	Seawater resistance
Cunial	66 kn/cm ²	11 kn/cm ²	Very good	Very good
Manganese bronze	48 kn/cm ²	8 kn/cm ²	Moderate	Less good
Stainless Steel CF3	50 kn/cm ²	8 kn/cm ²	Poor	Less good



Inland navigation shaft configuration.

Propeller shaft installations for all types of vessel

Design philosophy

Since very few vessels are completely identical each ship requires its own propeller design. Wärtsilä always searches for a design method which enables a propeller shaft installation to be designed quickly and flexibly, without diminishing the specific advantages of our proven basic design.

Our design rules are:

- The overall propeller shaft installation must be cost efficient and fit for use.
- The system must be straightforward to assemble in order to be cost-effective.
- Long operating life is an important aspect.
- The propeller shaft installation must have low maintenance requirements.
- Furthermore, the overall shaft installation must guarantee comfortable sailing with low noise and vibration levels.

In addition to the physical design (how the propeller shaft fits into the vessel) and the usual strength calculations, to meet these rules we also perform what we call “Whirling” and “Gap & Sag” calculations. The latter calculations are particularly important for ensuring vibration-free movement of the shaft and long operating life of the system. Our designers undertake these calculations for each individual design with maximum precision.

The Whirling calculation

The Whirling calculation is used to determine the critical speed of the propeller shaft system. The critical speed is the engine speed range at which the propeller shaft runs in

its resonant frequency range.

Operation in this speed range can lead to significant vibrations, in some cases even to fracturing of the shaft. The occurrence of shaft vibrations in the critical speed range is related to the interaction between the propeller, the shaft itself, the bearings and the gearbox. Important factors for the calculations include the number of propeller blades, the propeller weight, the position of the bearings, the bearing type and the mechanical properties of the shaft. The calculations aim to keep the critical speed range out of the operating range.

Such a system is called “subcritical”. If the critical speed cannot be kept completely out of the operating range, it must be chosen to lie at least outside the usual operating range. The affected speed range must be a range in which the system is unlikely to be run over prolonged periods.

Alignment and Gap & Sag calculation

The Alignment and Gap & Sag calculations aim to achieve optimum alignment of the propeller shaft. This is important because correct propeller shaft alignment ensures that the load on the bearings is optimal. A shaft mounted at a slant in correctly assembled bearings causes a concentrated load on the bearings, leading to accelerated wear of both bearings and shaft, as well as significant vibrations and even shaking. Determining the correct alignment may appear straightforward, but during daily use the bearings, the shaft and the gearbox will become hot, and they expand relative to their cold resting condition. A correct “cold” alignment, therefore, does not necessarily mean that a “warm” alignment also will be correct.

Gap & Sag calculations are undertaken to calculate the position of the shaft, the bearings and the gearbox under cold and warm conditions, and to determine the flange coupling sag for assembly. The system must be mounted



with the calculated slant when cold, in order to operate with the correct alignment later when warm. The Gap & Sag calculation is important for ensuring long service life and for determining the vibration characteristics of the propeller shaft system.

Lips shaft systems

In addition to oil and grease lubricated systems, also offer environmentally friendly open and closed water-lubricated systems that make use of durable DSS Manebar and JMT Sternguard seals and bearings systems.

Available systems & features

- Oil lubricated systems
- Water lubricated systems
 - Bronze liners & coated shafts
 - Stainless steel shafts
- Intermediate shafts
 - Fixed flanges
 - Loose flanges
- DSS Manebar and JMT Sternguard seals and bearings
- Hydraulic sleeve couplings
- Lineshaft bearings
- Shaft grounding device
- Turning gears
- Thrust bearings
- Shaft holding devices
- Sterntube header tanks
- Sterntubes

Benefits

- Streamlined design for yacht application (low resistance)
- Rigid construction for inland navigation and tugs (long lifetime)
- Low noise and vibration
- Easy maintenance design

- Total design of propeller/nozzle and shaft installation under one responsibility
- Installation and alignment by specialised Wärtsilä personnel is available
- Customer benefits Wärtsilä know-how of optimising a wide range of components belonging to the shaft installation such as brakes, thrust bearings, flexible coupling, turning gear and earthing systems (under one responsibility). The design includes whirling, alignment and Gap & Sag calculations.

Worldwide service and maintenance

Wärtsilä has a worldwide service network that assures you of reliable and efficient support wherever your vessel is operating. We guarantee you the quickest possible solution to any propulsion problem during the full operational lifetime of the vessel.

In addition to our own service centres (Singapore, Germany, the USA and the Netherlands), we also have an extensive international network of service and repairs licensees.

Our range of marine propulsion systems services includes:

- Retrofits and upgrades
- Metallurgical repairs
- Heavy-running modifications
- Underwater services and surveys
- 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. We are the only company with a global service network to take 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.

The Wärtsilä Group includes Imatra Steel, which specializes in special engineering steels.

For more information visit www.wartsila.com

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