

MAN Alpha

High-efficient Fixed Pitch Propellers



Engineering the Future – since 1758.

MAN Diesel & Turbo



Lowest **Total Cost of Ownership**

Increased **Efficiency**

Larger **Fuel Savings**

Higher **Reliability**

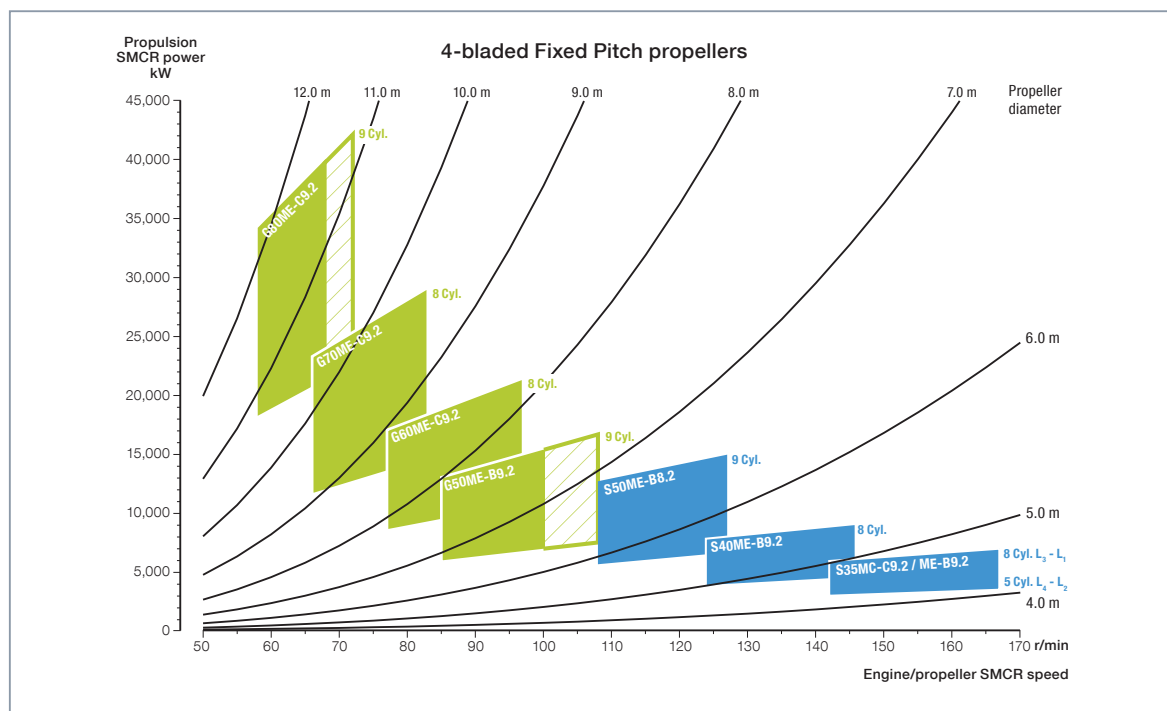


A wide range of different ship types are covered by the MAN Alpha FP Propeller range – customised to match their individual operational requirements and optimising points. The FPP generation consists of a complete range – tailor-made for the handling of engine outputs from 4,000 and up to 40,000 kW

MAN Alpha Fixed Pitch Propellers

Complete with shafting and stern tube solutions

MAN Diesel & Turbo is proud to present a Fixed Pitch Propeller (FPP) generation, which has been developed on the basis of the industry's state-of-the-art design and optimisation tools combined with the vast experience accumulated from more than 7,000 propellers. A long tradition and a proud propeller heritage date back to the first Alpha design, which was produced in 1902 and patented in 1903. Flexibility for covering efficiently any propulsion power requirement in the 4-40 MW range is our overall target. The optimised propeller and propulsion efficiencies contribute to the lowest EEDI/EEOI with decisive 'green aspects', as every gram of fuel saved by means of higher propulsive efficiency results in more energy-efficient transport and a reduced impact on the environment in general.



Power-Speed-Diameter examples for an extract of MAN B&W two-stroke low-speed engines and MAN Alpha FP Propellers

Increased Propulsive Efficiency

Hydrodynamic competences

For maintaining and developing MAN Diesel & Turbo's position in the propulsion forefront, many resources are invested and the latest advanced design tools including e.g. CFD (Computational Fluid Dynamics), FEM (Finite Element Methods) and Topology Optimisation are deployed. To verify the calculations, MAN Diesel & Turbo cooperates with the world's leading test tanks and research institutes.

Hydrodynamic design characteristics

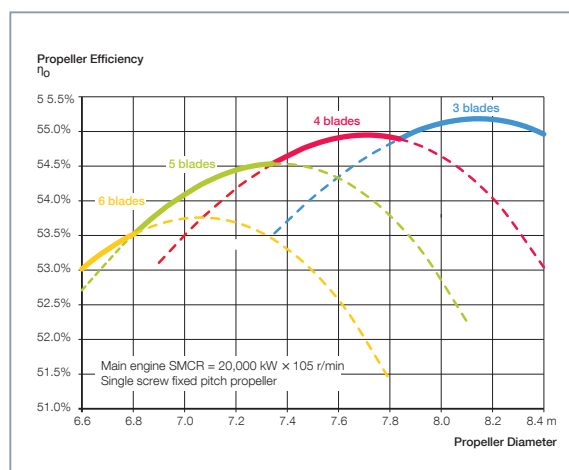
- Maximised efficiency with due respect to controlled cavitation, pressure impulses, vibration and noise
- Skew, rake, area-ratio and blade number parameters are all balanced and efficiency-optimised
- The shape of the hub is flow-optimised and reduced in size – resulting in a low drag
- The flow optimisation includes a streamlined shape of the hub and blade integration
- As always, the propeller designs are optimised to the individual ship application and wake field
- A holistic approach with engine layout considering SMCR fine-tuning, turbocharger layout, PTO solutions, light/heavy running and boosting solutions.

Operational advantages

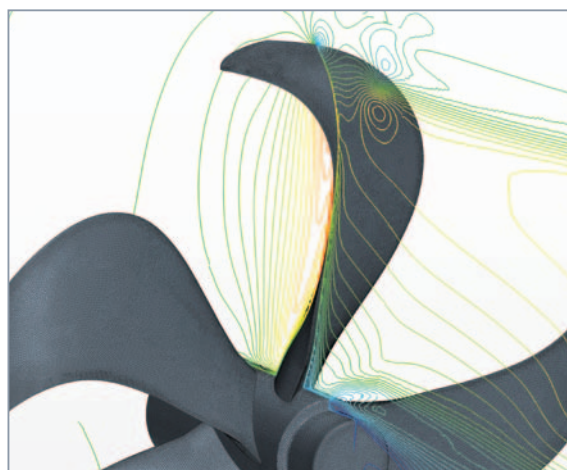
Increased propeller efficiency is translated into savings via lower fuel consumption, reduced exhaust gas emissions – or may be exploited as higher thrust for increased ship speed for a given engine power. Less power needed reduces the EEDI.

Benefits of the MAN Alpha FP Propellers

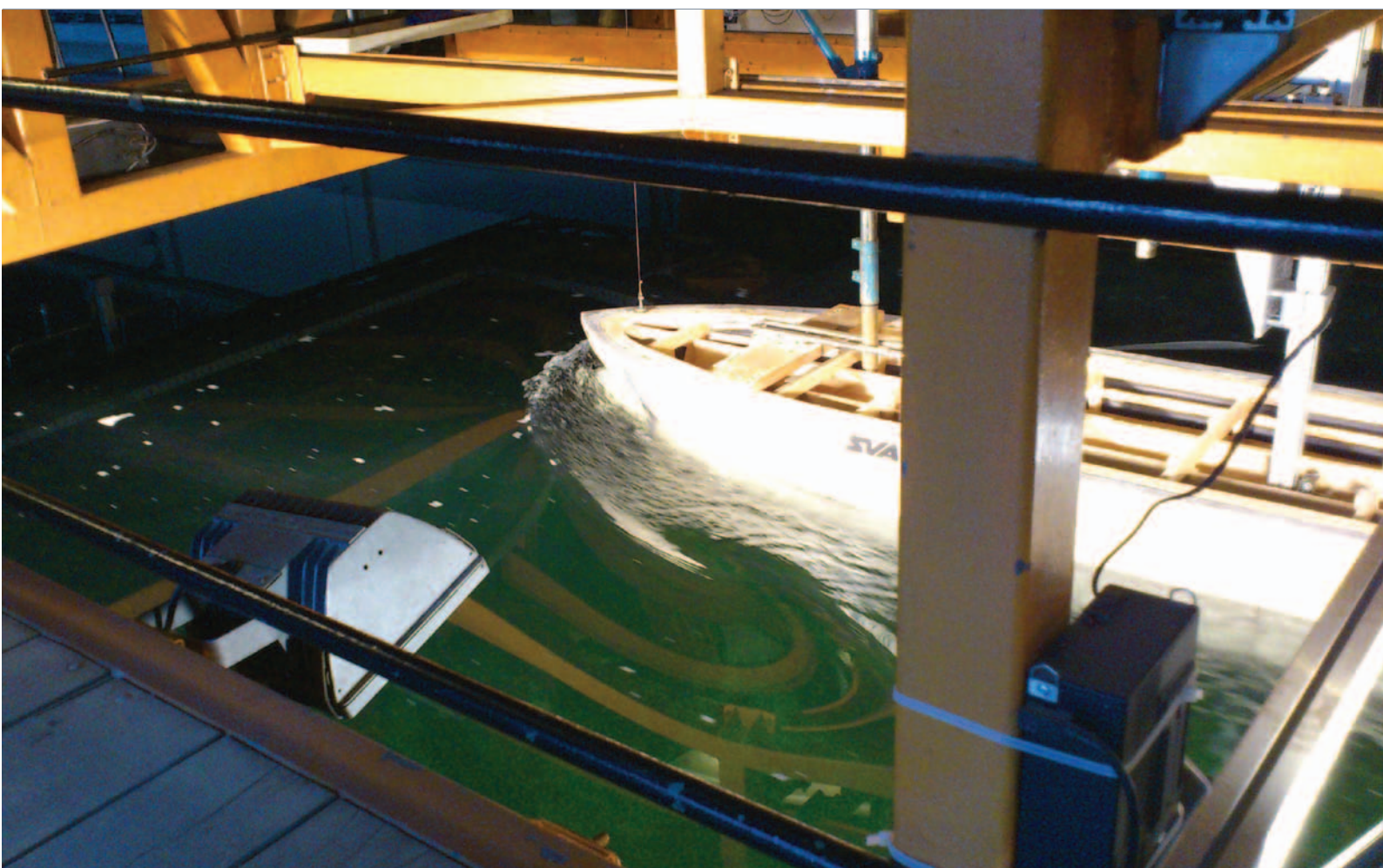
- Efficiency increased by up to 6% (Kappel design)
- Lower propeller-induced pressure impulses
- Reduced risk of cavitation – high blade loading possible for demanding applications.



Example of predicted efficiency – blade numbers and diameters



CFD streamlines during operation, showing reduced tip vortex



Hydrodynamic integration

The perfected layout and hydrodynamic propeller integration will be optimised with the ships hull and any 'flow-guiding' devices placed before the propeller, e.g. Mewis Ducts, pre-swirl fins and vortex-generators. After the propeller, the optimisation will consider integrated rudder bulbs, high-efficiency rudders, post-swirl fins or similar.



Fuel Savings and Low Noise

Innovative Kappel propeller blade designs

Optimisation: More MAN Alpha Fixed Pitch Propeller design solutions are ready – all the way from propellers based on the very advanced and unique Kappel tip fin design to conventional blade designs.

Nature of optimisation parameters

- Lower speed and larger propeller diameter
- Larger diameter and few propeller blades
- Lower pressure impulses and smaller clearance to the ship's hull – offer the deployment of a larger propeller.

Kappel design – tip fin benefits

Tip vortices are formed due to the difference in pressure between the pressure and suction side of the propeller as the water will move from the region of high pressure to the region of low pressure. The pressure on both sides near the tip will therefore equalise and the efficiency of the tip region will decrease. The Kappel propeller minimises the flow over the tip, and the outer region of the Kappel propeller therefore retains a high efficiency increasing the total efficiency

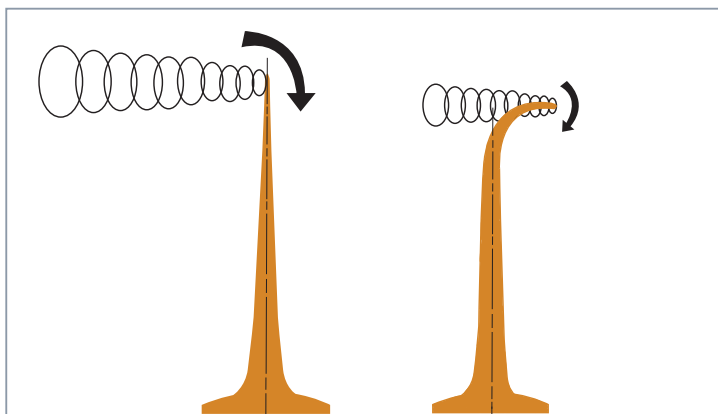
of the Kappel propeller compared to conventional propellers.

Kappel and G-type engine example

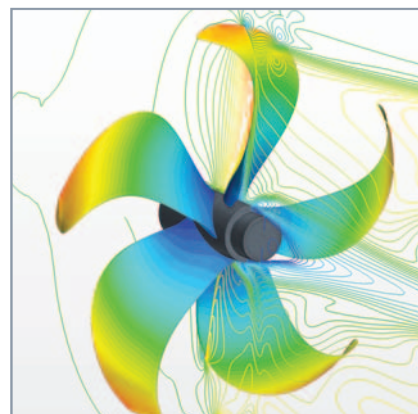
The new ultra-long-stroke MAN B&W G-type has a longer stroke and lower engine speed with increased-engine efficiency – and deploys a larger and more efficient propeller for tomorrow's energy-optimised aft ship designs. In that combination fuel consumption and CO₂ emission are reduced by up to 10%.

Low pressure impulse-to-hull advantages

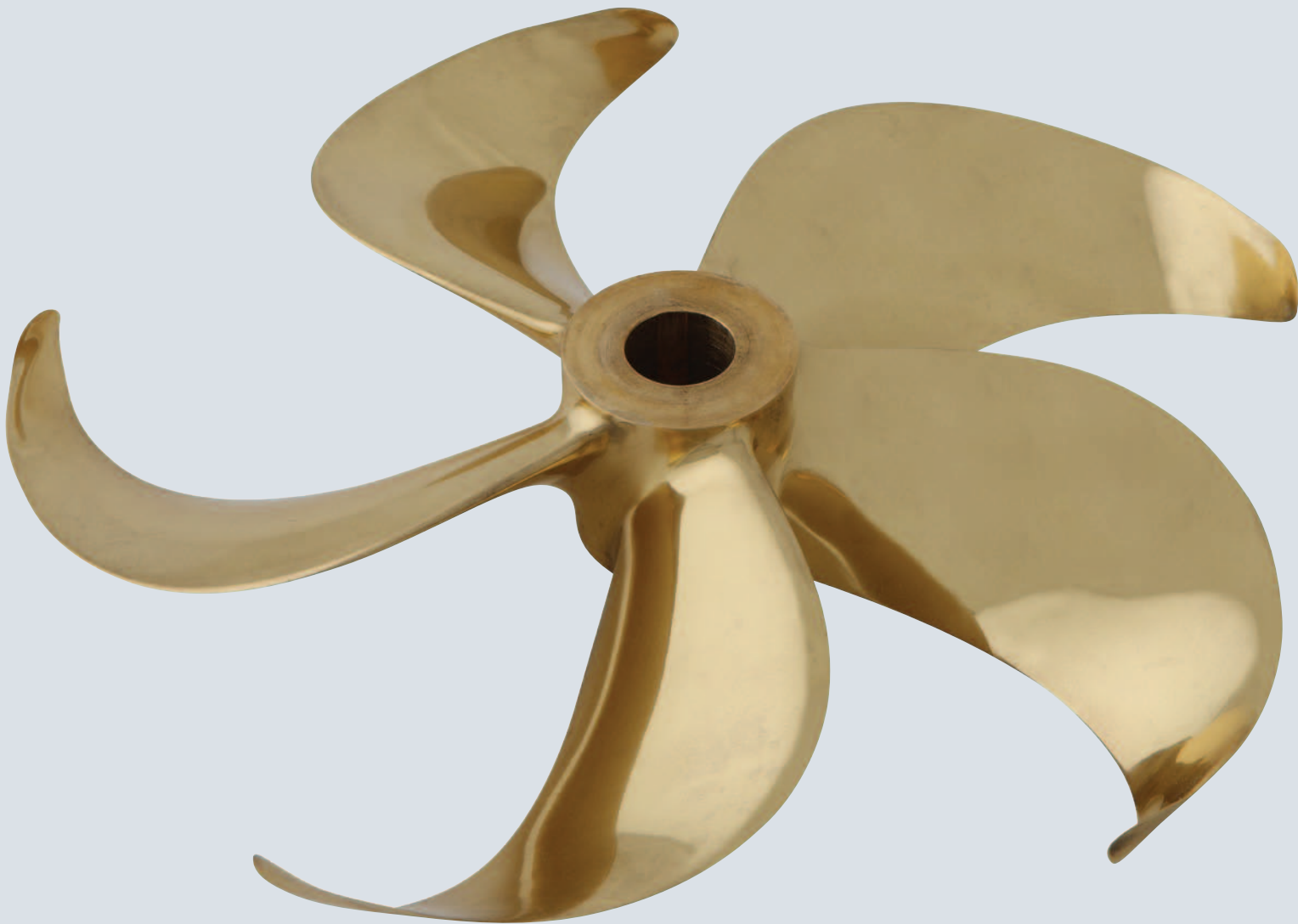
At boundary conditions with e.g. the ultra long-stroke low-speed G-type MAN B&W designs, the advanced Kappel propeller may make room for a suitable propeller installation – with a not too large propeller diameter and risk of excessive pressure impulses at hull.



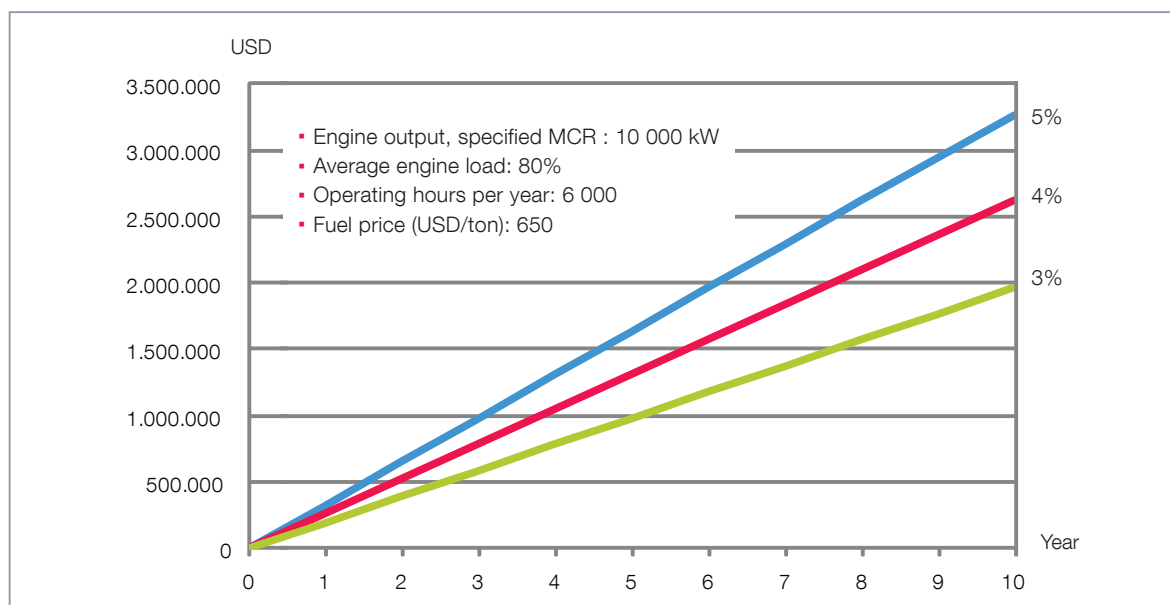
Tip vortices – conventional versus Kappel. Tip vortices are tubes of circulating water that are formed at the tip as the propeller generates thrust



Kappel propeller surface pressure distribution and streamlines



Scale model 1:28 – of a 6.4 metre MAN Alpha Fixed Pitch Propeller with Kappel blades



Fuel savings from Kappel propeller efficiency improvement
examples of 3, 4 and 5%

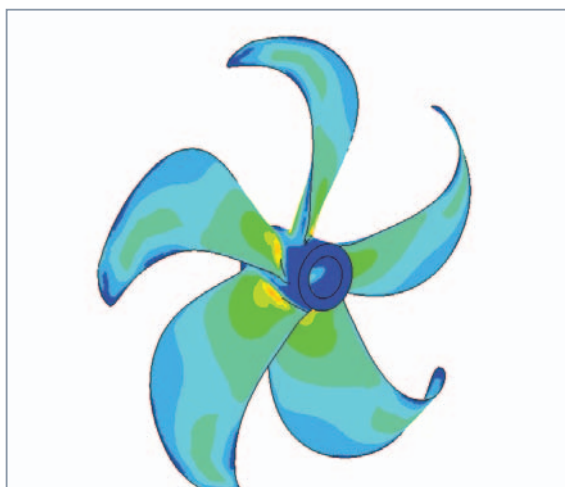
Reliable Propeller Design

Mechanical robustness and safe handling

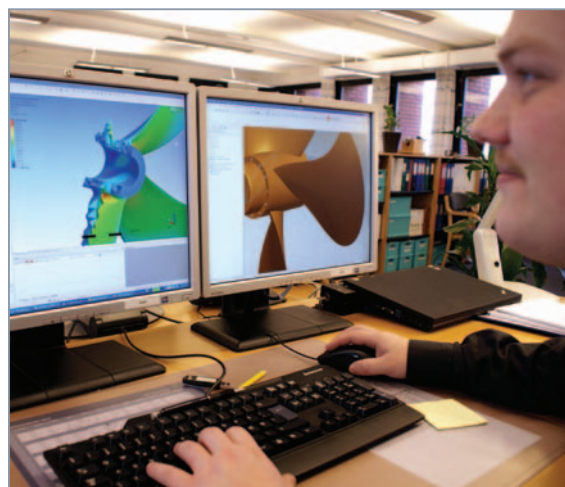
Less is more: The monoblock hub design is designed and simplified with due consideration to the propeller/shaft torque, material properties and weight. The MAN Alpha Propeller reliability and durability have always been very high, and the latest FP Propeller design follows that philosophy.

Mechanical design characteristics

- Robust approach – with ample design margins
- As standard, the propeller material is specified as G-CuAl10Ni. Other material available upon request
- Material fatigue levels are calculated for a 30 year lifetime, considering all possible external loadings in service
- Designed for ice operation according to the newest IACS and FSICR ice class notations
- Ice loadings include the influence of ice milling on the complete system's torsional response
- Compact hub/blade root design and low weight ensuring well-balanced load distribution
- Optimised for reduced material stresses during normal operation and extreme loads
- One sturdy and reliable hydraulic-tightened nut for the shaft/propeller press-fit assembly.

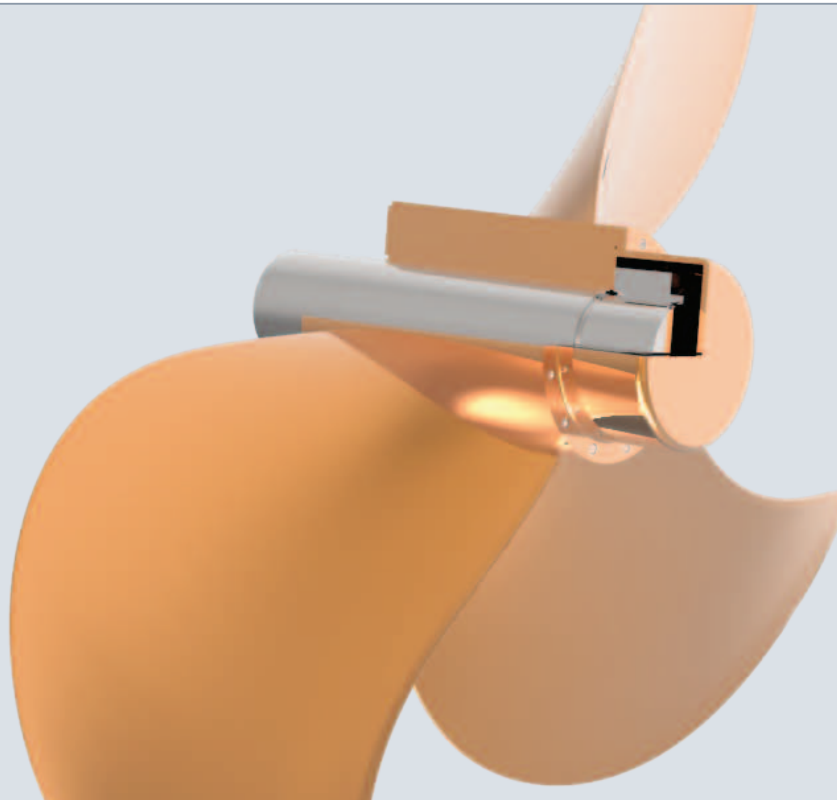


Distribution showing von Mises stresses at blade roots in a wake field under normal loading



Design processes are always performed on the basis of extensive and advanced mechanical analysis

Sturdy
Simple
Safe
Reliable



Installation and handling features for yards

- Hydraulic press-fit assembly of propeller and shaft
- Simple and safe handling is ensured during assembling at the building yard – and later at dismantling and assembling upon planned class dockings.

Operational advantages

- High reliability with few components
- Reduced bearing loads due to low weight
- Small hub dimensions resulting in high efficiency
- Pitch distribution balanced for astern efficiency
- Service and inspection friendliness.

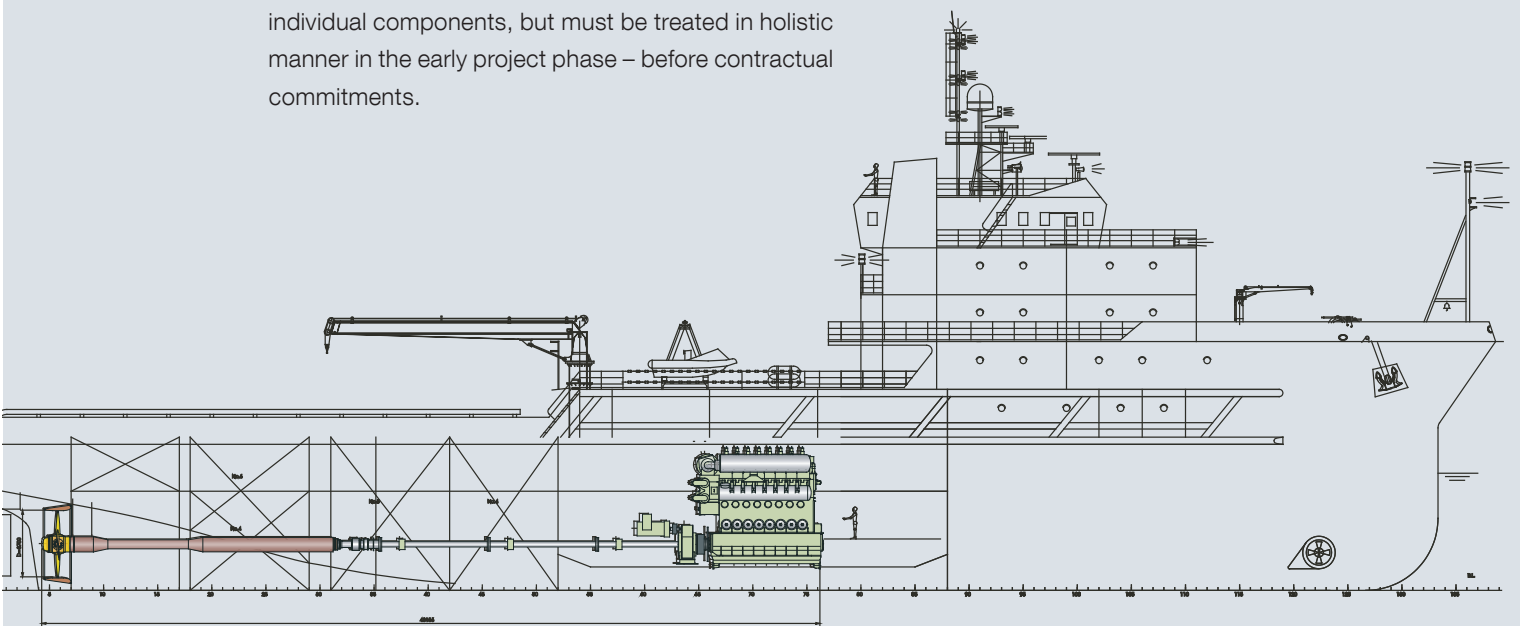


Avoid Technical and Economical Risk

The VibraSafe concept completes propulsion solutions

The nature of vibrations to be dealt with in complete propulsion system solutions

The vibration aspects inherent to complex mechanical systems like a complete propulsion plant can lead to potential problems ranging from annoyance during operation up to disastrous failures if not properly dealt with during the design phase. None of these potential problems can be solved by any single supplier of the individual components, but must be treated in holistic manner in the early project phase – before contractual commitments.



Clear customer benefits are derived from MAN Diesel & Turbo's VibraSafe concept with a holistic approach to vibrational behaviour of complete propulsion systems. Identification, control and suppression of vibrations in propulsion systems are crucial – and as an engine and propeller designer, manufacturer and licensor we have unique offerings: Advisory service – solutions – savings – safety and less risk.

VibraSafe – modification of key parameters

The VibraSafe concept ensures, that the propulsion system structural vibrations are minimised by optimising the complete plant by various steps including two-stroke engine uneven firing sequences, propeller blade number or phasing of propeller and firing order.

Torsional vibrations

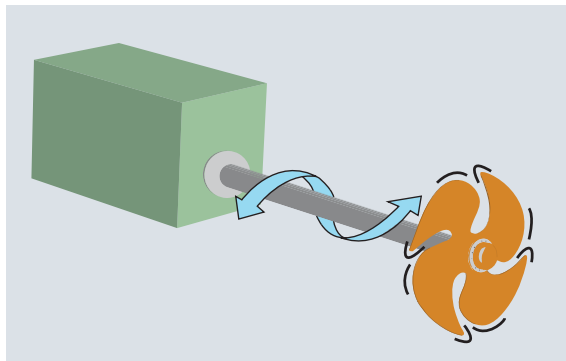
An MAN Alpha FPP shafting and propeller system will be optimised, adjusted and documented to ensure safe operation. The optimisation will be done by proper modifications to the main engine tuning or shaft line dimensions – taking the total cost structure of the complete plant into consideration.

Axial vibrations

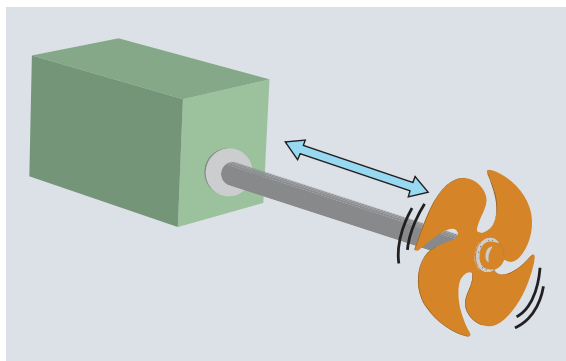
For propulsion plants driven by directly coupled 4- and 5-cylinder main engines, the axial vibrations can be excessive, if not properly counteracted, leading to annoying structural vibrations or thrust bearing failures. For an MAN Alpha FPP propulsion system, the problems will be identified and resolved by suitable modifications to the main engine or shaft line.

Whirling vibrations

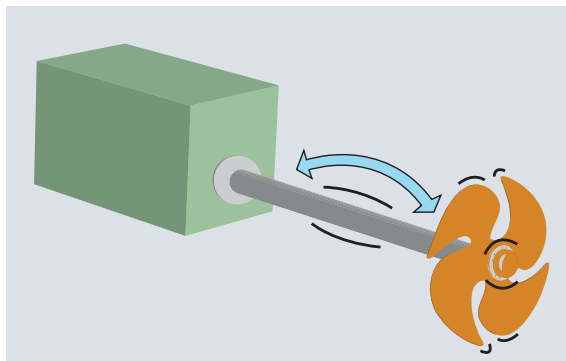
The whirling vibrations are generally non-critical for single screw installations, but may cause problems for long and slender shaft lines characteristic for twin screw vessels. Fully excited, whirling vibrations may lead to annoying structural vibrations, shaft bearing and stern tube seal problems. Whirling vibrations may be counteracted by proper layout of the shaft line and its bearings based on analysis and huge experience with complex propulsion systems.



Torsional vibrations



Axial vibrations



Radial vibrations – whirling

Plant Competence and Added Customer Value

Perfect tools and know-how for integrated solutions



The FP Propeller range offers excellent coverage

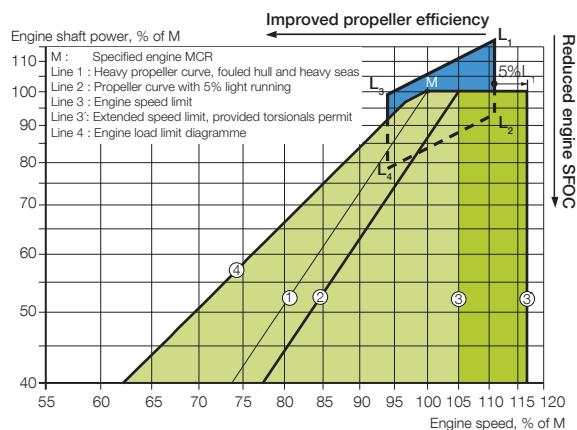
With propeller diameters from four to twelve metres, the programme handles engine outputs in the range 4,000-40,000 kW. The propeller solutions are available for diesel-mechanical two-stroke direct coupled low-speed, geared four-stroke medium-speed, and diesel-electric propulsion plants.

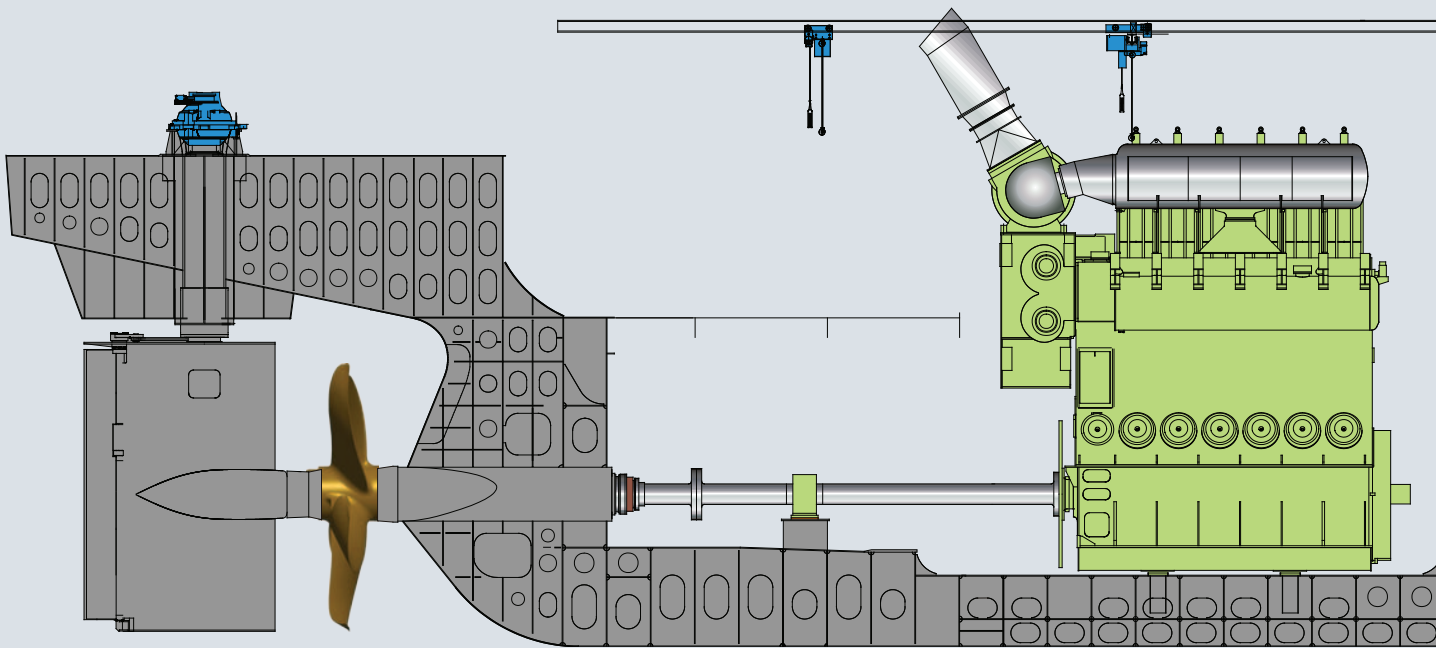
COPS – a unique layout tool

COPS is an abbreviation for Computerised Optimisation of Propulsion Systems. MAN Diesel & Turbo's COPS expert system ensures better and more accurate pre-optimisation of hydrodynamic/mechanical aspects, integrating e.g. statistical data, torsional vibration data of the complete propulsion system including main engine parameters. Engine layout and load diagram example for a two-stroke low-speed engine is shown to the right.

Prepared for biodegradable stern tube lubrication

The stern tube lube oil systems are adapted to both biodegradable oils and ordinary mineral oils. Switching from one type to the other is possible without any requirements for component changes. Optional stern tube systems based on water lubrication are available.





Tailored propeller systems and plant solutions: Efficient and compact propulsion packages with optimised installation dimensions are offered with consideration to e.g. ships' hull shape, engine room, shafting and stern tube equipment.

Optionals and special installation requirements

MAN Diesel & Turbo masters a vast number of disciplines in relation to optimisation of aftship parameters and special installation requirements, such as:

- Rudder design interaction
- Integration to rudder bulbs
- Wake equalising ducts
- Customised bollard pull and speed nozzles
- Guide vanes for wake field improvements
- Customised stern tube solutions – water or bio oil
- Special shaft brake and locking devices
- PTO solutions from main engine or tunnel gear
- Hydrostatic lubrication of stern tube bearings for low shaft speeds.



Quality and Production Control

Perfect specifications and proven suppliers

No compromises in propeller manufacturing

From the pool of MAN Diesel & Turbo's selected suppliers and manufacturing partners, we are cooperating with proven and well-established organisations in Europe and Asia. To ensure the highest level of safety, availability and continuity, all suppliers are quality-screened, audited and approved via MAN Diesel & Turbo's extensive supplier verification system.

For propellers, the International Standard Organisation has introduced a series of manufacturing standards according to ISO 484, from where different accuracy classes can be selected by the customer. As standard, MAN Alpha propellers will be manufactured and customised with 'high accuracy' class I tolerances and finished with a surface roughness according to class S 'very high accuracy'.

Highest MAN standards

Like for the extensive and advanced production of MAN Diesel & Turbo's diesel, gas and dual-fuel engines, turbomachinery, gas turbines, steam turbines, compressors, turbochargers and CP Propellers – including the genuine after-sales spare parts – the MAN Alpha Fixed Pitch Propellers are also produced only by high-end foundries and propeller manufacturers. The specialist supply of monoblock MAN Alpha Fixed Pitch Propellers is characterised by:

- Class approval by all major Classification Societies
- A thoroughly monitored pattern-building and casting process from start to finish
- High-quality castings
- A selected bronze-alloy material – G-CuAl10Ni with perfect casting, machining and fatigue properties.

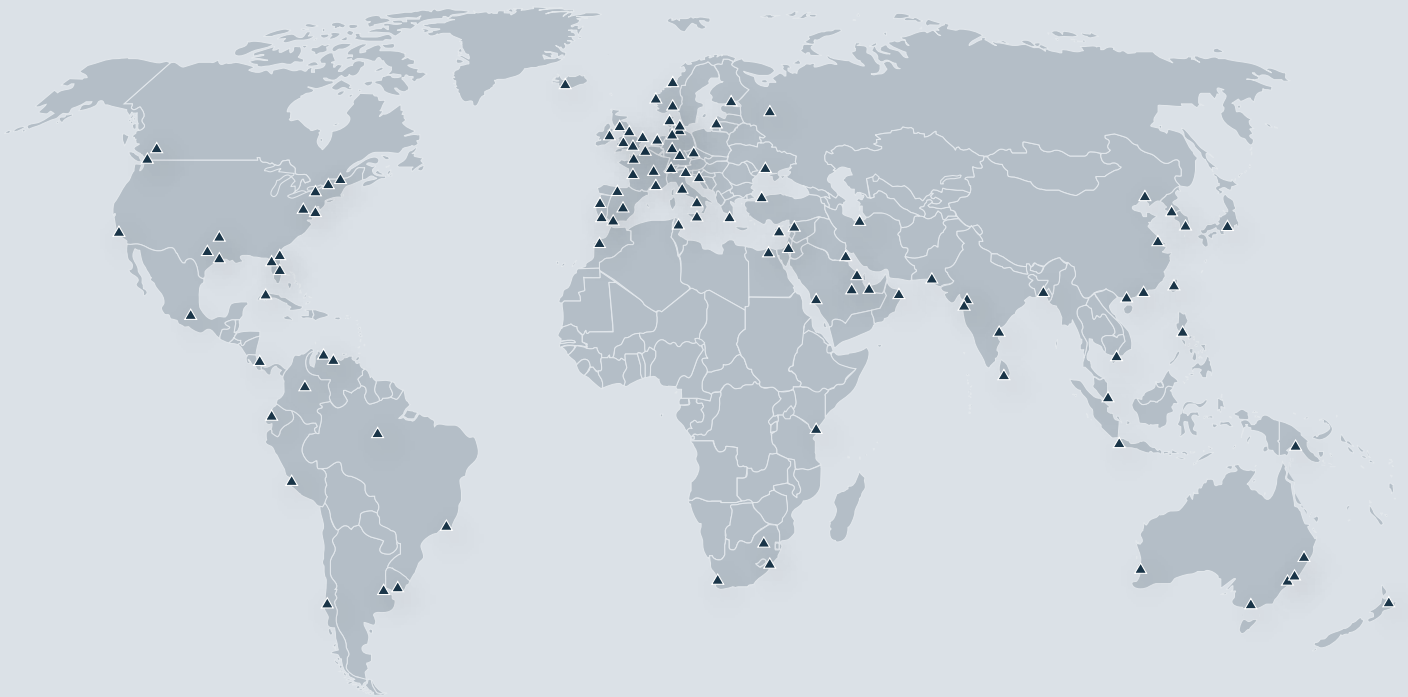


MANAGING RISK



Worldwide Propeller Service Support

PrimeServ hubs at all trading hot spots



PrimeServ's worldwide service support

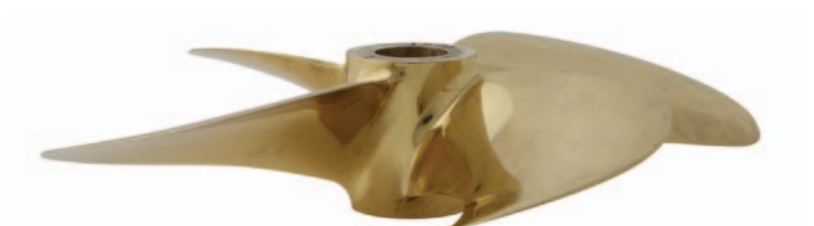
With more than 150 PrimeServ service stations and service partners worldwide, plus a growing network of PrimeServ Academies, the MAN Diesel & Turbo organisation is highly committed to expanding and developing the most efficient and accessible after-sales organisation in the business.

For propellers, as well as for engines, gearboxes and control systems – PrimeServ provides:

- Delivery of high-demand spares within 24 hours
- Fast, reliable and competent customer support
- Ongoing training and qualification of personnel
- Global service, open 24/7, 365 days a year.

Propeller retrofit packages

A wide range of propeller retrofit and upgrade solutions are offered for your existing fleet. Take advantage of new designs and technology or general product improvements, matching e.g. new requirements or changed operating profiles for your ships. Attractive investments are available with short payback time.



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MAN Diesel & Turbo

Niels Juels Vej 15
9900 Frederikshavn, Denmark
Phone +45 96 20 41 00
Fax +45 96 20 40 30
info-frh@mandieselturbo.com
www.mandieselturbo.com
www.manalpha.com