HIGHLY EFFICIENT
MAN ALPHA PROPULSION

PROPELLER
AFT SHIP SOLUTIONS
POWERING THE WORLD RESPONSIBLY
MAN Diesel & Turbo is the world’s leading provider of large-bore diesel engines and turbomachinery. Our portfolio includes two-stroke and four-stroke engines for marine and stationary applications, turbochargers, propellers and propulsion packages, as well as gas and steam turbines, compressors and chemical reactors.

Our propeller and aft ship products offer a wide range of high-efficiency propulsion solutions and services – attractive for both current, new and future ship designs, and for retrofit upgrading of existing propeller and aft ship installations.

We are constantly committed to increasing the performance and the energy efficiency of our solutions. Increased propulsive efficiencies provide savings and reduced environmental footprints via lower fuel oil consumptions and reduced exhaust gas emissions.
CONTROLLABLE PITCH
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Propelling ships and trade on all seas and waterways

From the early days of invention and shipboard deployment of a ‘screw propeller’, the principle of which can be dated back to Archimedes – the propellers have just developed decade by decade and grown in size, power density and design complexity. The propellers’ transmission of rotational power and torque into thrust and ship propulsion turned out more and more efficiently.

Today’s propeller demands and propulsion benchmarks for the individual ship applications have become very specific, further refined and optimized than ever before. Be it for example rough pulling power required by anchor handling tug supply vessels or efficient and super silent high-comfort sailing for cruise liners.

MAN Diesel & Turbo has delivered more than 7,000 propellers for the propulsion of ships at all corners of the globe – operating under various and extreme environments ranging from tropical fresh water to ice-packed arctic climates, and the more ordinary and dominating trades in oceanic, coastal, inland waterway shipping or workboat services via shallow waters, lakes, channels, rivers and harbors. With our MAN Alpha propeller designs, we are ready for the future challenges and demands regarding climate change, development of new ship designs and changes to global shipping.
A versatile and high-efficiency propeller program
The MAN Alpha CP Propeller designs are effectively embracing the power range up to 40,000 kW per shaft line. With no less than 23 different hub sizes, a cost and performance optimal solution is always offered. The standard series of propellers are 4-bladed configurations, with additional 3- and 5-bladed variants available. Further hub designs for the full feathering pitch setting possibility exist. Our standard blade/hub materials are Ni-Al-Bronze, with stainless steel offered as an option - and for special demands our propellers are ice-strengthened, designed and tailored to meet specific class rules up to the highest polar ice classes.

Shaft line systems with tail shafts, intermediate shafts and bearings are customized to a wide range of applications, and e.g., stern tube lube and sealing systems being based on various types of oil, biodegradable oils or water.
POWER FLEXIBILITY AND MANEUVERABILITY
Efficient propelling of vessels with varying propulsion demands

MAN Alpha CP Propellers are ideal for ships with varying operational modes and propulsion patterns ranging from dynamic maneuvering and bollard pull conditions to economical part-load service and full speed steaming. Our CPPs are versatile propulsors which meet the challenges of many different applications – and deliver excellent propulsion performance and efficiency at minimal vibration and noise levels.

Benefits

- Fuel savings and reduced emission levels
  High propulsive efficiency equals low fuel consumption and less exhaust gas emission
- Propulsion flexibility and highest overall efficiency
  Cutting-edge hydrodynamic blade designs as basis for top propulsion performance and versatility in operating profiles
- High comfort for passengers, crew and cargo
  Maximzed propeller efficiency with due respect to controlled cavitation, pressure pulses and noise
- Low wear rates and very long lifetime
  Secured by robust and reliable materials and components – designed with ample margins of strength

Applications

- COASTAL TANKER
- RO-RO VESSEL
- DREDGER
- LNG TANKER
- YACHT
- FERRY
- CRUISE
- WORKBOAT
- NAVAL DEFENSE
- ICE BREAKER
- OFFSHORE
- FISHING
- RESEARCH / SURVEY
- CHEMICAL TANKER
Customization based on sturdy and high-efficiency designs

The MAN Alpha FP Propeller designs effectively cover the full engine portfolio of MAN Diesel & Turbo. The propeller series are available in 3-, 4-, 5- and 6-bladed monoblock configurations casted in a single piece with hub and blades. Our standard material is specified as Ni-Al-Bronze, but other material alloys are available on request.

For special high ice-class ship and propulsion applications tailored FP Propeller designs with Bolted Blades or Bolted Adjustable Blades can be offered. Bolted Blades for possible exchangeability without docking the vessel and Bolted Adjustable Blades for the additional possibility of adjusting the ‘fixed’ pitch setting.

Shaft line systems with tail shafts, intermediate shafts, bearings, shaft alternators and couplings are always customized and optimized to the individual powertrain and ship.
ROBUSTNESS AND EFFICIENCY
Long-haul propulsion at lowest operational costs
MAN Alpha FP Propellers are ideal for ships where highest efficiency and sturdy simplicity is of top priority. The obvious choice for ocean-going vessels with straight forward propulsion plants and operational patterns with long-haul sailing at service speeds at or around the propeller design and layout point, close to or spot on the maximum propulsive efficiency. Straightforward FPPs are, however, also specified for smaller yachts and workboats.

Benefits
- **Lowest TCO (Total Cost of Ownership)**
  Operational savings are secured by a highly efficient design with few wearing parts – robustly designed for high reliability and longevity
- **Minimum fuel consumption and emission levels**
  Maximized propeller efficiency ensures reduced fuel consumption and a reduction in the exhaust gas emission levels
- **Efficiency optimized by design**
  The superior efficiency from the streamlined and smallest hub diam./propeller diam. ratio is exploited with due respect to controlled cavitation, pressure pulses and noise

Applications
- CONTAINER VESSEL
- CRUDE OIL TANKER
- OFFSHORE
- BULK CARRIER
- PRODUCT TANKER
- DRY CARGO VESSEL
- YACHT
- CHEMICAL TANKER
- CAR CARRIER
- OPV ICE BREAKER
- WORKBOAT
Unique propeller blade design gains the highest efficiencies

MAN Diesel & Turbo is offering the fuel-saving Kappel program for FP Propellers and for CP Propellers – meaning that the full range of MAN Alpha propellers is available with propeller blades of Kappel design. For retrofit upgrades numerous monoblock FP Propellers have been exchanged with Kappel, and also other makes of CP Propellers have successfully been fitted with the more efficient Kappel blades.

Geometrically, the Kappel propeller design is characterized by non-planar lifting surfaces and blade geometry, by which the blade profile can be better aligned to the complex flow patterns in the wake field generated by the ship’s hull. The Kappel design originally used design inspiration from birds’ wing tip feathers and principles of up-turned aircraft winglets. As a result, the propeller blades which are smoothly curved to the suction side provide a higher lift with reduced energy loss from the tip vortex flow.
Kappel
A LIFT TO THE UPPER CLASS
Kappel means superior propulsive efficiency

Propellers with the Kappel blade designs are ideal for high-end ship designs where highest efficiency, upper energy classes, lowest consumptions and minimum environmental footprints are prioritized. The increased propulsive efficiency provides power reductions, savings via lower fuel consumption, reduced exhaust gas emissions or can be exploited as higher thrust for increased ship speed at a given engine output.

Benefits

- **Lowest fuel consumption and emission levels**
  Maximized propeller efficiency ensures reduced fuel consumption and a reduction in the exhaust gas emission levels

- **Higher charter values and market attractiveness**
  Lowest EEDI/EEOI and higher ‘energy classes’ can be obtained for Kappel propelled vessels. Both newbuildings – and existing vessels being retrofit upgraded, can benefit and be prepared for the future with lower consumptions and a green image

- **Increased comfort**
  Lower propeller-induced pressure pulses to the ship’s hull will reduce the onboard noise and vibration

- **Propeller diameter increase**
  Lower pressure pulses allow smaller clearance to the ship’s hull – and offer deployment of an even larger and more efficient propeller

Applications

- CHEMICAL TANKER
- CONTAINER VESSEL
- CRUDE OIL TANKER
- FERRY
- BULK CARRIER
- PRODUCT TANKER
- NAVAL DEFENSE
- RO-RO VESSEL
- DRY CARGO VESSEL
- CAR CARRIER
- LNG TANKER
- CRUISE
CLEAN SHIPPING IS THE FUTURE
Any emission harmful for the environment must be further reduced or completely eliminated in the days ahead. The continued natural development in the direction of more green targets and restrictions will influence the maritime transportation and shipping industry. Future legislation will be driven to even stricter ‘clean shipping criteria’ by governments, non-governmental organizations, IMO, port authorities, ship owners, operators, customers and consumers – demanding actions to minimize the risk of pollution and prevent possible environmental damage.

A number of leakproof and environmentally friendly stern tube systems are available with our propellers. We provide stern tube solutions for water lubrication and systems approved for lubrication with biodegradable non-toxic lubricants. All our propellers can be delivered to comply with the VGP (Vessel General Permit) from US EPA (United States Environmental Protection Agency).
Improving the flow to and from propellers

MAN Diesel & Turbo masters a vast number of disciplines in relation to optimization of aft ship parameters and special installation requirements. The perfectioned layout and hydrodynamic propeller integration are always optimized with the ship’s hull and any flow-guiding Efficiency Improving Device (EID) and its position:

- Placed before the propeller
  Pre-swirl and wake equalizing ducts, pre-swirl fins or vortex generators
- Placed at the propeller
  A propeller nozzle, a fairing cone, or propeller hub cap fins can be deployed
- Placed after the propeller
  The optimization can include high-efficiency rudders and twisted rudders, integrated MAN Alpha rudder bulbs, post-swirl fins or similar

More EIDs can be combined in advantageous ways with tailored propeller designs. Tank test results and real-life operations show e.g., that the integration of Kappel designs perform in beneficial synergy as open propellers with a number of EIDs. For ducted operation with propeller nozzles, however, our propeller blade designs are specifically optimized for pulling performance exploiting a more wide-chord layout with extended chord lengths towards the blade tip.
Examples of efficiency gain from individual EIDs

Various solutions on the market today – and how they can be combined

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<th>Pre-swirl fins</th>
<th>Wake equal. duct</th>
<th>Kappel design</th>
<th>Hub cap fins</th>
<th>AHT nozzle</th>
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Can be combined
Can sometimes be partially combined
Should not be combined
Propeller and aft ship offerings - tailored with EIDs

Successful combinations have proved their contributions to propulsion power savings and an ever growing experience pool on EID implementation has accumulated during the recent years – both for newbuilding installations and for retrofit upgrades of existing vessels. Ducted and open propellers, propeller designs with low skew, high skew, and the Kappel design have all been optimized to perform efficiently with the individual ships’ hull shapes, EIDs and operational patterns of the vessels.

Examples of efficiency benefits of Kappel propellers and EIDs

- Kappel propeller alone
  - Efficiency increased by up to 6 %
- Kappel propeller with MAN Alpha Rudder Bulb
  - Efficiency increased by up to 9 %
- Kappel propeller with pre-swirl wake equalizing duct
  - Efficiency increased by up to 11 %
- Kappel propeller with pre-swirl wake equalizing duct and MAN Alpha Rudder Bulb
  - Efficiency increased by up to 12 %

and even more for retrofit upgrade solutions.
**AHT – Alpha High Thrust nozzles**

For optimizing the propeller thrust and pulling performance of specialized vessels, customized AHT nozzle designs are offered for boosting the vessels' working patterns. The AHT nozzle designs offer superior performance compared to the ‘19A’ propeller nozzles, which have been common standard in the marine industry. The increased bollard pull achieved when using the AHT nozzle is not only a result of the CFD-optimized nozzle profile, which is double-curved on both the inner and outer surface. Other contributing factors are e.g., nozzle length/diameter optimization, nozzle built-in support, aft ship lines adaption, and tilting and azimuthing of the nozzle.

High-thrust and speed customized AHT nozzle installations are popular for vessels requiring increased pulling power and still limited free-sailing resistance.
PUSH, PULL AND SUPPLY
Superior pulling performance for heavy duty vessels

Our range of ducted propellers and AHT nozzles are the thrust boosters for high performance vessels enabling bollard pull and towing force at very high levels. The propeller blades are specifically designed and tailor-made for optimized operation with the AHT nozzles – customized into the aft ship vessel designs. The blade number optimization and selection is also a result of the hydrodynamic integration and both our Controllable Pitch and Fixed Pitch Propeller concepts are available.

Benefits

- **More pulling power**
  Due to the increased propeller thrust - especially at lower ship speeds
- **Reduced fuel consumption**
  A specific bollard pull or towing force can be delivered at a reduced power output and engine rating
- **Individual customization - balanced to application and aft ship design**
  Provides the perfect match of ahead and astern performance together with reduced free-sailing resistance
- **Retrofit potential: gain up to 23.5 % more bollard pull**
  Possible when upgrading older nozzles to the AHT design combined with state-of-the-art MAN Alpha propeller blades optimized for nozzle-operation

Applications

- FISHING TRAWLER
- ANCHOR HANDLING TUG SUPPLY
- DREDGER
- TUG BOAT
- SEISMIC RESEARCH / SURVEY
- ICE NAVIGATING VESSEL
Power and maneuverability – right at your finger tips
Reliable and accurate propulsion control all the way – from the navigator’s finger tips to the propeller tips. Any maneuvering order given is translated into electrical speed setting, pitch or clutch signals, governing the hydraulic servo circuits of engine/gearbox and propeller systems. The Alphatronic 3000 Propulsion Control System offers unrivaled “Human to MAN” interface with ergonomically logic and clear layout of panels, levers, buttons, displays and touch screens ensuring safe and efficient maneuver interactions.

Alphatronic 3000 controls both straightforward CP Propeller and FP Propeller installations and can be customized for various propulsion application combinations with MAN low-, medium- and high-speed engines in a wide range of single- and multi-propeller diesel-mechanical, hybrid or diesel-electric propulsion setups.
ALPHATRONIC IN CONTROL
**New levels of design and functionality**

The inherent ‘electrical shaft system’ between control levers ensures synchronization, bumpless and safe transfer of maneuver responsibility from one control station to another. Automatic thrust and engine power synchronization is available for twin propeller plants. The configurable touch screens meet a wide range of customer-specified functions for both controllable pitch and fixed pitch propeller based propulsion plants. The modular Alphatronic 3000 panel concept fits elegantly into bridge and engine control room console layouts, and the installation is made easy for consoles with limited space and free depth. The control panel functionality is pre-tested and made ready for shipyards’ plug-and-play installation.

**Benefits**

- Safe and reliable ship maneuvers
  Quick system response ensures efficient vessel maneuverability
- Saves fuel and minimizes emissions
  Economic operation due to optimized engine load and thrust control, and the deployment of an optional speed pilot feature with GPS interface for various economy-sailing modes
- Engine lifetime protection
  The engines are protected against overload in general and further thermal protection is provided via controlled running-up and -down programs

**Applications controlled by Alphatronic 3000**

- **TWO-STROKE LOW-SPEED**
- **CP PROPELLER**
- **FP PROPELLER**
- **PTO**
- **FOUR-STROKE MEDIUM-SPEED**
- **TWIN-IN SINGLE-OUT**
- **POWER BOOST**
- **FOUR-STROKE HIGH-SPEED**
- **SINGLE- AND MULTI-PROPELLER**
- **PTH**
- **HYBRID PLANTS**
Advanced tanker design loaded with flexibility and efficiency

Propulsion plant competence example: Mastering the disciplines of all powertrain and aft ship elements offers the possibility of deploying their synergies to obtain the most efficient and flexible propulsion solution. Our recent delivery for a state-of-the-art VLEC (Very Large Ethane Carrier) represents such an example with a single-propeller single-engine propulsion system. The vessel is designed to the highest propulsive efficiency and prepared for multi-fuel operation on HFO, MDO, MGO, as well as ethane and LNG.

From a propeller and aft ship perspective, the vessel is propulsion-optimized with a twisted leading edge rudder fitted with MAN Alpha Rudder Bulb, a MAN Alpha 7.6 meter Kappel CP Propeller with fairing cone, stern tube and shaft system with shaft alternator – powered by a two-stroke MAN B&W 6G60ME-GI engine.
Propulsion and power package including the complete propeller and aft ship system driving a Very Large Ethane Carrier:

1. MAN Alpha designed rudder bulb on ships rudder
2. MAN Alpha fairing cone on propeller hub
3. MAN Alpha Kappel CP Propeller, type VBS1810
4. Oil-lubricated stern tube with liners and aft seal
5. Welding ring, adaptor flange, oilbox and forward seal
6. MAN Alpha hydraulic coupling flange type ODS650
7. Journal bearing
8. Shaft alternator, 3,000 kW
9. Rotor shaft for alternator
10. MAN B&W engine type 6G60ME-C9.5-GI-Tier III with SCR
11. Alphatronic 3000 propulsion control system, ECR and bridge
12. Hydraulic power unit for propeller system, type 1,500 L
13. MAN 6L28/32H Holeby GenSet (4 sets in total)
MASTERING HIGH, MEDIUM AND LOW
Complete propulsion packages for all engine concepts

A vast knowledge and development base has accumulated during our many years with focus on the projecting, design, optimization, sales, order processing, supply, commissioning and after sales servicing of complete propulsion systems. Today’s core portfolio of propeller and aft ship products and system solutions integrates perfectly with the wide range of MAN Diesel & Turbo high-speed, medium-speed and low-speed engine designs. No standard concepts fit all.

Tailored solutions are available for individually optimized applications ranging e.g., from a MAN 175D high-speed-powered patrol boat and a MAN 32/44CR medium-speed-powered container vessel to a MAN B&W G45ME low-speed-powered tanker. System competence makes the difference in any case!
CUSTOMER BENEFITS
Added value for shipyards, owners and operators

**Take direct advantage of**
- Reduced installation costs
- Reduced operational costs
- A single point of contact to one responsible organization

**Shipyards’ projecting benefits**
- Pre-project plant conception, power and speed prognosis and estimation of propulsion package parameters with a high degree of system accuracy.
- Layout of auxiliary systems and package engineering based on integrated overall propulsion expertise.
- Propulsion equipment interfaces and integration matters are solved at an early stage.
- Torsional vibration calculations and possible special ice class requirements are dealt with in standard quotations.
- Shaft alignment and calculations for optimal bearing loads and positions are provided.
- One competent contract partner during projecting, planning, purchasing, installation, and commissioning of the equipment.
- Optimal ‘package logistics’ ensure safe supply of all components – and possible single batch delivery matching the installation schedule.

**Shipyards’ handling benefits**
- Thorough handling of engine, gearbox, propeller and control system leads to minimal shipyard work on a reduced number of connecting points.
- One package of documentation providing information on foundations, piping, electrical wiring, auxiliary systems, and covering on-board interfaces and alignment of the entire power train.
- One team of commissioning engineers responsible for the propulsion package during start-up and sea trials.
- Less shipyard responsibility and administration – minimal engineering, installation work and installation costs.

**Owners’ operating benefits**
- Optimal operating economy is ensured thanks to the optimized layout of engine, reduction gearbox, propeller, propulsion control and safety system.
- Operating reliability, durability and predictable service intervals are assured by a tailored package solution.
- One company supplying, testing and commissioning the package, together with the subsequent lifetime accumulation of performance and operating experience for the propulsion components.

**Owners’ service benefits**
- One package of service documentation, maintenance programs and spare parts catalogues for the propulsion equipment – as the basis for efficient service routines and identification of parts.
- One service organization addressing all propulsion plant support requirements via the worldwide network of MAN PrimeServ representatives, authorized workshops and service centers.
- Service contracts are offered in more levels from the basic to the full and very extensive, with all scheduled services performed by MAN PrimeServ.
- Our MAN PrimeServ Academy offering complete propulsion system instruction and training for engineers, operators and service staff.
**RETROFIT AND UPGRADE**

**Make your vessels fit for the future – at the next docking**

In many cases economy upgrading and derating have great fuel saving potential, short payback time and can advance existing vessels to higher energy classes. Efficient retrofit solutions may range from relatively simple propeller or blade exchange to more extended concepts where our system competence and holistic view of the complete propulsion plant – including engine, turbocharger, PTO, gearing, shafting, propeller and aft ship equipment – really pays off.

As an example six Suezmax tankers gained 17.5% fuel savings with an upgrading and derating solution implemented at their 5-year dockings. A complete package with Kappel propeller, pre-swirl and wake equalizing duct, main engine upgrading with new turbochargers and fuel nozzles, increased compression ratio and optimized valve timing.

With the new Kappel propellers, new intermediate shafts were installed to match and countermeasure the torsional vibration patterns from the 3-bladed propellers, shaft lines and derated engines. After the technical sea trial, NOx measurements were performed on the first ship in order to produce a new (IMO) Technical File.
MAN PrimeServ

MAN PrimeServ is the dedicated MAN Diesel & Turbo service brand. Via a network of over 100 service centers worldwide, MAN PrimeServ provides 24/7 service across the globe. Our range of services includes technical support, consulting and OEM spares, as well as maintenance, repair and individualized service plans like our PMC, Propeller Maintenance Concept. The PMC service packages for propeller maintenance are offered in connection with 5 and/or 10 year inspections – in accordance with the docking periods recommended by the classification societies. Similar concepts (GMC and AMC) are available for our gearboxes and Alphatronic controls.

MAN PrimeServ’s aim is to provide:

- Prompt delivery of high-demand spare parts within 24 hours
- Fast, reliable and competent customer support
- Individually tailored O&M contracts
- Ongoing training and qualification of operators and maintenance staff
- Global service, 24 hours a day, 365 days a year
- Diagnosis and troubleshooting with our high-performance Online Service
As already mentioned, retrofitting and upgrade services are offered to bring propellers, propulsion systems, engines and turbochargers already in service up to the very latest standards of performance and efficiency. Using the latest digital technology, we enable you to maximize the performance and availability of your MAN equipment by accessing real-time data analysis, remote support and rapid solutions. We also offer an extensive range of training courses at MAN PrimeServ Academies around the world.

For more information please visit: www.man.eu/primeserv
GET IN TOUCH AND PROPEL AHEAD

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Propeller & Aft Ship

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Retrofit & Modernization

Visit our website and learn more about upgrading and benefits.
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MAN Diesel & Turbo
Niels Juels Vej 15
9900 Frederikshavn, Denmark
Phone +45 96 20 41 00
info-frh@mandieselturbo.com
www.manaalpha.com | www.marine.man.eu