Rolls-Royce

Moving your business in the right direction

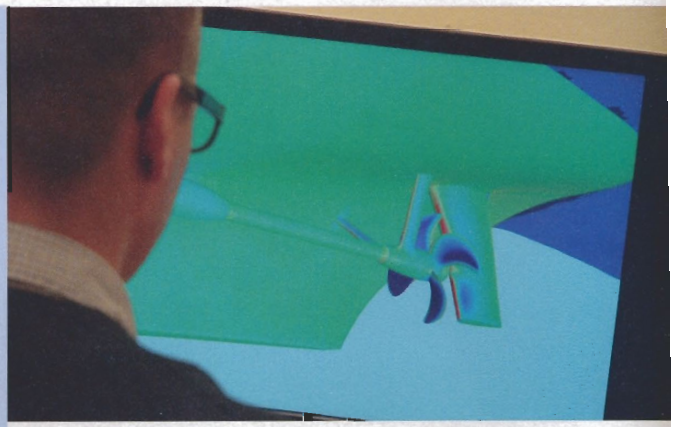
propulsion

The force in marine propulsion

Rolls-Royce is the leading developer and supplier of propulsion equipment. A supplier who has the capability to meet your demands regarding performance and cost-effectiveness.

Ongoing research and development is the key to the success of Rolls-Royce, with a total investment in the overall product range exceeding £6 billion in the last decade. Combined with a technology and skills base accumulated over 100 years, Rolls-Royce today has the broadest range of propulsion products, services and expertise in the world.

The Rolls-Royce commitment to customer satisfaction is your guarantee of the highest levels of quality, expertise and performance.
And with a truly international presence Rolls-Royce provides service and maintenance worldwide.

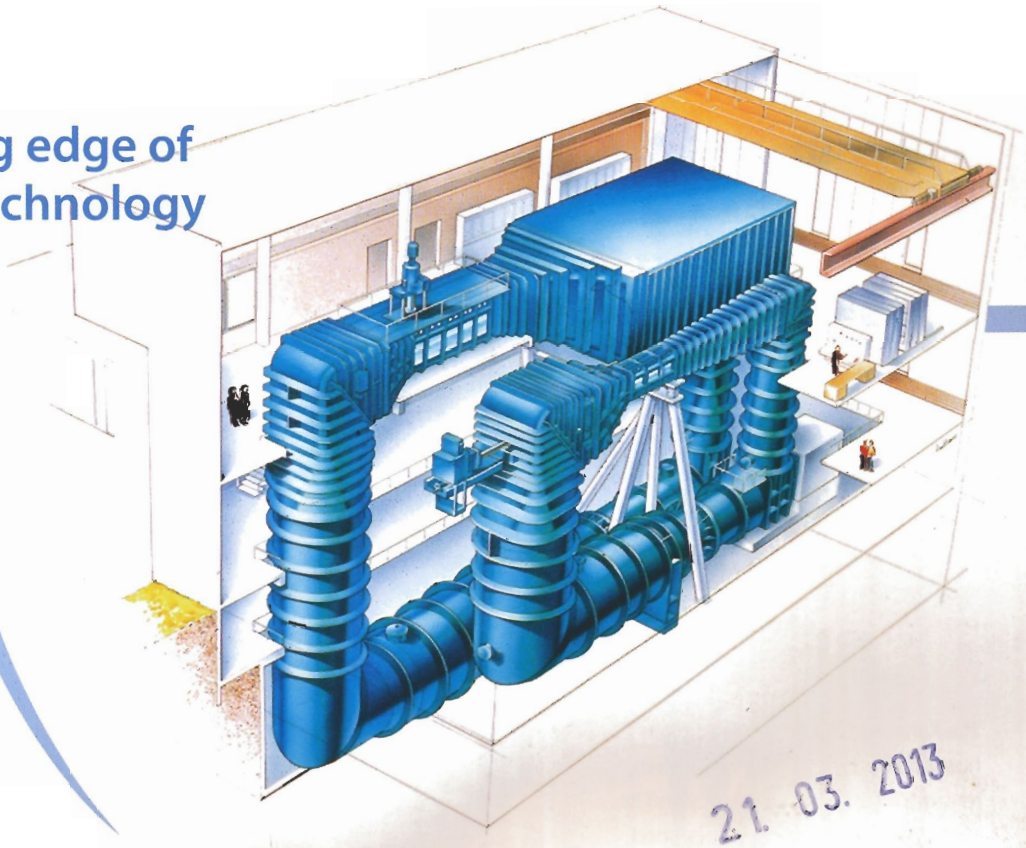


State-of-the-art technology combined with the latest hydrodynamic design codes are routinely used in the optimisation of propulsion equipment.

Content:

Rolls-Royce

At the leading edge of propulsion technology



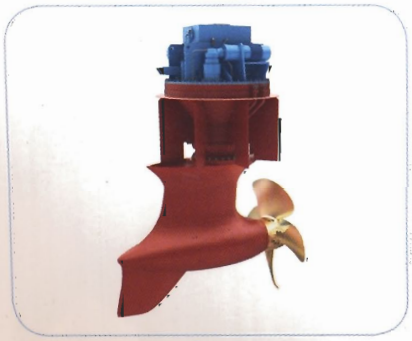
Unlike other propulsor suppliers, Rolls-Royce has its own marine propulsion laboratory in Kristinehamn, Sweden, equipped with two cavitation tunnels. One conventional closed recirculating cavitation tunnel is used for testing propellers, waterjet pumps and thrusters in "open water", i.e. in homogenous inflow. This tunnel offers a 2.5 m long, 800 by 800mm test section with water velocities up to 11 m/s. The test object is driven by an upstream drive shaft for tests of propulsors under ideal inflow conditions.

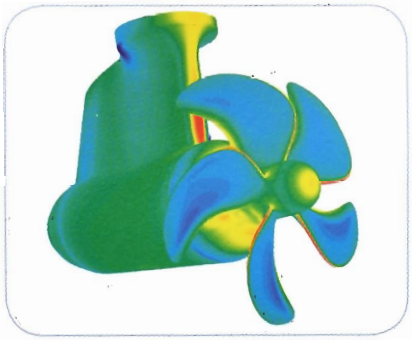
As one of the few free-surface type tunnels in existence, the second tunnel is used for testing high speed propellers operating in partially or fully submerged conditions, in parallel or oblique flow. Propellers are tested in behind condition (behind a hull dummy), and waterjets are tested together with inlet and steering and reversing unit as a complete system. This cavitation tunnel offers a 4 m long, 800 by 800 mm test section with water velocities up to 12 m/s and possibility for a free water surface in and downstream of the test section.

Since the laboratory first opened in 1942, about 1.400 models of propellers and waterjet pumps have been tested.

In the quest for optimum propulsion efficiency, with minimum noise and vibration, Rolls-Royce engineers employ advanced theories and calculation methods. During the last 15 years, the viscous CFD has become an important tool in the hydrodynamic research work. Simulation of a complete ship hull and propulsion unit is realizable today. Main methods can be divided into transient (time dependent) and steady state simulations. Generally, a non-transient simulation is fast an accurate, but some simulation needs to be solved transient, such as a rotating propeller or waterjet operating in its environment (wake field).

The strength of the Hydrodynamic Research Centre (RRHRC) is to combine the advantages of both the experimental and computational fluid dynamic methods when developing new products.





Decades of designing and producing propellers and thrusters, the use of sophisticated software and having our own propulsion laboratory, is what enables us to develop the most efficient propulsion systems possible.

All propulsion products are delivered with remote control systems. The electronic control systems are undergoing continuous improvements to meet all technical and ergonomical demands.

Rolls-Royce controllable pitch propellers

Typical applications:

- fast ferries
- cruise ships
- container ships
- cargo vessels
- tankers
- naval vessels
- offshore vessels

The Kamewa CP-A controllable pitch hub is an evolution of the XF5 system, renowned for its high efficiency and its blade bearing arrangement designed to avoid peak pressures and cavitation. Compared with its predecessor, the CP-A offers improved power to weight ratio by 20%, a significant increase in efficiency and a blade foot with decreased exposure to cavitation, thanks to the latest mechanical design and hydrodynamic techniques. At the same time, the blade foot bearing surfaces have been increased to provide even greater strength and wear-resistance. The system can be supplied with four or five blades of high skew or moderate skew type, conventional or nozzle design.

Key features:

- Two main hub types are available; standard for speeds below 30 knots and H for speeds above 30 knots
- The range of hub sizes will cover powers from approx. 0,5 to 75 MW
- The CP-A hub offers normal pitch control and can also be supplied with full blade feathering
- Bronze or stainless steel blades and hub can be specified, and a version is available in which the blades and blade seals can be exchanged under water
- Open water, nozzle, and ice-class options
- Full US Mil-Spec shock versions are available

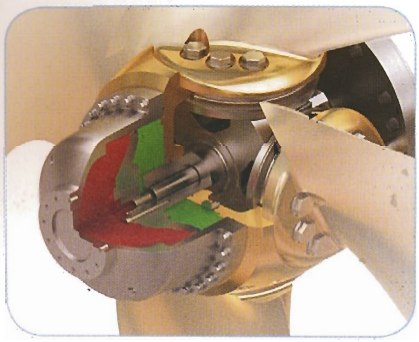
The CP-A is available with three types of oil distribution systems; D-F, I and D-M.

Type D-F: The oil distribution box is mounted on the forward end of the reduction gearbox. Additional intermediate shafts can be arranged between the propeller shaft and the gearbox.

Type D-M: A separate shaft carries the oil distribution box, and additional intermediate shafts can be arranged between the propeller shaft and the OD box shaft.

Type I: Oil distribution integrated in reduction gearbox. The reduction gearbox is a free-standing gearbox intended for integrated propulsion systems.

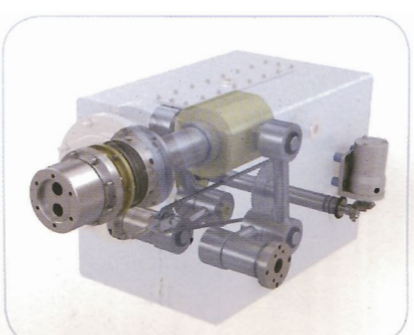
Computational fluid dynamics (CFD) and cavitation tank testing were used to refine the contours of the propeller hub and blade roots. Improved hydrodynamic performance results in lower fuel consumption and reduced emissions.



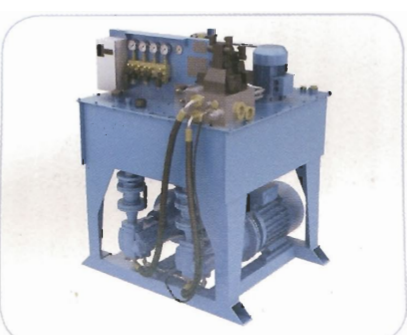
The new CP-A hub is designed for improved efficiency, strength and cavitation properties.

System D-F

- OD box in front of gear



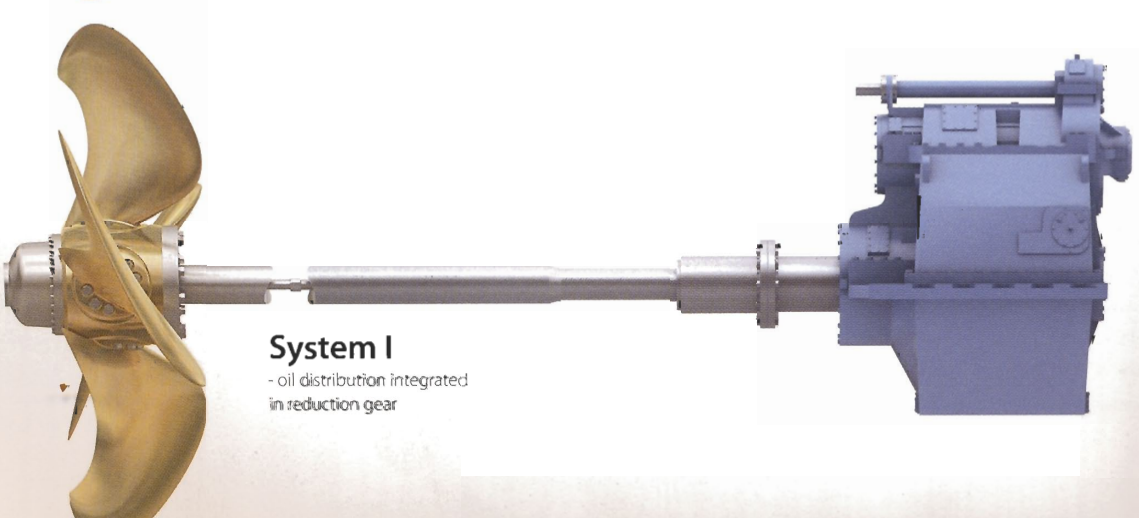
The new FA oil distribution box provides reduced oil volume, easier seal replacement and improved pitch feedback accuracy.



The new compact hydraulic system offers greatly reduced weight and oil volume and about 50% less energy consumption at constant pitch.

System D-M

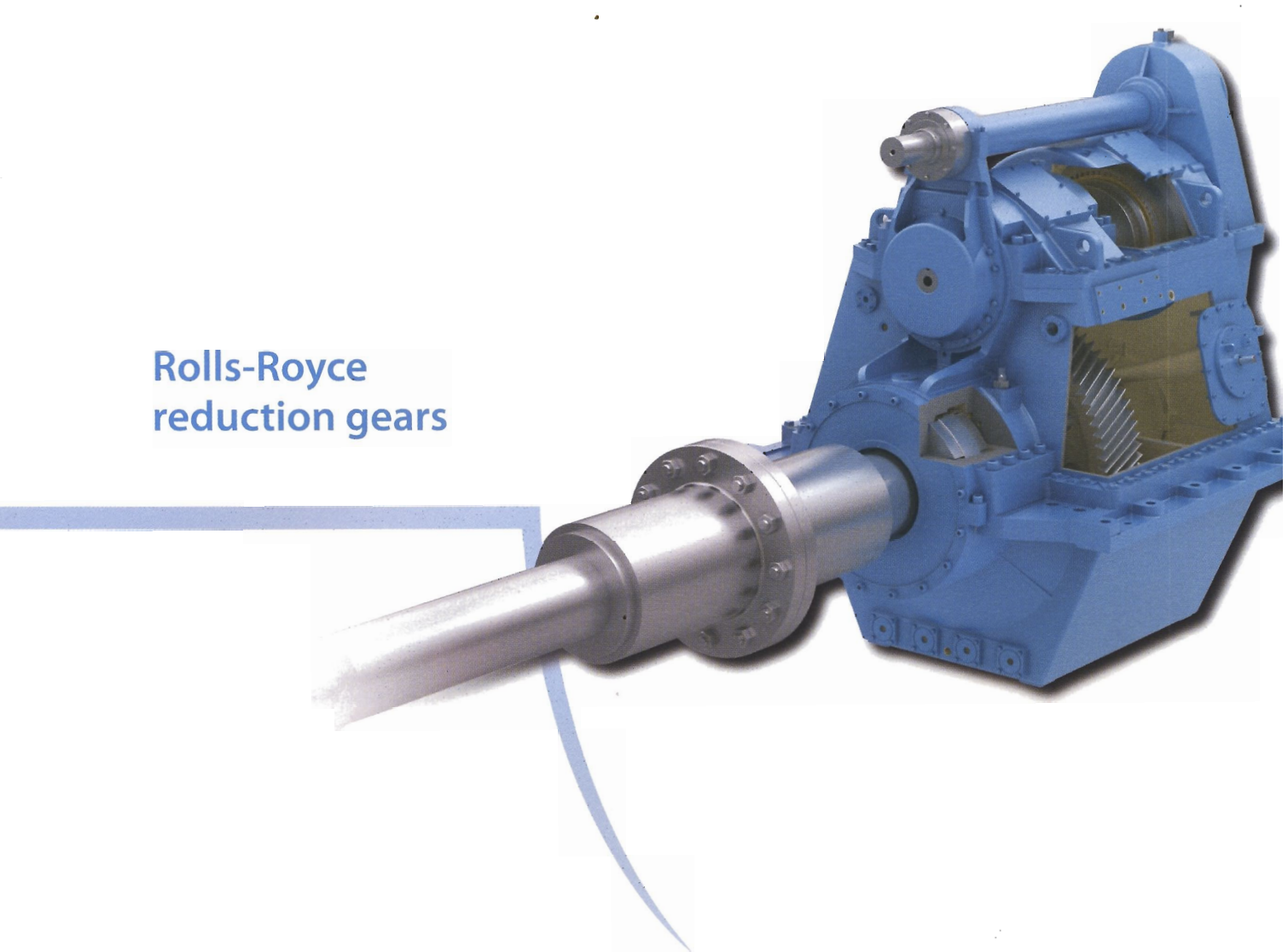
- OD box in shaftline



System I

- oil distribution integrated in reduction gear

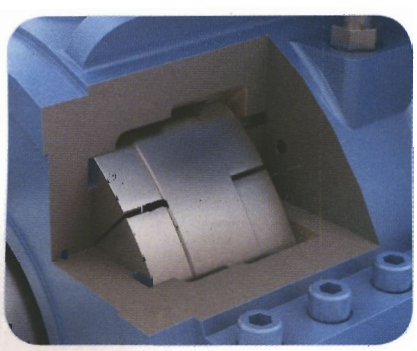
Rolls-Royce reduction gears



Rolls-Royce reduction gearboxes
The reduction gearbox is a freestanding gearbox intended for integrated propulsion systems. It is designed as a combined speed reduction unit with common hydraulic system for gear and propeller. The gear has a built-in hydraulically operated clutch and is provided with seating brackets for bolting to the ship's foundation. The input shaft is provided for mounting of the flexible coupling, and the output shaft with a cylindrical shaft or flange.

The hollow bored propeller shaft carries the oil tube.

The reduction gearboxes are normally equipped with one-step reductions from 1.5:1 to 6.3.



The thrust bearing is of the tilting pad type, absorbing the propeller thrust in both ahead and astern direction.

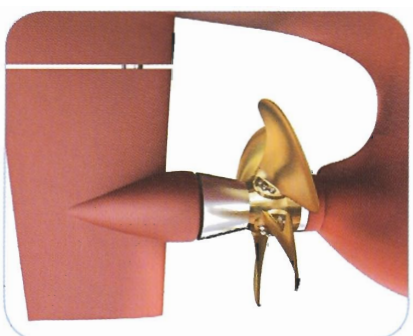
Technical data reduction gearboxes

Technical data	AGHC/AGFC	AGHC-P/AGFC/P	AGHC-S/SC/AGFC-S/SC
Max. Torque in (Nm)	23 000 - 235 000	23 000 - 235 000	23 000 - 235 000
Max torque out (Nm)	90 000 - 950 000	90 000 - 950 000	90 000 - 950 000
Reduction ratio, min./max. one step	1.5:1 - 6.3:1	1.5:1 - 6.3:1	1.5:1 - 6.3:1
Reduction ratio, max. two step	12:1	12:1	12:1
Weight (dry), kg	3 000 - 28 000	3 300 - 28 500	3 300 - 28 500
Gearbox PTO transmitted power, KW		800 - 4 000	800 - 4 000
PTO/PTI speed, rpm		1 200 - 1 800	1 200 - 1 800
Max. step up ratio		1:3	1:3.0
Min. step up ratio		1:1	1:1.33

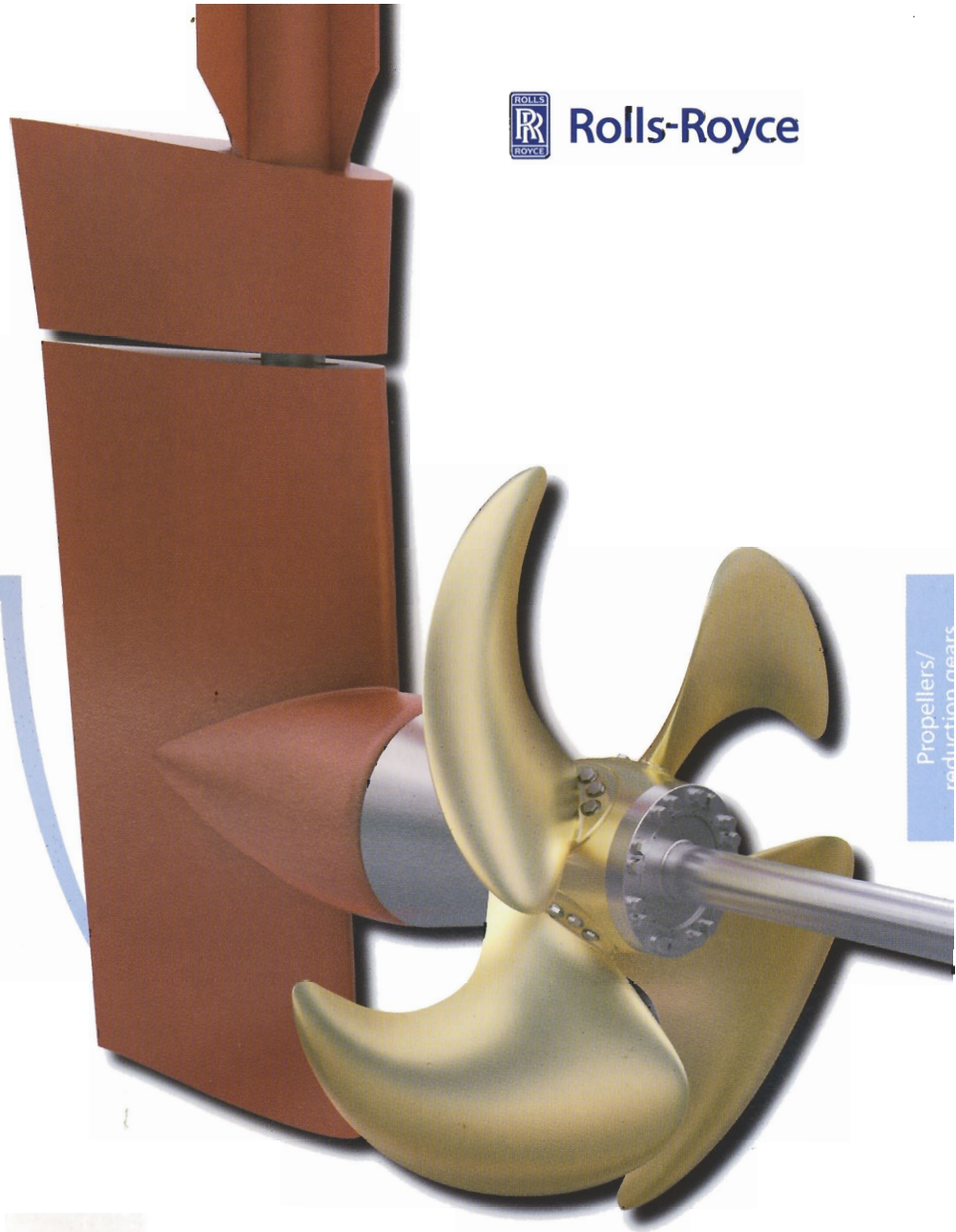
All data subject to change without prior notice.

Rolls-Royce

Rolls-Royce high efficiency propulsion and manoeuvring system



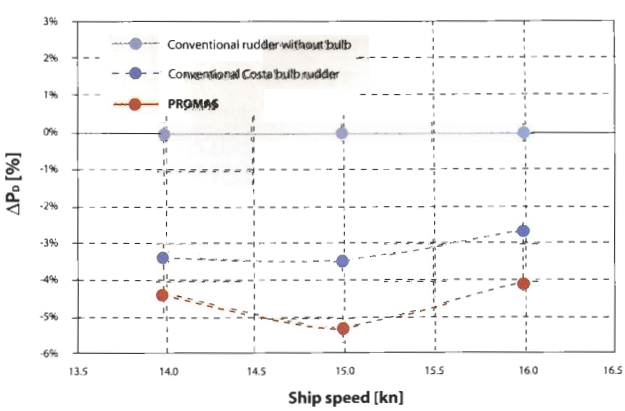
The rudder bulb is close to the propeller hub, but not attached to it. The nose of the bulb is curved, and gives good control of water flow from propeller to rudder even at large steering angles.

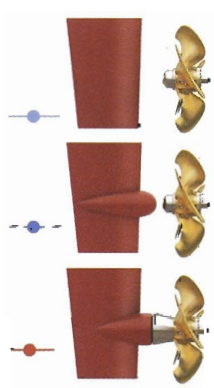


The Rolls-Royce high efficiency propulsion and manoeuvring system, Promas, integrates the propeller, a hub cap, a rudder bulb and the rudder itself into a hydrodynamic efficient entity.

A tapered hubcap fitted to the hub of the propeller leads the water flow on to a bulb which forms part of the spade rudder. The rudder has a twisted leading edge, optimised for the flow from the propeller, which converts into additional forward thrust some of the swirl energy in the slipstream that is normally lost.

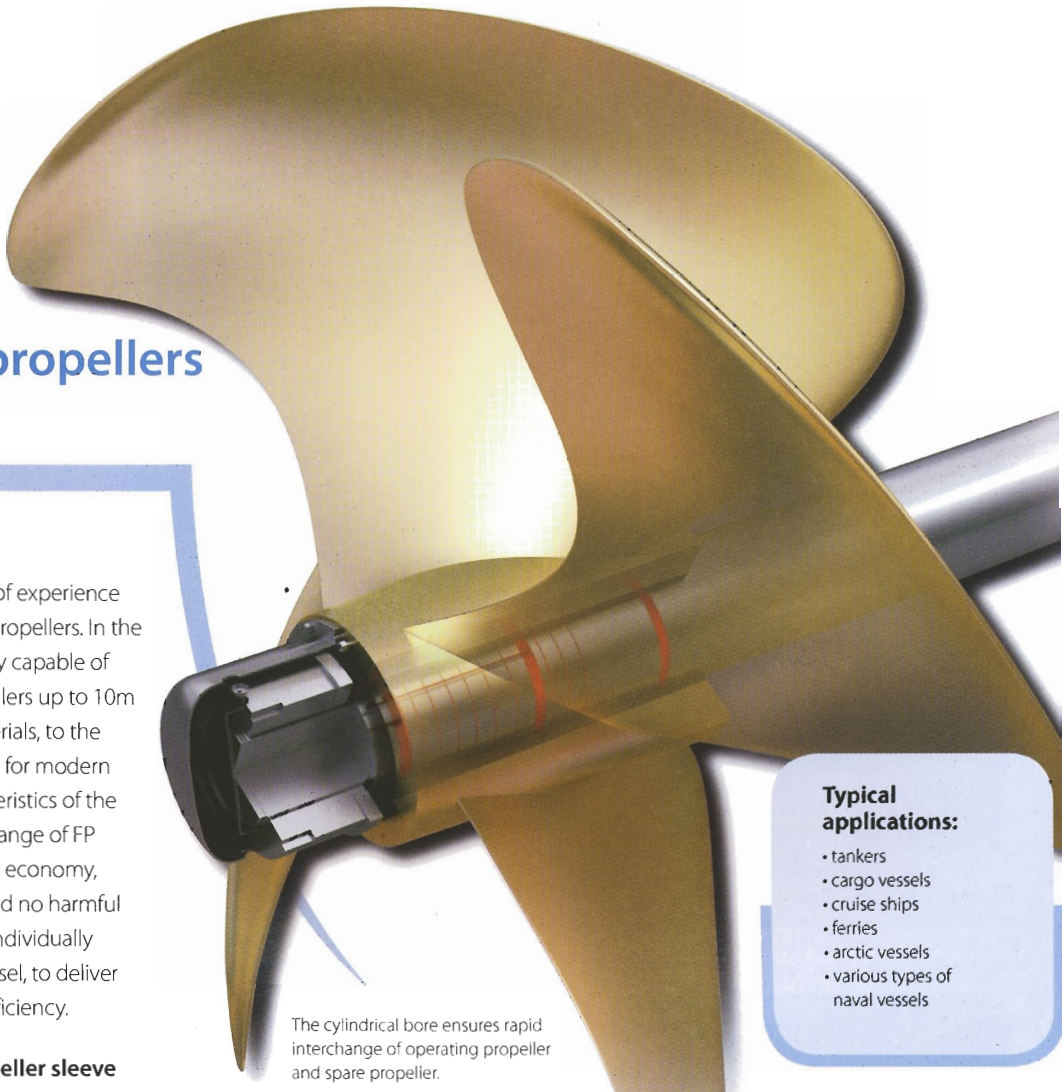
The result is an increase in propulsive efficiency of about 6 to 8% depending on application, leading to reduced fuel consumption and emissions. Large steering forces can also be developed.
Promas has been developed using CFD (computational fluid dynamics), and the results are verified by testing in the cavitation tunnel at the Rolls-Royce Hydrodynamic Research Centre and large scale model testing with relevant hulls. Available with CP and FP propeller.





- Single screw – Chemical tanker
- Efficiency improvement by conv. Costa bulb 2.5 - 3.5%
- Efficiency improvement by RR rudder 4.0 - 5.1%

Rolls-Royce fixed pitch propellers



The cylindrical bore ensures rapid interchange of operating propeller and spare propeller.

Typical applications:

- tankers
- cargo vessels
- cruise ships
- ferries
- arctic vessels
- various types of naval vessels

Rolls-Royce has many years of experience in the design of fixed pitch propellers. In the US we have our own foundry capable of producing fixed pitch propellers up to 10m diameter in a variety of materials, to the exacting tolerances required for modern naval platforms. The characteristics of the Bird-Johnson and Kamewa range of FP propellers provide good fuel economy, low vibration/noise levels and no harmful cavitation. They are usually individually designed for the specific vessel, to deliver the optimum in propeller efficiency.

The Rolls-Royce SKF propeller sleeve

This propeller sleeve is a unique concept that simplifies propeller removal and mounting, provides full inter-changeability between operating propeller and spare propeller, and reduces the need for a spare propeller shaft. It offers considerable cost savings in terms of downtime, maintenance and repairs. The SKF propeller sleeve also generates major savings by speeding up the installation process, eliminating match marking or gauges. The FPP is designed with either a taper shaft or SKF sleeve.

Rolls-Royce offers a complete FPP package

- Individual design
- Monoblock propellers of moderate or high-skew designs for both open and nozzle applications
- Shafting with stern tube, bearings, sealings, nozzle, etc.
- The SKF Propeller Sleeve
- Shaft calculations, such as whirling and alignment
- Performance guarantees

New Generation Workwheels®

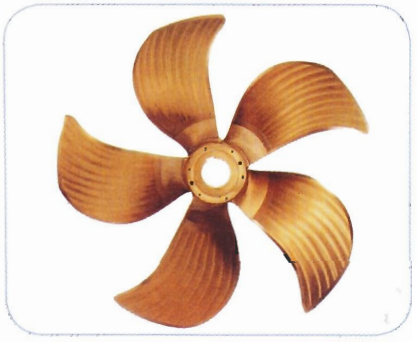
Part of the Rolls-Royce product portfolio – New Generation Workwheels® – are available in five standard propeller designs specifically suited for workboats and manufactured in manganese bronze, NiAl-bronze and stainless steel. Designed to outperform conventional three and four-bladed designs, New Generation Workwheels® apply state-of-the-art technology routinely used in the design of large commercial and naval propellers. The improved performance is a result of the application of latest hydrodynamic design codes, which are applied in both design and off design operating conditions.

Key features:

- Five blades
- Optimised variable pitch distribution
- Non-linear blade skew of 18 degrees
- Advanced new technology blade sections

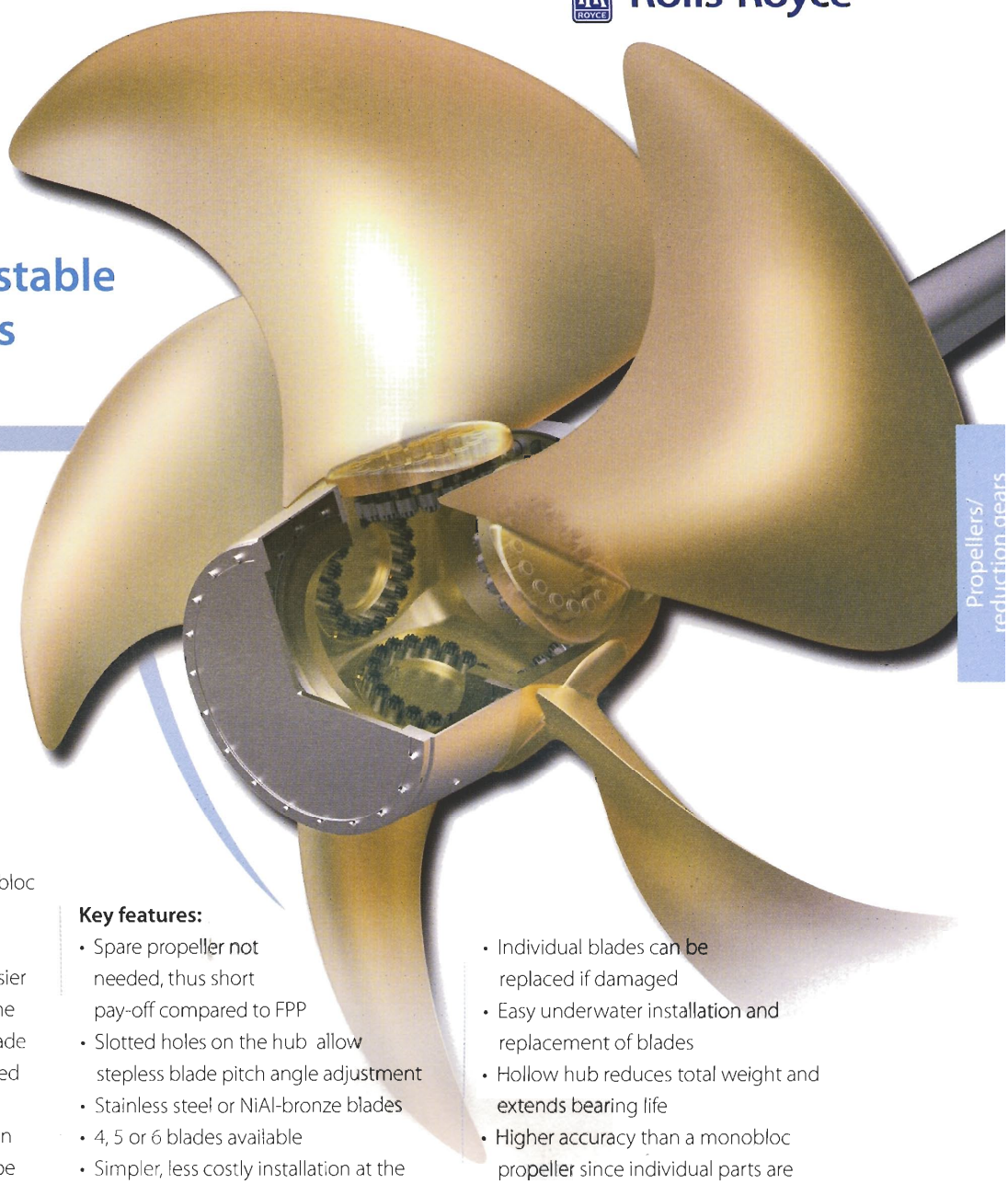
Product benefits:

- Close to 50% reduction in ship hull vibrations due to propeller induced hull pressures
- About 50% reduction in ship machinery vibration levels due to propeller induced unsteady shaft forces
- Improved propeller efficiency



New Generation Workwheels® deliver optimum cavitation and vibration performance with improved structural integrity.

Rolls-Royce adjustable bolted propellers



The adjustable bolted propeller allows the most efficient blade matching for optimum efficiency, while simplifying the installation process. The Kamewa range of ABP is based on a hollow hub with blades bolted to it from the inside. A unique feature is the method of bolting the blades to the hub using simple hand tools.

In comparison to conventional monobloc fixed pitch propellers the ABP has higher quality blade machining and educed overall weight, which give easier shipment, handling and mounting. The slotted holes on the hub allow the blade pitch angle to be conveniently adjusted at commissioning, or in service to compensate for long-term variations in hull resistance. Individual blades can be replaced without drydocking, and only spare blades have to be stocked rather than a complete monobloc propeller.

Key features:

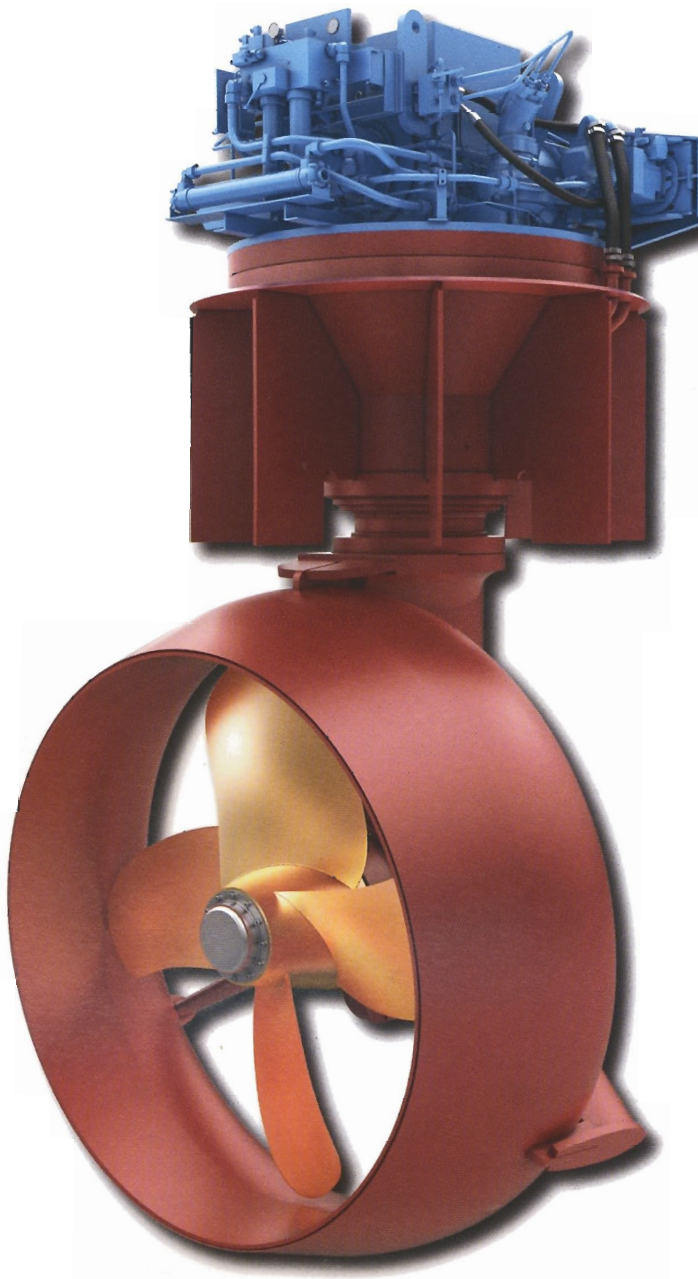
- Spare propeller not needed, thus short pay-off compared to FPP
- Slotted holes on the hub allow stepless blade pitch angle adjustment
- Stainless steel or NiAl-bronze blades
- 4, 5 or 6 blades available
- Simpler, less costly installation at the shipyard. Match marking not needed
- Smaller, lighter components mean lower costs for shipment, storage and handling
- Individual blades can be replaced if damaged
- Easy underwater installation and replacement of blades
- Hollow hub reduces total weight and extends bearing life
- Higher accuracy than a monobloc propeller since individual parts are machined more efficiently
- No limitation in size or weight

Typical applications:

- cruise vessels
- tankers
- cargo/container vessels
- various types of naval vessels

The ABP offers fast and simple installation compared to a monobloc unit.

Rolls-Royce azimuth thrusters



Rolls-Royce is one of the world's leading suppliers of azimuth thrusters. The basic idea behind an azimuth thruster is that the propeller can be rotated 360 degrees around the vertical axis, providing omni-directional thrust. The Rolls-Royce range of azimuth thrusters therefore offer superior manoeuvrability. The simple and robust construction provides high operational reliability along with easy maintenance, which result in a best possible total economy.

The flexibility in design makes the azimuth thrusters ideal to a wide range of vessels. The low noise and vibration levels further enhance the area of use. The Rolls-Royce thrusters can be delivered for diesel or electric drive. The units are available as open or ducted with fixed or controllable pitch, or with contra-rotating propellers. The azimuthing thrusters are delivered with remote control systems.

Typical applications:

- tugs
- offshore supply/service vessels
- cargo vessels
- workboats
- ice breakers

Arctic operations

Rolls-Royce has a long history of delivering azimuth thrusters for vessels operating in icy conditions. These vessels range from tugs and road ferries to icebreakers, with classifications from Baltic ice classes to high Arctic icebreaker ice classifications.
The applications require project specific tailoring for the best possible azimuth thruster solution.

Typical technical data	Ducted FP prop.	Ducted CP prop.	Open prop.	CRP
Propeller diameter (mm)	1 050 - 3 000	1 600 - 3 200	1 250 - 3 500	1 250 - 2 700
L, nominal stem length (mm)	1 500 - 4 200	2 500 - 4 200	1 500 - 4 100	1 500 - 3 305
Weight, dry (kg)*	1 850 - 43 000	11 200 - 43 000	1 500 - 34 500	1 800 - 15 000
Nominal input speed (rpm)	750 - 1 800	750 - 1 800	750 - 1 800	1 500 - 1 800
Nominal input power (kW)	330 - 3 000	1 050 - 3 200	330 - 3 000	330 - 1 500
Bollard pull range (metric tons per two units)	9.5 - 92	28 - 92	-	-

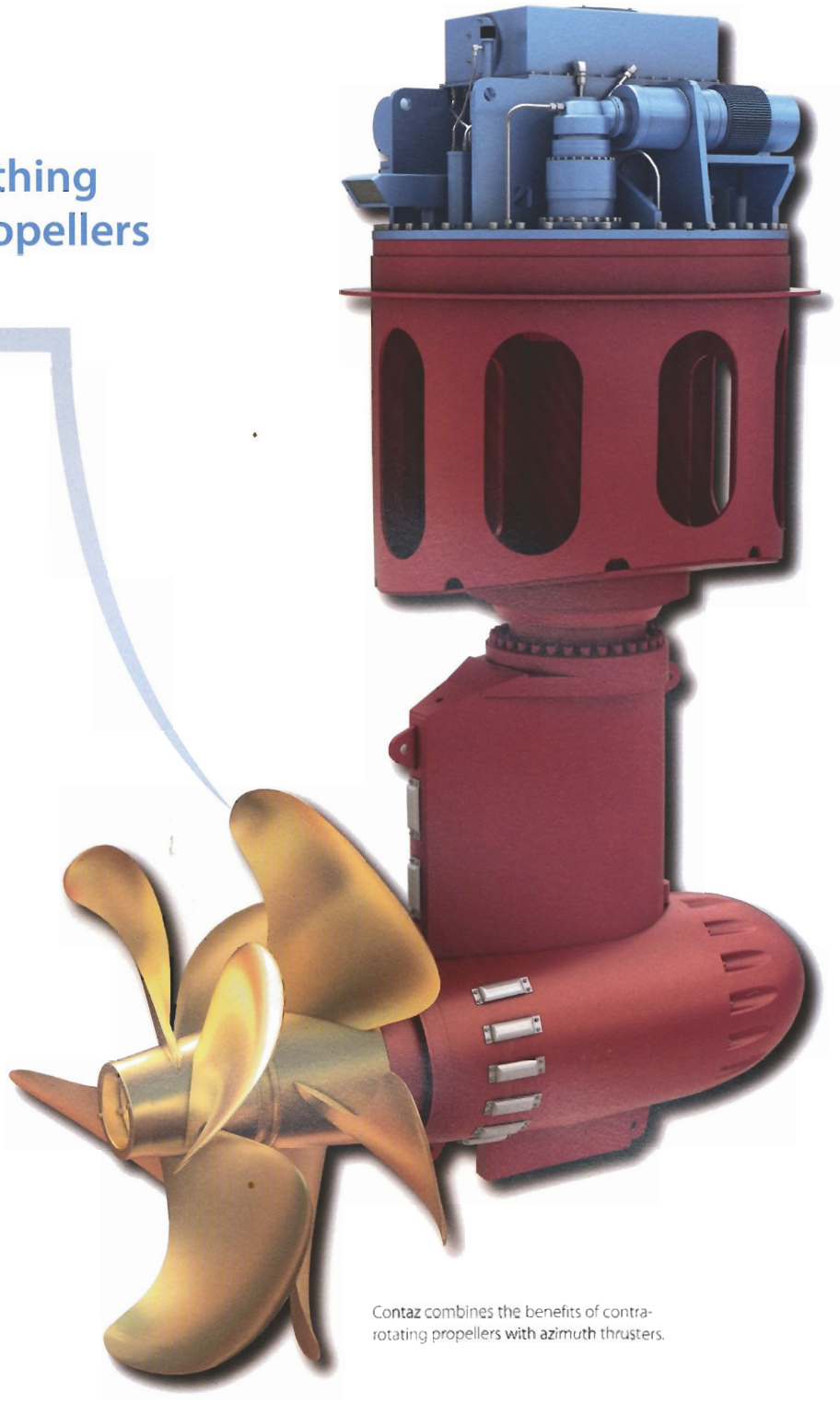
For larger units, see table page 15.
Max. dry weight of weld-in installation. All data subject to change without prior notice.

Rolls-Royce azimuthing contra-rotating propellers

The Rolls-Royce azimuthing contra-rotating propeller, type Contaz, is the world's first thruster system designed and built especially for merchant vessels. It combines the benefits of contra-rotating propellers with steerable thrusters. The latest bearing, gear and shaft technology are the keys to the Contaz – refined and developed through decades.

The Contaz also represents a new way of designing and building ships, and to arrange its power and auxiliary systems for maximum economy, utilisation and comfort. Every unit is specifically designed and built for the particular ship it is going to serve.

The overall benefits are better outline arrangement, better propulsion efficiency, better fuel economy, better coursekeeping stability and reduced vibration and noise.



Contaz combines the benefits of contra-rotating propellers with azimuth thrusters.

Typical applications:

- passenger/car ferries
- offshore supply vessels

Technical data	Contaz 15	Contaz 25	Contaz 35
Maximum propeller diameter (mm)	3 200	3 700	4 200
Stem length H (mm) Min.	4 250	5 000	5 600
Max.	8 500	9 500	11 000
Weight, dry (kg)*	3 200	5 000	7 300
Nominal input speed (rpm)	750 - 1 200	750 - 1 200	750 - 1 200
Power max. kW	2 200	3 000	3 700

Dry weight at shortest stem length (kg). All data subject to change without prior notice.

Rolls-Royce azimuthing pulling propeller

The Rolls-Royce azimuthing pulling propeller, type Azipull, is a low drag, high efficient pulling thruster. It combines the advantage of the pulling propeller with the flexibility of using almost any type of drive to suit the customer's specific requirement. The Azipull is designed for continuous service speed up to 24 knots, while maintaining excellent manoeuvrability. High hydrodynamic efficiency, fuel efficiency, course stability, low noise and vibration levels are other key characteristics of the Azipull.

Internally, it has a purely mechanical drive system based on well-proven technology using bevel gears at the top and bottom of the leg. Power is fed to the unit through a horizontal input shaft within the hull, and the unit incorporates its own steering motors for azimuthing.

The Azipull combines the advantages of an azimuthing thruster offering high manoeuvrability, and low drag, high efficient propulsor enabling high speeds. The flexibility of the unit is also enhanced by the fact that it is available in both CP and FP versions. The Azipull is delivered with remote control systems.

Typical applications:

- offshore supply/service vessels
- offshore stand-by vessels
- coastal ferries
- cargo vessels
- naval vessels

The streamlined leg and skeg recover swirl energy from the slipstream, raising the overall propulsive efficiency. The leg has a wide chord to optimise rudder effect and improve the vessel's course stability.

Technical data	AZP085	AZP100	AZP120	AZP150
Propeller diameter (mm)	1 900 - 2 300	2 300 - 2 800	2 800 - 3 300	3 300 - 4 200
Power (max cont.rating)	900 -1 600	1 400 - 2 500	1 800 - 3 500	3 000 - 5 000
Nominal input speed (RPM)	1 200 - 2 000	720 - 1 800	720 - 1 200	600 - 1 000
Dry weight (kg)	13 tonnes	31 tonnes	45 tonnes	85 tonnes

All data subject to change without prior notice.

Rolls-Royce azimuthing swing-up thrusters

This thruster swings up into a housing in the hull when not in use. It can quickly be swung down about a horizontal axis into the operating position. In operation, it functions as an azimuth thruster and is designed to develop maximum bollard pull in the manoeuvring condition, or to provide positioning power for station keeping. The thruster has the added safety benefit of functioning as a «get you home» drive. A high thrust is developed in relation to input power, and this thrust can be vectored in any desired direction.

In the stowed position the thruster does not protrude below the vessel's keel/baseline, an important consideration for shallow water operations. Additional azimuth thrusters are often located at the lowest possible position in the hull due to space envelope restrictions, especially for equipment mounted at the bow, and thrusters need to be retracted into the hull when not in use.

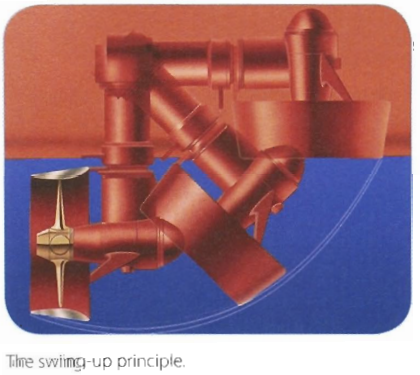
Key features:

- Can be delivered as containerised unit
- Available in CP and FP propeller
- Electric or diesel drive
- Remote control system

This thruster unit is used in both swing-up and combi version.

Typical applications:

- tankers
- cargo vessels
- cruise ships/ferries
- artic vessels
- drilling rigs
- various types of naval support vessels



The swing-up principle.

Rolls-Royce combined azimuth/side thrusters

The Rolls-Royce combined azimuth/side thruster is stored in the ship's hull by rotating the complete unit 90 degrees around the horizontal axis. In the retracted position, the thruster can be operated as a side force thruster. The upper part of the thruster is hinged, enabling the thruster to be lowered through an arc into its azimuthing position or retracted into a recess where it lies horizontally in the hull.

The Rolls-Royce thruster is designed as a nozzle propeller in lowered as well as retracted position. This means low noise and higher thrust compared with a traditional tunnel thruster.

The combi thruster version is comprised of an equivalent standard swing-up unit installed in a specially designed hull module.

Typical applications:

- offshore supply/service vessels
- offshore production vessels
- ROV/survey support ships
- tugs
- fishery research vessels
- various naval support vessels

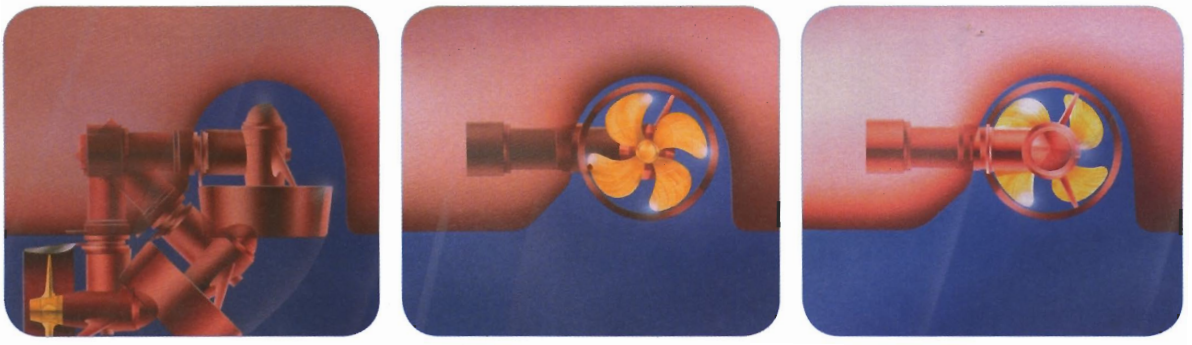
When in swing-up position (retracted) the steering gear may be rotated so that the propeller unit is used as a transverse thruster.
Speed of response in terms of changing thrust direction is similar to conventional thrusters. The steering unit can be rotated through 180° in some 10 seconds. The combi thruster is delivered with remote control system.

Key features:

- Available in CP and FP propeller
- Electric or diesel drive

Two operation modes:

- 360° rotatable as azimuth
- Side thruster when retracted



The thruster is 360° rotatable and swings up into a shallow recess in the hull bottom.

Technical data for combined azimuth/side thrusters and swing-up thrusters.

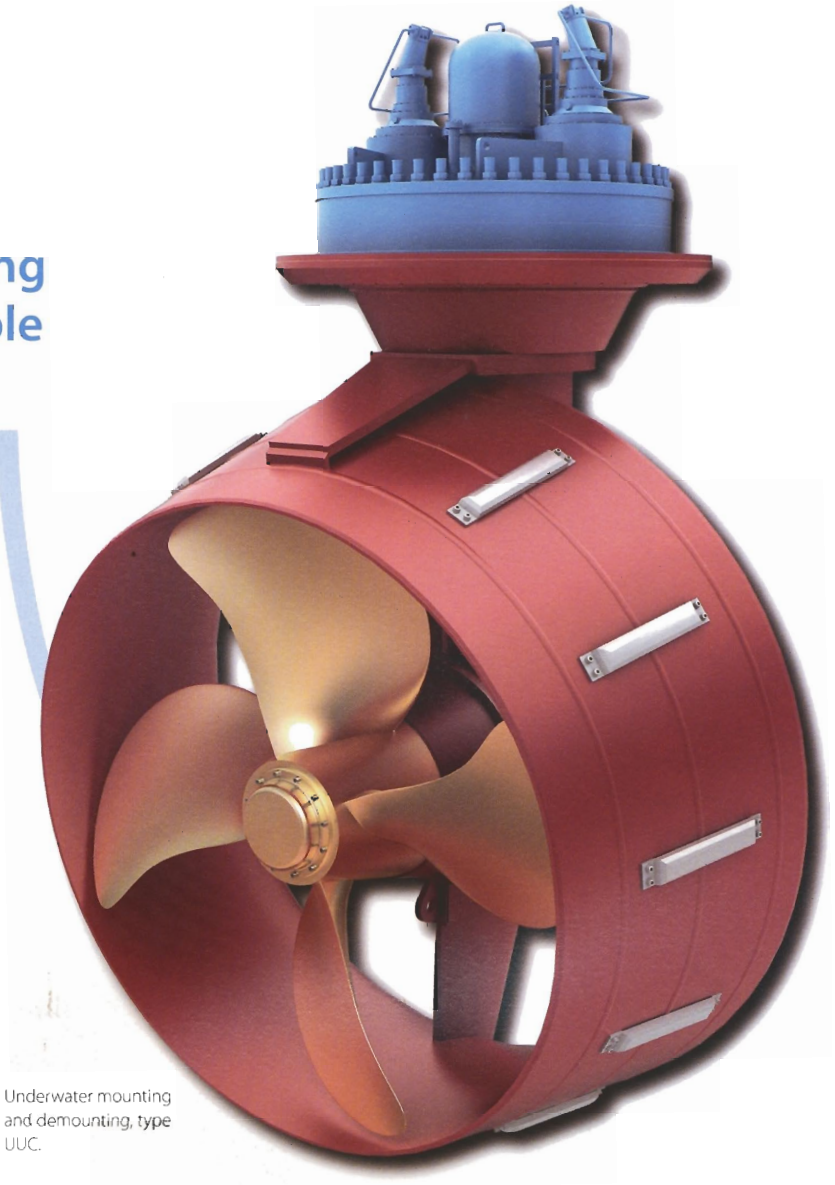
Technical data	TCNS 073			TCNS 092	
Input speed (rpm)	1 500	1 800	2 000	1 500	1 800
MCR (kW)	736	880	1 000	1 650	2 000
Propeller diameter (mm)	1 800			2 200	
Weight thruster w/steering gear	9 500			16 000	
Weight hull module	9 000			17 000	

All data subject to change without prior notice.

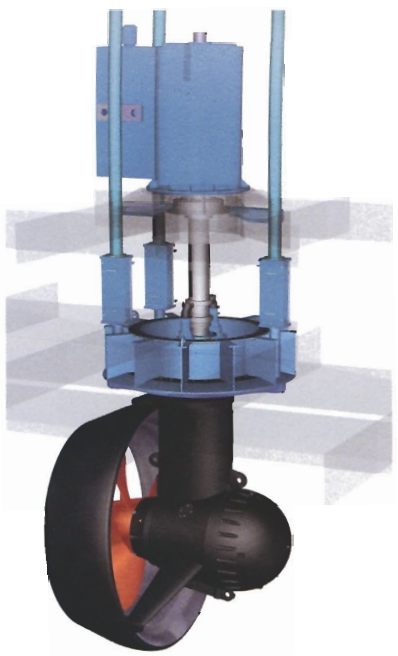
Rolls-Royce azimuthing underwater mountable thrusters

The range of Rolls-Royce underwater mountable thrusters are designed for easy underwater mounting and dismantling without dry-docking the application. This is of utmost importance to large vessels and semi-sub oil drilling rigs.

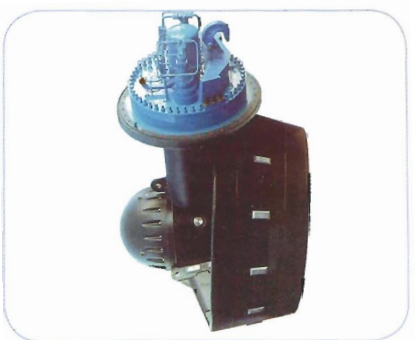
There are two alternative ways to connect the lifting wires: Connecting inside the ship to the thruster flange (see picture below) or externally to the lifting lugs on the thruster flange (See picture in the middle). The former is typical on the drill ships and the latter on the Semi Submersibles.
All necessary plugs, blinds and domes are supplied with the thruster for underwater (de)mounting.



Underwater mounting and demounting, type UUC.



The basic unit is also available for dry-dock installations



USE is designed for installation in dry conditions. This type can be mounted directly to the hull or on a container. The container can be either of retrievable or retractable type.

USL is a compact design with bottom well and foundation for vertical drive motor. USL installation method means wet mounting from the top through a wet casing.

Technical data

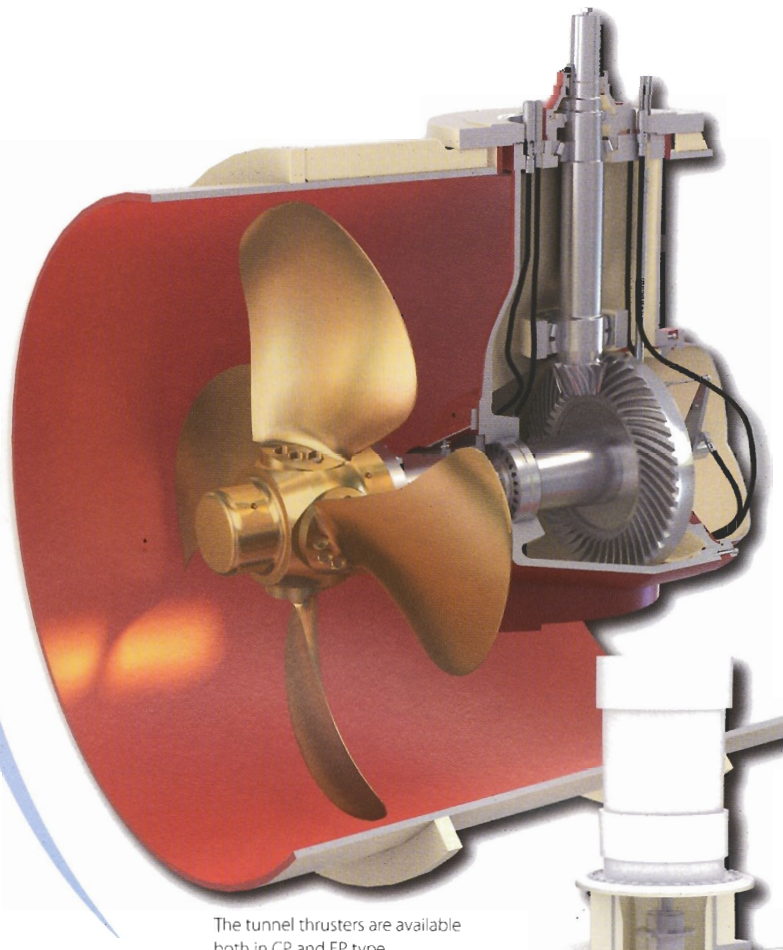
Size	305		355	405	455		505
Prop. Dia (m)	3.0	3.2	3.5	3.8	4.1	4.1	4.5
MCR (kW)	3 000	3 200	3 800	4 600	5 000	5 500	6 500
Input (rpm)	720	720	720	720	720	750	600

The final data is subject to application and to be reconfirmed by Rolls-Royce.

Typical applications:

- semi-sub drilling rigs/ships
- production vessels
- other large vessels

Rolls-Royce tunnel thrusters



The tunnel thrusters are available both in CP and FP type.

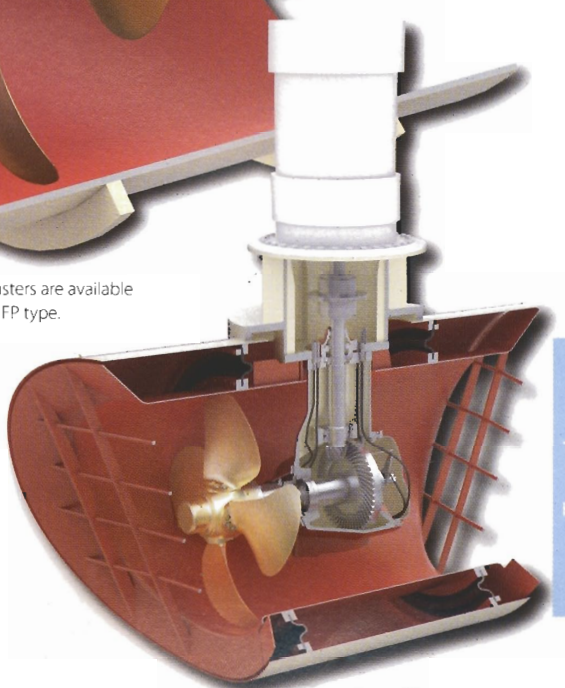
The Rolls-Royce range of tunnel thrusters are fitted to a wide range of vessels operating in all corners of the world. The tunnel thruster is designed for giving max. side force to the ship in manoeuvring condition. The system normally consists of the thruster unit with tunnel, hydraulic equipment, remote control and electrical drivemotor with starter. Thrusters are available in both CP and FP versions.

Super Silent type

The Super Silent thruster is designed with double walls in the full tunnel length, and flexible mounted inner tunnel. This concept provides noise reduction up to 10 dB compared to standard designs. A reduction up to 25 dB can be reached in combination with floating floors and other measures by the shipbuilder.

General features:

- Reduced tip speed (Super Silent only)
- Skew blades
- 10 dB noise reduction (Super Silent only)
- Heavy duty propeller with double lip seal
- Shaft seal pressure control with drain connection in DP thrusters
- Mechanical locked bearings in DP thrusters
- Available in CP and FP type



Super Silent thruster with double mounted tunnel.

Typical applications:

Suitable for and installed in all types of vessels.

Technical data , type TT-CP/FP

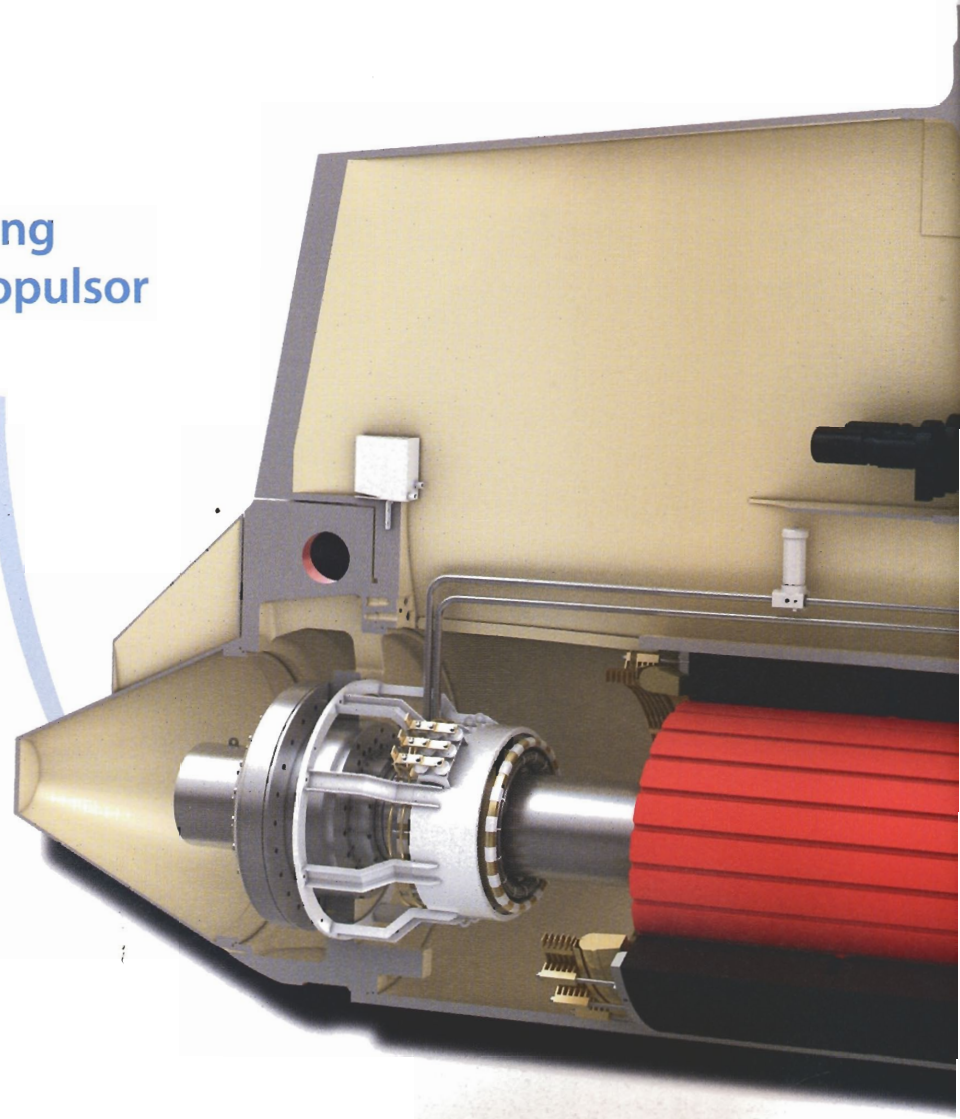
D mm	Maximum Power kW					
	El motor			Diesel		
	Version AUX	Version ICE/DPN/DPD	Version DPN/DPD	Version AUX	Version ICE/DPN/DPD	DPN/DPD
1100	330 - 390	300 - 350	300 - 350	290 - 340	260 - 310	260 - 310
1300	495 - 595	445 - 535	445 - 535	435 - 520	390 - 475	260 - 310
1650	750 - 865	700 - 780	700 - 810	650 - 760	600 - 685	650 - 710
1850	900 - 1 050	800 - 950	850 - 950	800 - 930	700 - 840	700 - 840
2000	1 295 - 1 030	1 165 - 925	1 205 - 950	1 140 - 905	1 025 - 815	700 - 840
2200	1 240 - 1 510	1 115 - 1 365	1 180 - 1 440	1 090 - 1 325	980 - 1 190	1055 - 845
2400	1 580 - 1 910	1 420 - 1 720	1 420 - 1 710	1 390 - 1 680	1 250 - 1 510	1245 - 1510
2650	2 400 - 2 150	2 160 - 1 935	2 205 - 1 980	2 110 - 1 892	2 000 - 1 700	1935 - 1735
2800	2 650 - 2 380	2 385 - 2 140	2 385 - 2 140	2 330 - 2 090	2 096 - 1 880	2095 - 1880
3000	2 510 - 3 000	2 260 - 2 700	2 260 - 2 700	2 210 - 2 640	1 990 - 2 370	1990 - 2380
3300	3 100 - 3 700	2 790 - 3 330	2 790 - 3 330	2 730 - 3 250	2 450 - 2 930	2450 - 2930

All data subject to change without prior notice.

Technical data , type TT-SS

Thruster type	D	Max. rpm	Prop. rpm	Max. Power
TT1850 SS	1850	1 180	290	800
TT2000 SS	2000	1 180	245	925
TT2200 SS	2200	1 180	276	1 355
TT2200 SS	2200	1 180	243	1 050
TT2400 SS	2400	1 180	257	1 720
TT2400 SS	2400	1 180	228	1 350

Rolls-Royce azimuthing electrical podded propulsor



The Rolls-Royce electrical pod, type Mermaid, propulsion system offers flexibility in machinery and vessel arrangement, and gives improved efficiency and excellent manoeuvrability.

The outboard unit is 360 degrees rotatable for manoeuvring purposes. In transit the steering is optimised to achieve optimal comfort and performance. The main component in the underwater unit is the electric motor, either a synchronous type with brushless excitation or with an induction motor. In both cases, the stator is shrink fitted in the pod housing to optimise hydrodynamics and cooling. The rotor is mounted directly on the propeller shaft which is supported by state-of-the-art roller bearings on both sides. It is also equipped with a shaft brake, locking device and equipment to slowly turn the shaft in order to assist when undertaking maintenance work.

The propeller is a fixed pitch high skew type, designed for low noise and low vibration. It can be delivered either as a monobloc or with separately bolted blades, with the benefit that they can be changed individually in case of damage. All seals against seawater are of environmentally friendly type, i.e. seal failure will prevent any oil spill into water.

Owner/Operator benefits:

- Increased cargo capacity or reduced vessel size
- Increased propulsion system efficiency
- Reduced total installed power generation
- Reduced total fuel consumption and exhaust emissions
- High capability remote controlled break and locking unit
- High manoeuvrability
- Reduced noise and vibration levels
- Environmentally friendly seal systems
- Optional: Underwater mounting

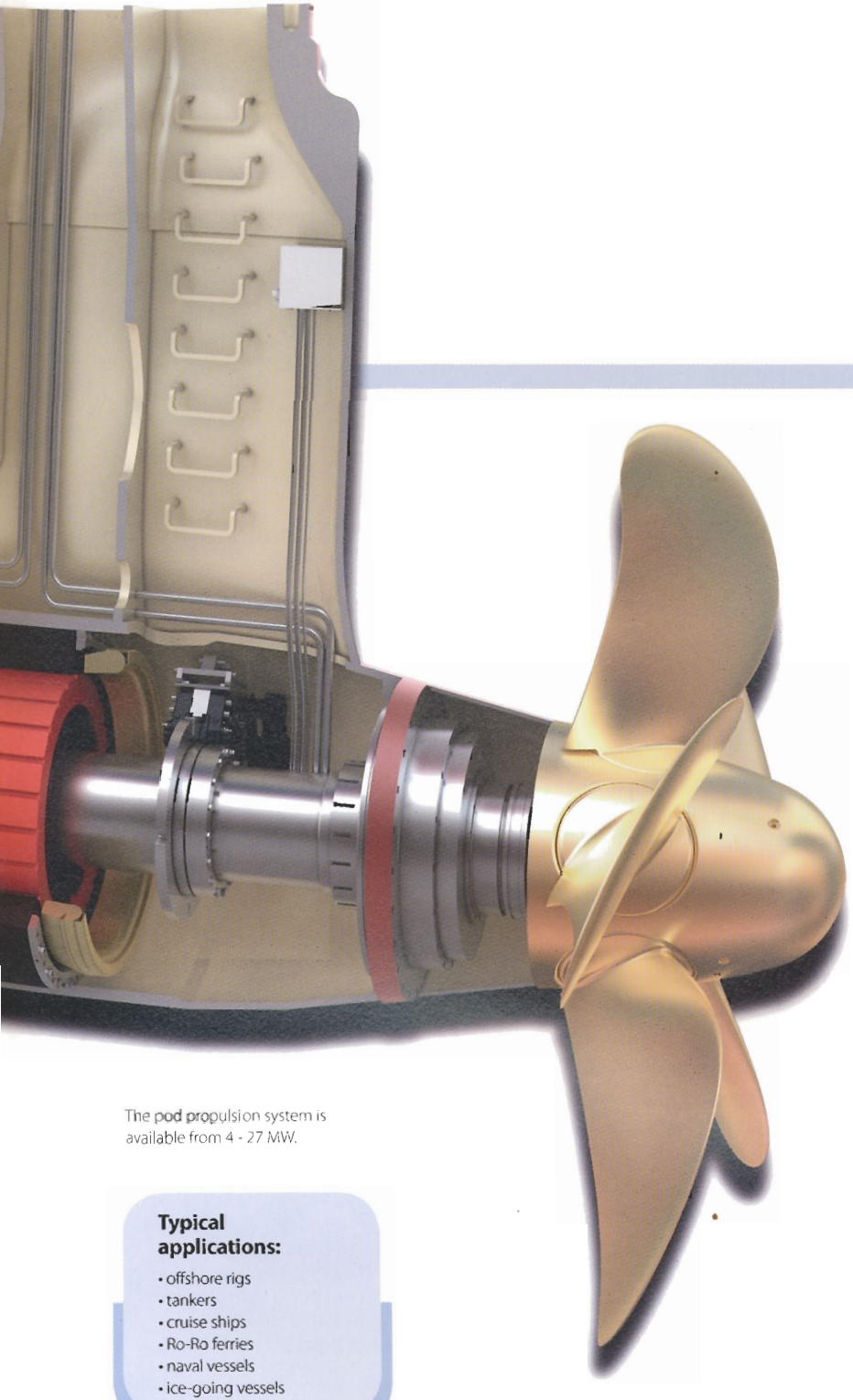
Shipyard and construction benefits:

- Flexible machinery arrangement
- Modularised design
- Simpler vessel machinery installation
- Simpler hull form and structure
- Reduced installation time and cost
- Fewer components
- Reduces shipyard/sub-supplier coordination

Technical data POD	185	210	232	250	277
P Synchronous (MW)	5 - 11	7 - 16	11 - 20	13 - 23	15 - 27
P Induction (MW)	5 - 10.5	7 - 13.5	9 - 17	11 - 20	13.5 - 23.5
N Shaft (rpm)	110 - 210	105 - 195	100 - 180	95 - 170	90 - 160
D Propeller (m)	3.6 - 5.4	4.1 - 5.9	4.5 - 6.4	4.9 - 6.9	5.4 - 8
Weight (t)	70 - 115	110 - 155	145 - 190	185 - 220	230 - 270
Speed (kN)	Up to 24				

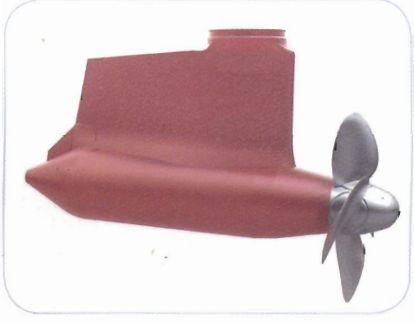
All data subject to change without prior notice.

Rolls-Royce



The pod propulsion system is available from 4 - 27 MW.

A special pushing design is available with nozzle, especially suitable at low speed. The power range is from 5 to 13 MW.



The ice-strengthened design ranges from all Baltic classes up to the toughest arctic conditions. Available with excellent hydrodynamic performance up to IACS PC4.

Pods for heavy ice applications can be designed up to PC1. The power range is from 4 to 15 MW.

Typical applications:

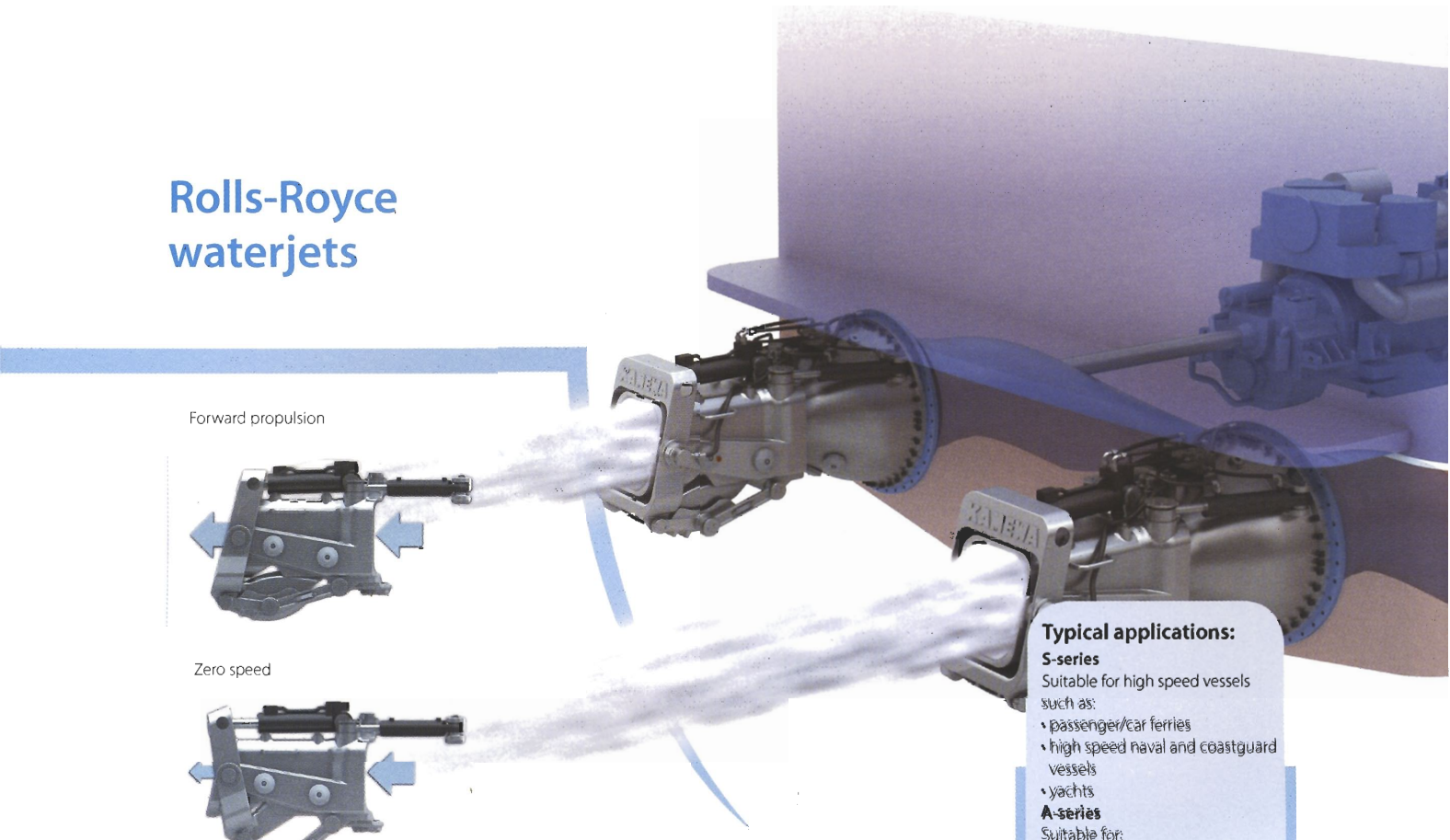
- offshore rigs
- tankers
- cruise ships
- Ro-Ro ferries
- naval vessels
- ice-going vessels

Mermaid pods for Iceclass

Motortype	Induction PWM		
	210	232	250
Pd – Bollard Pull (MW)	4 - 11	8 - 13	10 - 15
N Shaft BP (rpm)	105 - 155	100 - 147	95 - 140
D Propeller (m)	3.7 - 5.0	4.5 - 5.65	4.9 - 6.0
Bollard Pull thrust (kN)	600 - 1 200	800 - 1 500	1 000 - 1 650
D Pod (mm)	2 230	2 470	2 650
Weight (t)	70 - 115	110 - 155	145 - 190
Open water speed (kN)		14-19	

All data subject to change without prior notice. Other sizes can be available upon request.

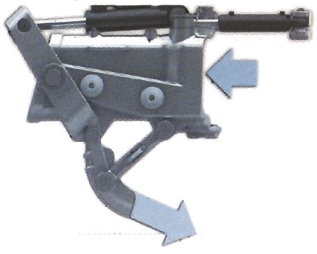
Rolls-Royce waterjets



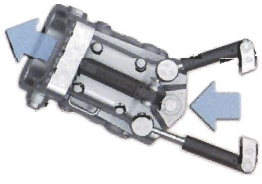
Forward propulsion

Zero speed

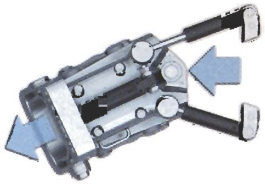
Reversing



Steering port



Steering starboard



The ability to accelerate, reverse, stop and steer is excellent compared to propeller propulsion.

Typical applications:

S-series
Suitable for high speed vessels such as:
- passenger/car ferries
- high speed naval and coastguard vessels
- yachts

A-series
Suitable for:
- smaller passenger ferries
- rescue boats
- smaller high speed naval craft

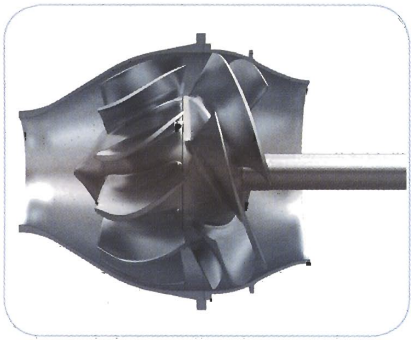
Superior performance and manoeuvrability

The waterjet has many advantages over a propeller. The Rolls-Royce range of waterjets have a very high pump efficiency. This provides higher speeds with the same power, or, substantially lower fuel consumption at a constant speed and lower power.

At constant rpm, Rolls-Royce waterjets absorb approximately the same power regardless of the ship's speed. The engine cannot be overloaded, which means fewer breakdowns and an increased life cycle.

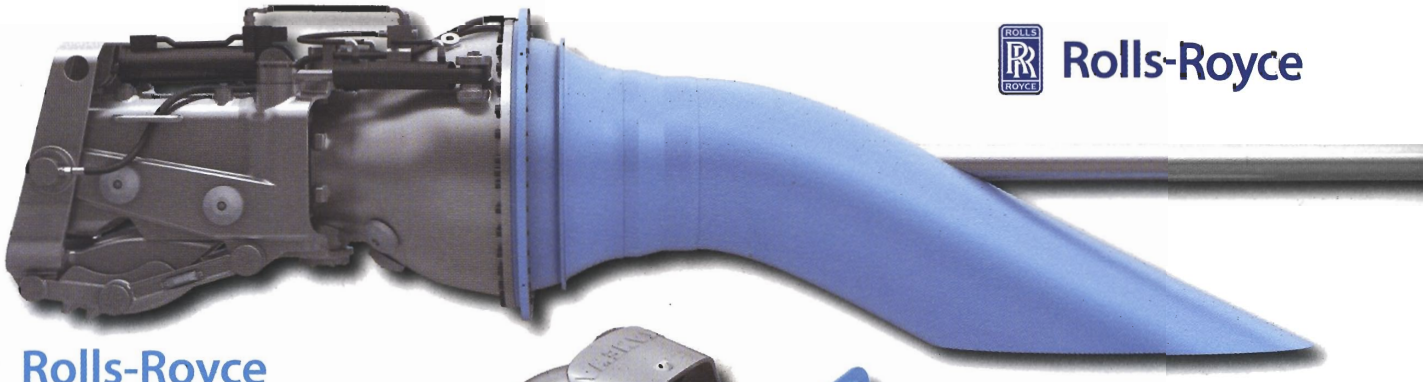
Waterjets produce less vibration and noise than propellers. At speeds over 20 knots, the vibration and noise can be reduced by more than 50 percent. In addition, with two or more waterjets, manoeuvrability is excellent, making quick dockings with perfect precision standard every time.

The impeller's rotation is never reversed, so no reversible gearbox is needed for this action.



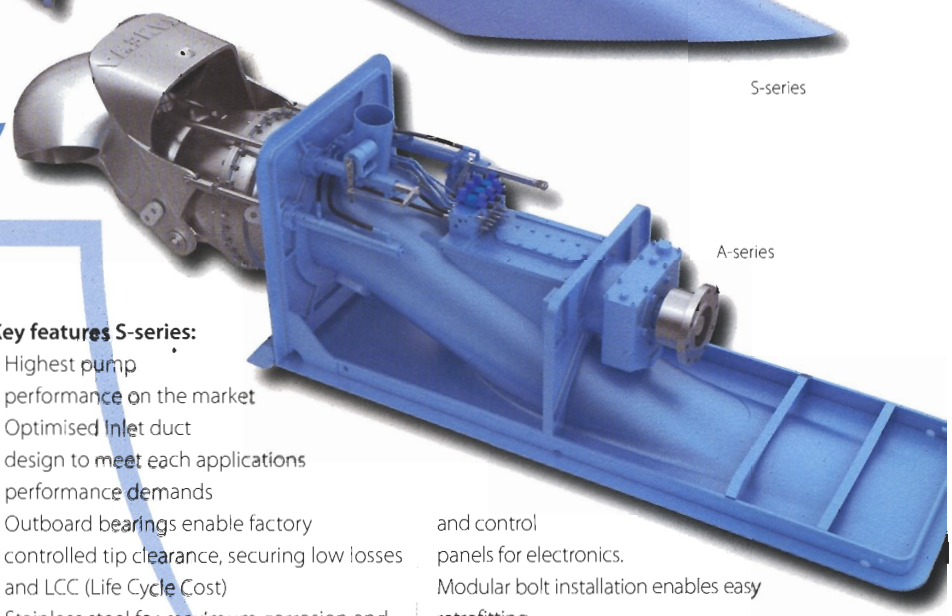
The impeller's task is to pressurise the water. The reaction force that is created when the water leaves the pump is utilised to propel the ship.

Rolls-Royce



S-series

Rolls-Royce mixed-flow waterjets, S-and A-series



A-series

Waterjets S-series

The Kamewa S-series of waterjets is developed for the most demanding applications. The Kamewa waterjet S- and A-series are equipped with the market's highest performance water-jet pump of mixed-flow type, developed at our own Rolls-Royce hydrodynamic research centre in Sweden to meet the market demands on efficiency and environmental aspects. To facilitate the hydrodynamic performance of the pump, the built-in bearings keep the impeller in correct position and provide control of the important tip-clearance. The outboard bearing position also simplifies the overall load distri-bution in the aftship and leads to efficient use of the inlet duct as load carrying structure.

The Kamewa S-series have five impeller blade designs, eight pump outlet nozzles and at least 10 variations of inlet duct designs are utilised to optimise the unit for each application. Minimal and simple cable installation is achieved through computerised databus-based system for steering and reversing control, which can be used for both manual and joystick manoeuvring. The system provides redundancy and real-time control with a very high level of security.

Key features S-series:

- Highest pump performance on the market
- Optimised inlet duct design to meet each applications performance demands
- Outboard bearings enable factory controlled tip clearance, securing low losses and LCC (Life Cycle Cost)
- Stainless steel for maximum corrosion and wear resistance

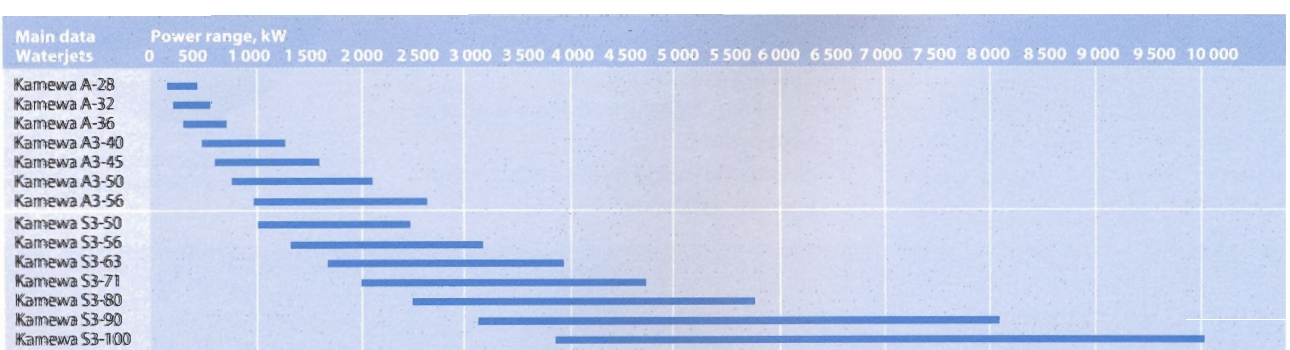
Waterjets A-series

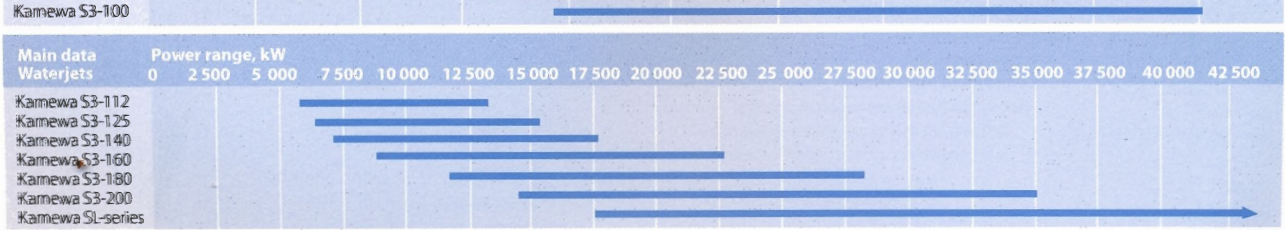
All Kamewa A-series waterjets are supplied with integrated and high performing aluminium inlet duct, with hydraulic valve block with pipings mounted on it.
New compact reversing bucket is one of the most efficient on the market, providing 65-70% reversing thrust level of the forward thrust. Totally new steering nozzle in stainless steel with minimised hydrodynamical losses and noise level provides superior speed at turns.

All Kamewa A-series waterjets can be delivered with new modular interceptor trim tabs bolted directly on the waterjet, including hydraulics and control panels for electronics.
Modular bolt installation enables easy retrofitting.
The A-series is the lightest and most efficient waterjet on the market in its size range, providing remarkable fuel and maintenance cost savings in addition to enabling low CO2-emissions.
All Kamewa S- and A-series waterjets can be supplied as booster unit with our steering and reversing gear.

Key features A-series

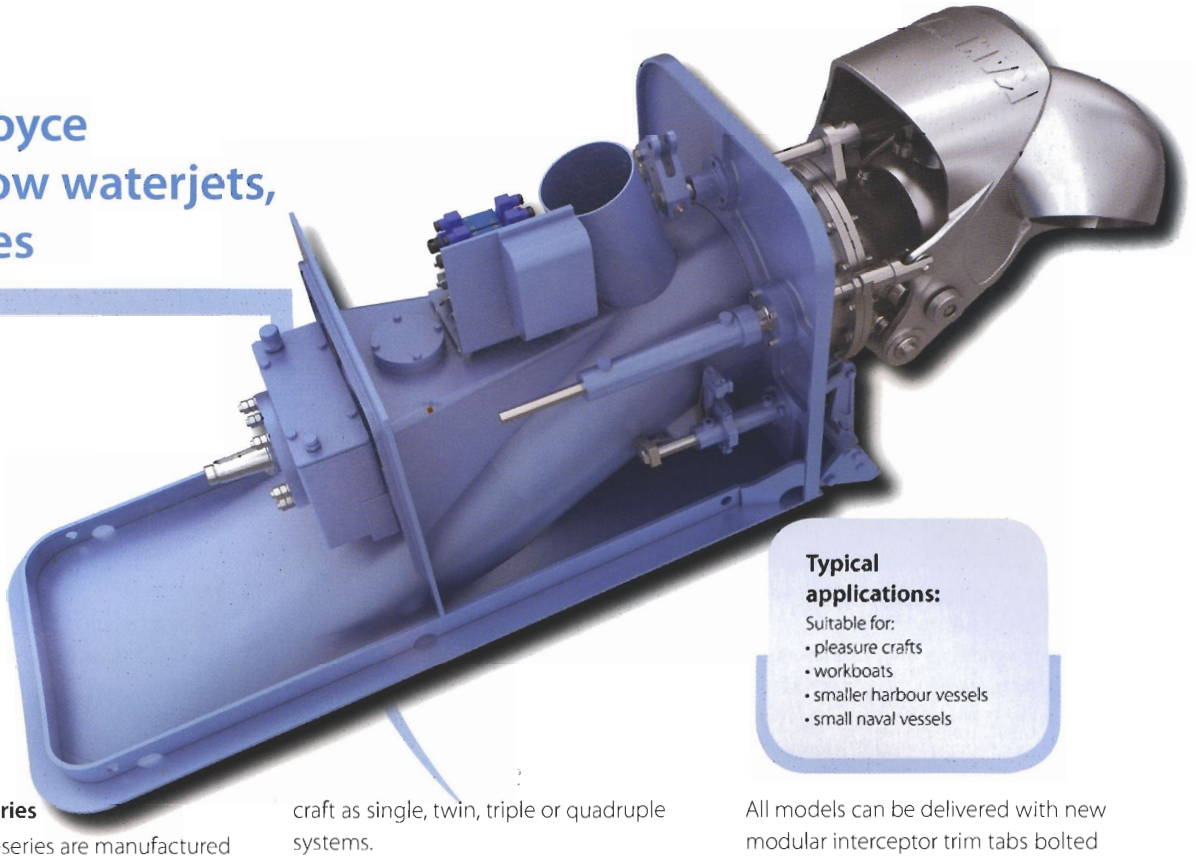
- Complete unit with high speed inlet duct and integrated hydraulics
- Unsurpassed steering and reversing performance
- Rugged stainless steel pump combined with lightweight aluminium structure
- Highest pump performance on the market





All A3 waterjets are equipped with a stainless steel pump unit. All models in the A-series will gradually be replaced by A3.

Rolls-Royce axial flow waterjets, FF-series



Typical applications:
Suitable for:
- pleasure crafts
- workboats
- smaller harbour vessels
- small naval vessels

Waterjets FF-series

The Kamewa FF-series are manufactured from strong, corrosion resistant materials. The impeller shaft and steering/reversing rods are made of stainless steel, remaining components are made of light aluminium. The interior surface of the impeller housing is lined with a special rubber-like material to minimise wear and noise. The pump is a single-stage axial flow design, providing a high volume flow with good pulling thrust at lower speeds. Usually, the Kamewa FF-series jets do not require reduction gears.

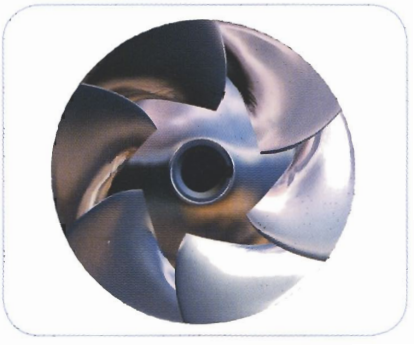
All Kamewa FF-series waterjets can be supplied as booster unit without steering and reversing gear.
The Kamewa FF-series waterjets have in several comparison tests proved to have 5% higher thrust force than the competing waterjets. The Kamewa FF-series can be installed on both displacement and planing craft as single, twin, triple or quadruple systems.

Our product is under constant development

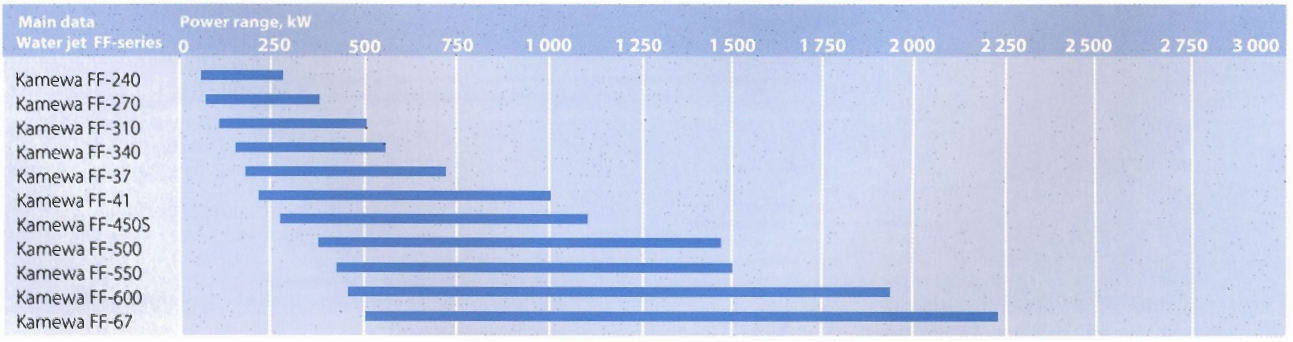
A new series of waterjets is being developed, and is already available in FF37, FF41 and FF67. These new models incorporate numerous improvements on pumps, reversing buckets and steering nozzle and provide the best size/weight-ratio in its class including built on hydraulics.

- Improved performance and efficiency over the entire speed range and up to 10% improved bollard pull at the same time
- 16% higher thrust in reverse
- 2 – 3 knots higher speed and less noise at hard turns
- No play in steering means better control improved efficiency.

All models can be delivered with new modular interceptor trim tabs bolted directly on the waterjet including hydraulics and control panels for electronics.



Axial flow impeller is usually designed to match the rpm of the engine and therefore reduction gear is not always required.



Rolls-Royce®

Rolls-Royce plc

Rolls-Royce Offshore
PO Box 1522
NO-6025 Aalesund
Norway
Tel: +47 815 20 070
Fax: +47 70 01 40 05

Rolls-Royce Merchant
PO Box 1522
NO-6025 Aalesund
Norway
Tel: +47 815 20 070
Fax: +47 70 01 40 05

Rolls-Royce Naval
PO Box 3, Filton
Bristol BS34 7QE
England
Tel: +44 117 974 8500
Fax: +44 117 974 8666

Rolls-Royce Submarines
PO Box 2000, Raynesway
DE21 7XX Derby
England
Tel: +44 1332 661 461
Fax: +44 1332 249 047

www.rolls-royce.com