



**EFFICIENT
PROPULSION &
MANOEUVRING**

BY

BRUNVOLL

INNOVATIVE SOLUTIONS FOR EFFICIENT PROPULSION & MANOEUVRING

Brunvoll – the single source supplier of complete propulsion, positioning and manoeuvring systems.

Each installation can be tailor made to meet individual requirements. Our expertise ensures optimized propellers, designed to handle all challenges of the harsh marine environment.



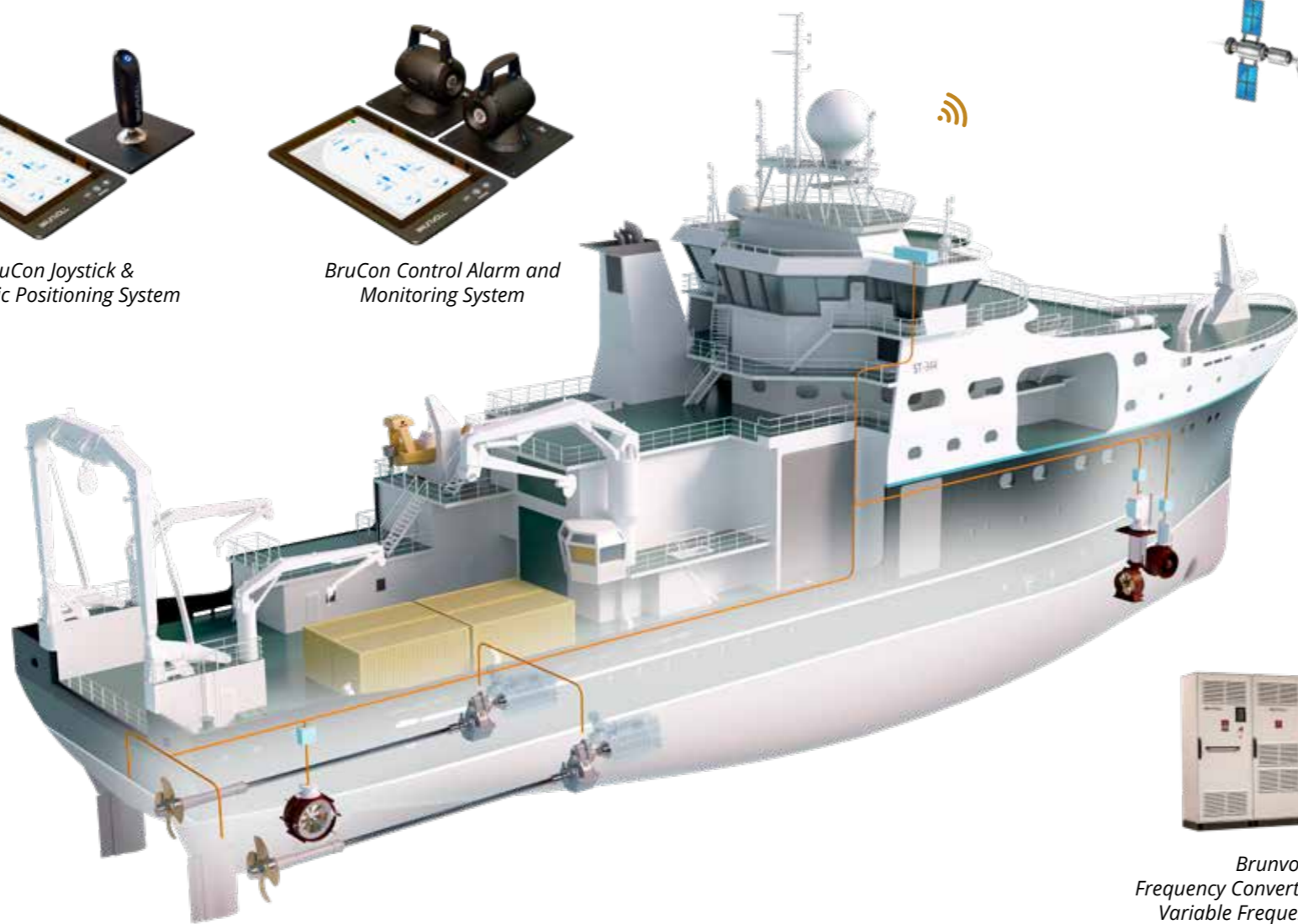
Brunvoll Azimuth RDT Thruster



BruCon Joystick & Dynamic Positioning System



BruCon Control Alarm and Monitoring System



BruCon CMS with Brunvoll Operation Centre - for remote access & assistance



Brunvoll Azimuth Push Ducted Propulsion Thruster



Brunvoll Azimuth Pull Open Propulsion Thruster



Brunvoll Main Propeller & Shaft Line



Brunvoll Contra Rotating Propeller with direct Electric Drive



Brunvoll Reduction Gear boxes



Brunvoll Frequency Converter Starters & Variable Frequency Drives



Brunvoll RDT (Rim Driven Thruster)



Brunvoll Retractable Combi Azimuth Thruster



Brunvoll LowNoise Resiliently Mounted Tunnel Thruster



Brunvoll Tunnel Thruster

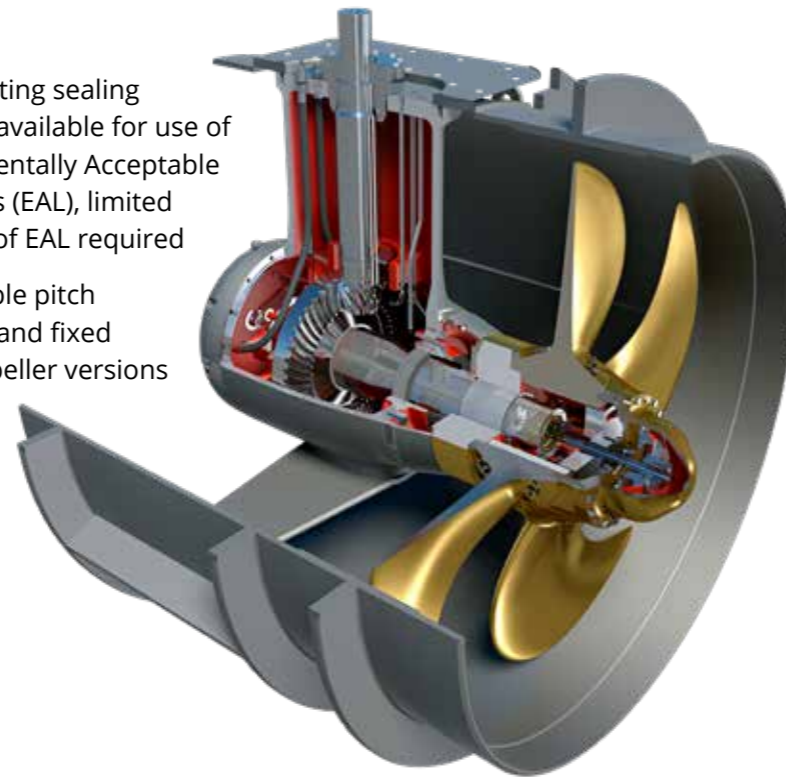


Brunvoll Retractable Azimuth Thruster

TUNNEL THRUSTERS

Brunvoll Tunnel Thrusters are designed for demanding marine requirements and has an extensive track record.

- Non-polluting sealing solutions available for use of Environmentally Acceptable Lubricants (EAL), limited amounts of EAL required
- Controllable pitch propeller and fixed pitch propeller versions available



Standard or Customized?



Standard version

With landing bars to avoid direct welding on the tunnel wall

With straight-cut tunnel extensions

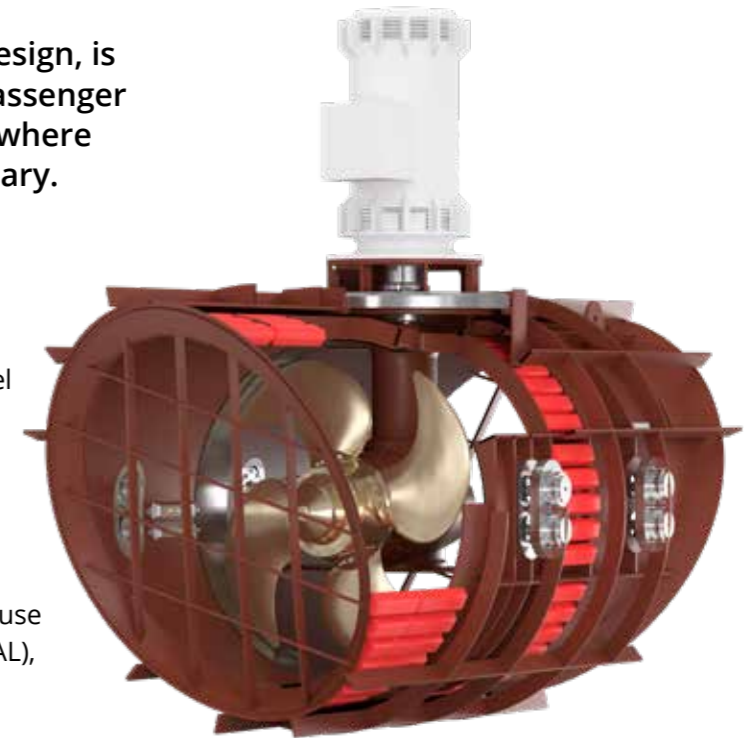
With tunnel extensions cut to suit hull lines and protection grids

Customized solutions – easy hull integration

LOWNOISE TUNNEL THRUSTERS

Brunvoll LowNoise Tunnel Thruster design, is used on cruise liners, super yachts, passenger ships, research- and offshore vessels where extensive noise suppression is necessary.

- Noise reduction of 11 - 15 dB(A)
- Resiliently mounted, full length double tunnel
- Complete from factory with no assembly at the yard
- Easy hull integration, no additional welding of tunnel extensions at yard
- Non-polluting sealing solutions available for use of Environmentally Acceptable Lubricants (EAL), limited amounts of EAL required



The figures below show typical noise levels in a cabin 3-4 decks above the thruster room:



Brunvoll's noise reduction **55** dB(A)



Ordinary noise reduction **67** dB(A)



NO noise reduction **72** dB(A)

- Quieter sailing means better sleep, improving the alertness and efficiency of the crew. Passengers enjoy a new degree of comfort
- Thruster noise represents a major problem for crews
- The stress and discomfort it causes may threaten both performance and safety on board

RETRACTABLE AZIMUTH THRUSTER

Brunvoll Retractable Azimuth Thruster provides manoeuvring capabilities extending the operational weather window of the vessel, increasing capacity, flexibility, productivity and safety.

It provides opportunities for innovative and flexible use of thruster functionality for positioning, track keeping and redundant «take-home»

Direct power transmission using a vertical top-mounted electric motor eliminates the need for special shaft and quick-release coupling arrangements when the thruster is lowered into and retracted from the working position. This solution also eliminates the need for gearboxes to connect the prime mover to the thruster – resulting in better total efficiency.

- Reliable and proven technology
- Shaped like a long column, installed vertically in the thruster compartment
- Compact design – minimal footprint – and good access for visual inspection of vital parts
- Delivered with azimuth- and retracting arrangement with guiding column in pre-assembled condition fitted on the tank top/sea chest integration plate
- Lowered into operating position and retracted into the hull by means of hydraulically operated lifting equipment
- When Thruster is retracted, it is mechanically locked by means of spring loaded locking devices and the hull opening will be closed by a flush-plate attached to the bottom of the propeller nozzle
- Controllable pitch propeller and fixed pitch propeller versions available
- Non-polluting sealing solutions available for use of Environmentally Acceptable Lubricants (EAL), limited amounts of EAL required



RETRACTABLE AZIMUTH COMBI THRUSTERS

Brunvoll Combined Azimuth/Tunnel Thruster is a unique Brunvoll solution – working as a Tunnel Thruster in retracted position and as an Azimuth Thruster in lowered position.

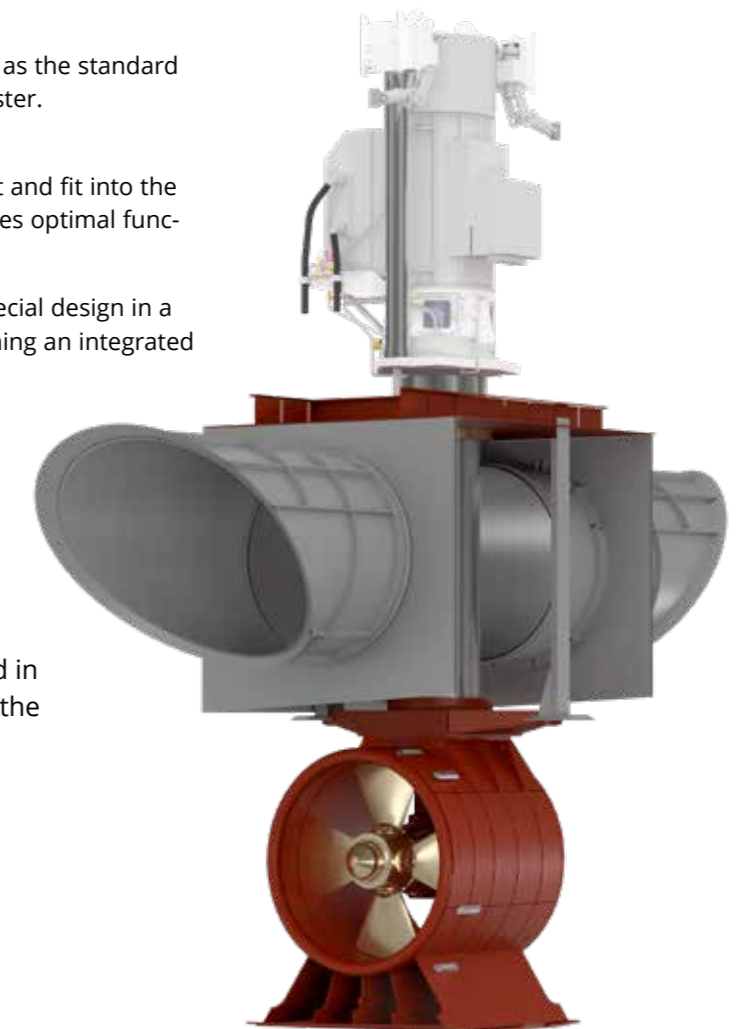
This special solution has the same basic features as the standard compact version of the Retractable Azimuth Thruster.

Special features for the Combi Thruster:

The propeller nozzle has a special design to adopt and fit into the hull section with its tunnel extensions. This ensures optimal function as tunnel thruster

The vertically top mounted electric motor is of special design in a reinforced housing with the flange in each end, forming an integrated part of the vertically moving column.

- A popular choice for product tankers, reefers, chemical tankers and container ships in the merchant fleet
- This unique solution is of growing interest for advanced fishing vessels and is installed in several pelagic fishing vessels operating in the North Atlantic



It works as a tunnel thruster in upper position, and as an azimuth thruster in lower position.

AZIMUTH PROPULSION THRUSTERS

– PUSH DUCTED PROPELLERS

Push ducted propellers, built for heavy duty operations, designed with emphasis on maximum bollard pull and focus on hydrodynamic- and total energy efficiency with low drag and good manoeuvrability.



All Brunvoll Propulsion Azimuth Thrusters are:

- All Brunvoll Propulsion Azimuth Thrusters are available with L- and Z-drive configurations
- Weld-in fixed mounted, or –
- Well mounted bolt-in arrangement allowing the complete thruster to be lifted out/into the ship as one piece without dry docking
- Great flexibility in stem lengths/propeller arm lengths
- Robust design, and attention to details make for trouble-free performance
- Brunvoll focuses on excellent technical solutions to ensure that our thruster units can handle all the challenges of the marine environment
- Replaceable propeller blade bearing liners
- Controllable pitch propeller and fixed pitch propeller versions available
- Non-polluting sealing solutions available for use of Environmentally Acceptable Lubricants (EAL). Limited amounts of EAL required

– PULL OPEN PROPELLERS

Pull open propellers, designed as a highly efficient pulling thruster with good manoeuvrability, course stability and low resistance.



- Optimized for minimum drag
- High rudder efficiency
- Optimal propulsion performance
- Low noise and vibrations
- Full feathering CP-propellers are available as well as various shaft brakes in accordance with specific project requirements

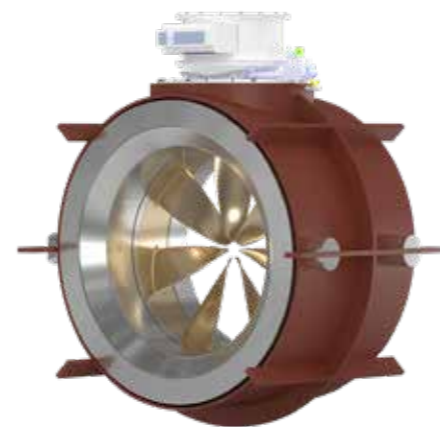
RIM DRIVEN THRUSTER (RDT)

Thruster with motor and propeller in one compact unit.

- Integrated Permanent Magnet (PM) motor for Variable Frequency Drive
- Efficient operation with no transmission losses
- Compact design with savings in weight and space
- No central shaft and no shaft supporting struts improves propeller efficiency and reduces propeller induced noise and vibration
- No risk of oil pollution as the bearing design eliminates need for oil lubrication
- The simplicity of the system reduces costs



RDT Azimuth Thruster



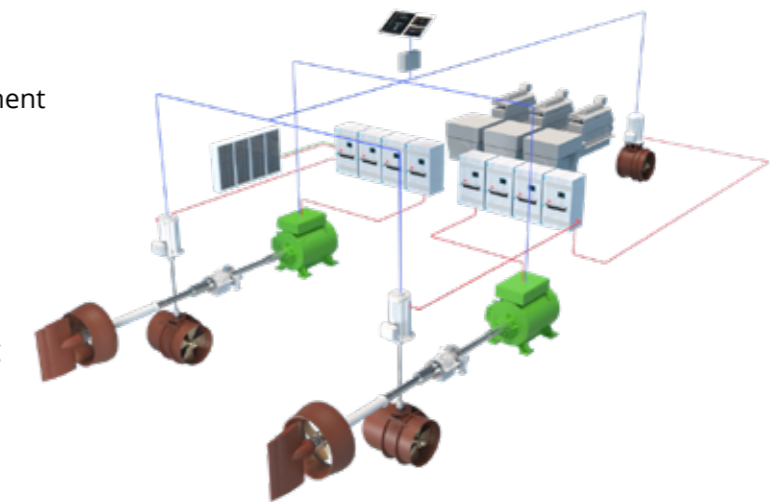
RDT Tunnel Thruster

DIRECT DRIVEN HYBRID ELECTRIC PROPULSION SYSTEMS

Brunvoll hybrid propulsion systems are available in many configurations - also as direct driven propellers from electric motors.

Hybrid Electric Propulsion

- Standard electric motors, either permanent magnet motors or induction motors
- Single screw or twin screw
- CP- or FP-propellers
- Contra Rotating Propeller
- Stern tube, propeller shaft and coupling
- Brunvoll nozzle
- Brunvoll Integrated Costa Propulsion



Contra Rotating Propellers (CRP)

A unique combination of known technologies

- A complete propulsion system with Contra Rotating Propellers in a redundant single screw configuration, approved by DNV for two electric motors.
- A configuration of fixed pitch monoblock propellers individually driven by two electric motors through a unique shaft-in-shaft arrangement
- Each propeller rotates independently, allowing for optimal efficiency
- The CRP main propulsion system is available in the range from 1MW to 5MW



The CRP-system is:

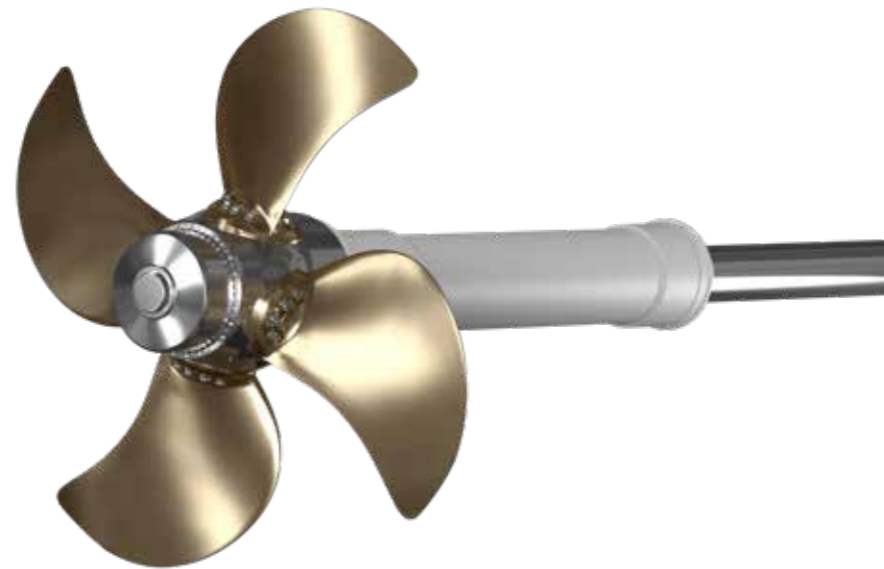
- Efficient
- Redundant
- Compact

CP-PROPELLERS

Customised propeller design for optimal efficiency and multi objective performance.

There is a continuous demand for optimised propeller designs to achieve the highest energy efficiency. All our propellers are designed to meet the customer demands for the particular ship.

Propeller blade data such as diameter, pitch, rpm, skew, and load distribution, are carefully selected to give the best solution. Tailor-made blade design ensures optimum propeller efficiency with lowest possible vibration and noise levels.



Feathering is an option on standard CP-propellers. On a feathering propeller the blade angle can be adjusted in line with the water flow.



Benefits with a CP-propeller

- Maximum bollard pull can easily be attained by adjusting the pitch to right level irrespective of water depth, current, rudder angle etc.
- Varying sea loads have minor influence on the CP-propeller as the pitch can always be set to an ideal position for the actual condition
- The CP-propeller increases flexibility if available engine power is reduced

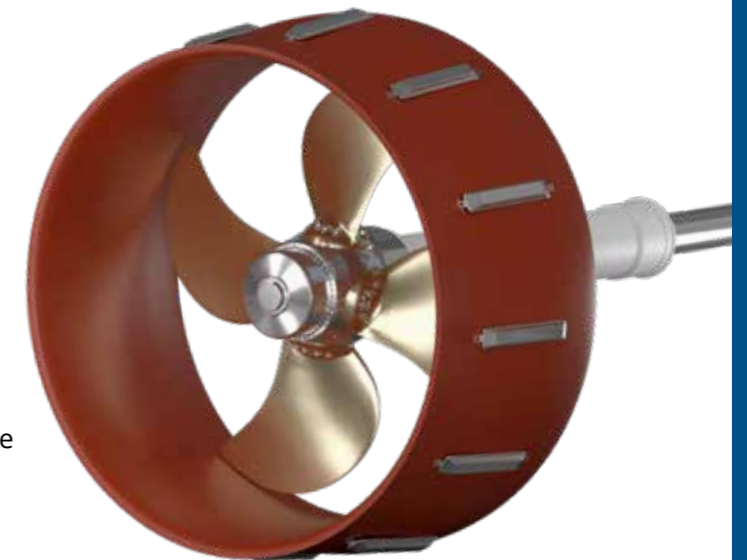
PROPELLER NOZZLES & INTEGRATED COSTA PROPULSION

Increase propulsion efficiency by applying the optimum nozzle profile.

A ducted propeller gives up to 30% higher thrust at low speed compared to an open propeller.

Brunvoll is optimising the propulsion efficiency by applying the most suitable nozzle profile for the given service profile.

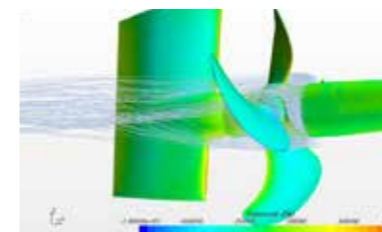
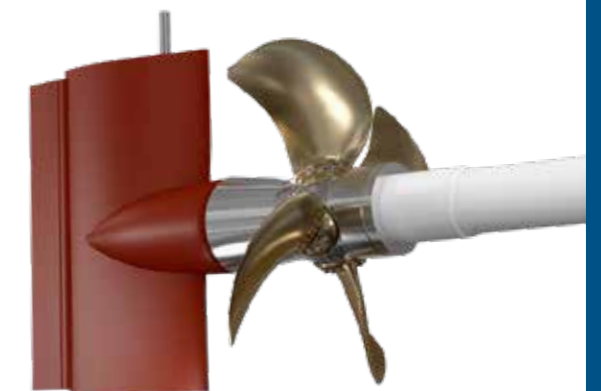
- Brunvoll HE nozzle profile is recommended for ships with high bollard pull requirements and low propeller load at higher vessel speed
- The 19A nozzle profile is recommended for many ships due to its good overall performance in different operating conditions



Integrated Costa Propulsion (ICP)

ICP consists of a twisted leading-edge rudder with hub cap acting as one system. ICP improves energy efficiency and reduces fuel consumption

- Significantly increased propulsion efficiency
- Reduced noise, pressure pulses and cavitation
- Robust and reliable construction
- Improved low-speed manoeuvrability
- Ideal for most ship types



REDUCTION GEARBOXES

All gearboxes are configured to the ship's operating profile for optimum energy efficiency. Propulsion systems and gearboxes fit with any make and type of engines and electric motors regardless of energy source.



Horizontal
Up to approx.: 20.000 kW



Vertical
Up to approx.: 20.000 kW



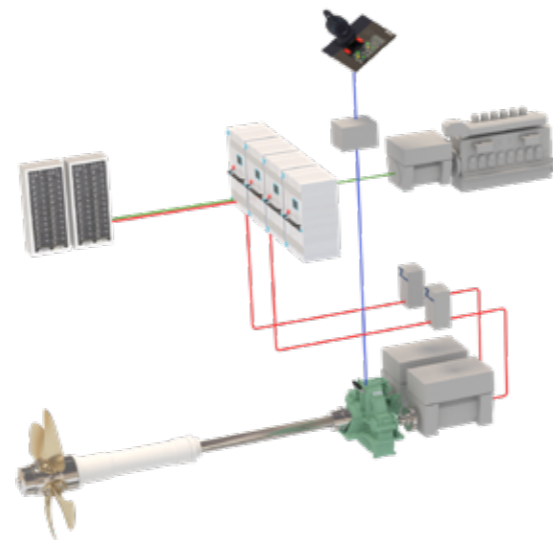
Vertical K-type
Up to approx.: 8.000 kW



Twin-in Single-out
Up to approx.: 2 x 10.000 kW



2-speed gear
Up to approx.: 12.000 kW



- The purpose of the reduction gearbox is to, optimum and efficient, accommodate prime mover's torque and rpm to the propeller
- The gearbox also transfers the thrust force from the propeller to the ship structure
- Power Take-Off (PTO) at the gearbox enables energy distribution from the main engine, via the shaft generator, to power other onboard systems and equipment
- A hybrid propulsion configuration can be achieved by use of the PTI (Power Take-In) to power the propeller from different energy sources
- The gearbox may have multiple power inputs and outputs, giving high flexibility and redundancy

HIGH EFFICIENCY WITH 2-SPEED PROPULSION SYSTEM

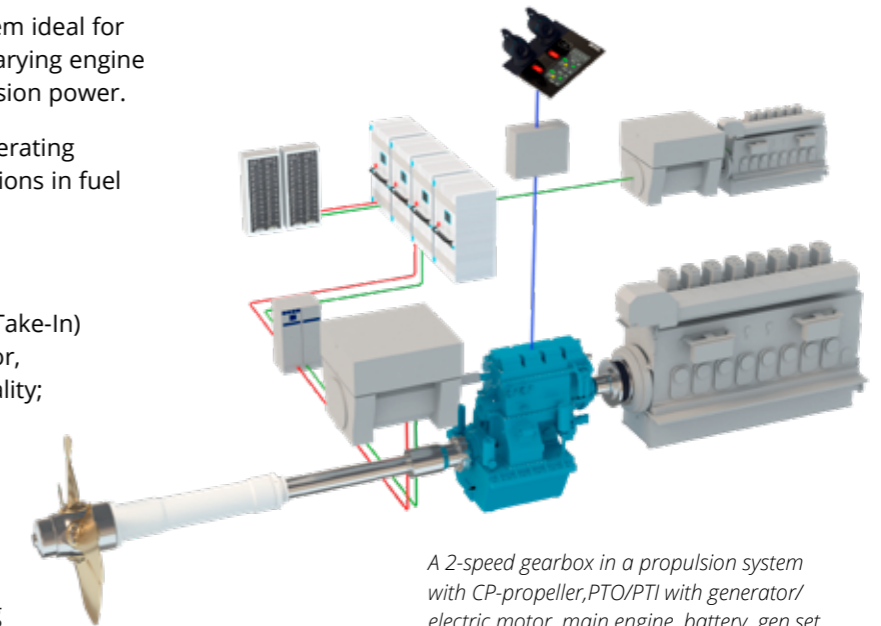
The 2-speed reduction gearbox provides for different propeller rpm for different operating modes.

This is a highly efficient propulsion system ideal for vessels working at constant or slightly varying engine speed, but with need for varying propulsion power.

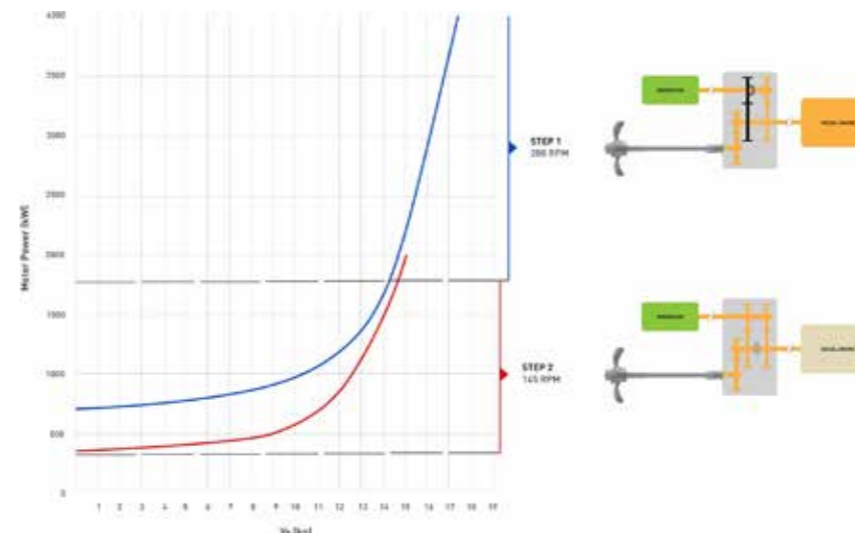
Reduced propeller rpm in low-speed operating conditions, will give considerable reductions in fuel consumption and emissions.

With a PTO/PTI (Power Take-Off/Power Take-In) and a combined generator/electric motor, the system achieves increased functionality;

- The PTI allows for boost mode, Power-Take-Home (PTH), or for pure electric operation mode
- The PTO will continue generating electric power to the vessel during operation of the prime mover



A 2-speed gearbox in a propulsion system with CP-propeller, PTO/PTI with generator/ electric motor, main engine, battery, gen.set and control system.



The graph shows the direct effect in energy saving by reducing the propeller rpm.

BRUCON PROPULSION AND MANOEUVRING CONTROL

A control system for all types of propulsion, rudder and thruster configurations. The optimal choice for the most demanding system applications.



BruCon is the common automation platform used for all Brunvoll automation products.

Standardised hardware and software components ensure common approach to user interaction, physical appearance and system architecture.

This will simplify maintenance and reduce spare parts stock.

- Customized and selectable user interface with extended information according to operational requirements
- BruCon makes it easier to identify any potential problem, cutting installation and commissioning costs, after-sales service costs and maintenance effort
- As well as being a reliable stand-alone system, BruCon provides easy integration with other monitoring and control systems
- There is no time lag between the command and the response or feedback signal

BRUCON DYNAMIC POSITIONING SYSTEMS

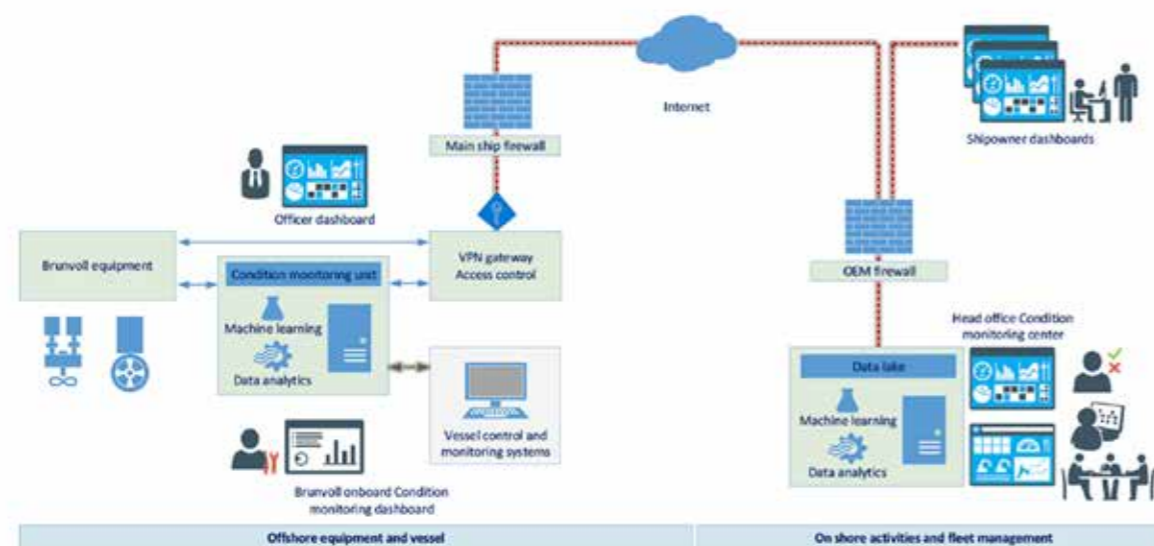
Brunvoll Dynamic Positioning (DP) and Joystick (JS) systems, with focus on enhanced user experience and performance. Designed for all kind of vessels.



- The BruCon DP controls thrusters, propulsion and rudder units in the most efficient and economical way possible
- Interface to all relevant sensors and position reference systems
- BruCon DP follows our long traditions for in-house development and plays an important role in Brunvoll's strategy for autonomous vessel operation
- BruCon JS is part of the BruCon product family and can be used either as standalone or as part of a DP installation as the independent Joystick
- Designed to comply with IMO DP1, DP2 and DP3 requirements

BRUCON CONDITION MONITORING SYSTEM (CMS)

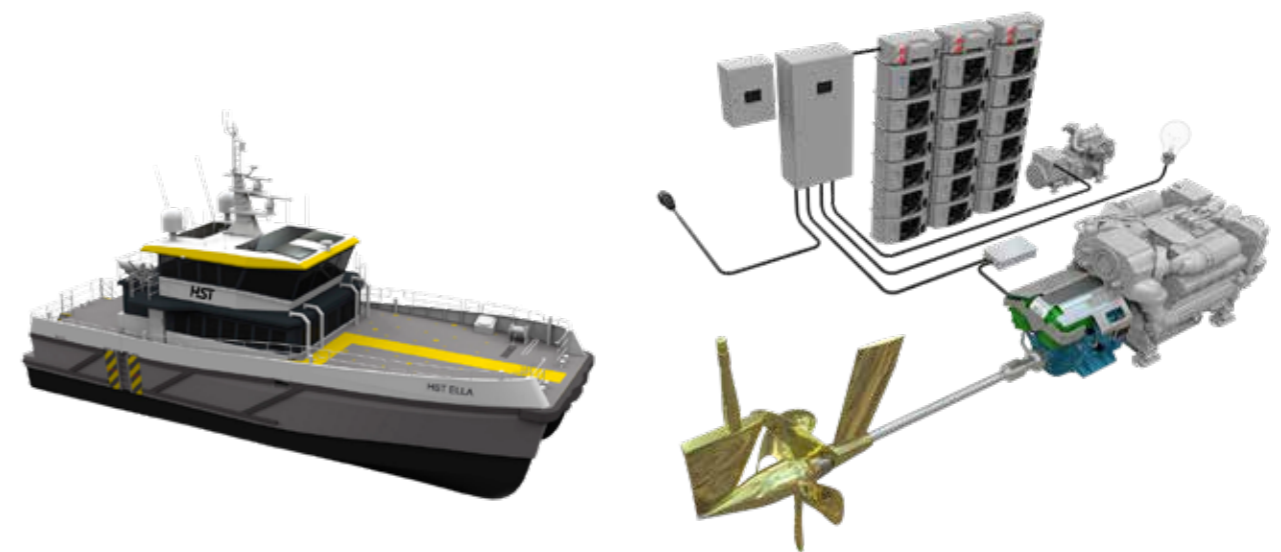
Online support by expert OEM personnel available 24/7. Keeps owners and crew informed of the condition of vital propulsion units and manoeuvring thrusters via a web dashboard.



- Enhanced equipment monitoring with reduced need for dry-docking the vessel for visual inspection
- Reduced cost and downtime through preventive maintenance triggered by the CMS
- Easier troubleshooting due to quantification of equipment operation
- Access to the expert OEM competence of Brunvoll

ELECTRIC & HYBRID PROPULSION INTEGRATION

Hybrid propulsion systems benefit from the flexibility in combining different energy sources e.g. battery, fuel cells, diesel/dual fuel engines.



- Hybrid Propulsion Systems for optimum energy efficiency of the vessels
- The Hybrid system configuration is a fuel efficient and versatile arrangement
- Brunvoll specialize in compact and light weight hybrid solutions, taking full responsibility of the system integration
- Our wide range of system configurations consists of a hybrid package for propulsion with hotel load supply and standardised charging solutions on shore
- This solution is ideal for operations in areas with requirements for low noise and reduced local emissions, such as harbours and protected areas
- A system configuration may consist of various components depending on the vessel type and operation profile. Brunvoll has a wide range of configurations to meet the market demands

SALES & AFTER SALES SUPPORT

Brunvoll supplies a wide range of propulsion, positioning and manoeuvring systems for various types of vessels.

It is our pride to provide our customers with After-Sales Service Technicians that can work precisely and meet required deadlines despite the complexity of the Brunvoll Systems installed onboard.

Our After-Sales Service Technicians are multi disciplinary with their wide background and wealth of experience. They can easily adopt to most situations and resolve issues related to our products and systems to the complete satisfaction for our customers.

Brunvoll After-Sales Service Technicians are available from our factories in Norway and multiple service stations in our world wide agent network.



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