



# becker marine systems



## Becker Bulb Rudders

IMPROVED PROPULSION EFFICIENCY WITH TOP MANOEUVRABILITY

IMO Tier 2, VGP, EEDI and SEEMP are some examples of the increasing number of environmental regulations and guidelines coming out recently. All of these target the overall reduction of emissions caused by vessels during operation at sea.

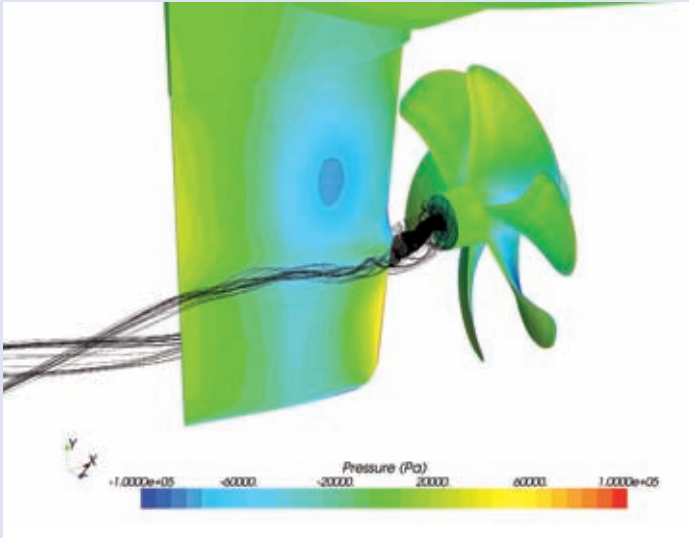
As the world leader for manoeuvring and energy-saving devices, Becker Marine Systems is a very strong partner in the market for environmentally friendly and money-saving technologies. Due to its longtime experience, Becker Marine Systems is able to provide customised rudder solutions for every type of vessel and operational profile.

Replacing a vessel's conventional half spade or full spade rudder with a Becker bulb rudder will increase its propulsion efficiency by approx. 3-4%. It also turns the rudder arrangement into a high-performance propulsion/manoeuvring package. The main benefits are:

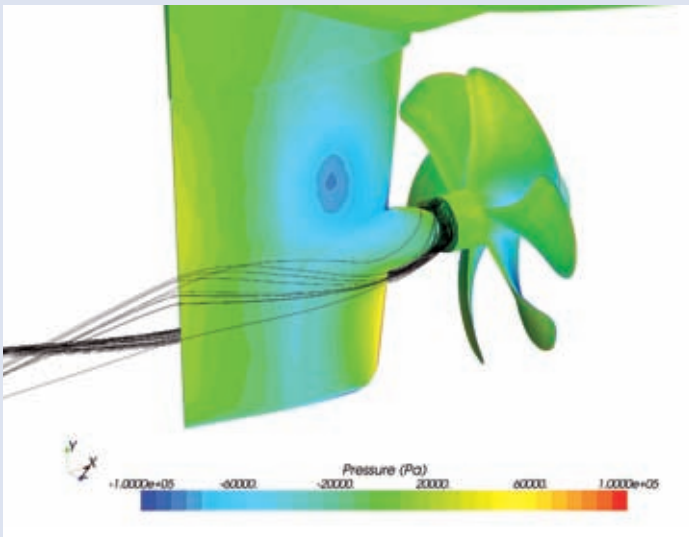
- No rudder-induced hub cavitation
- Reduced rotational losses in the slipstream
- Reduced hub vortex losses
- Reduced vibration and noise



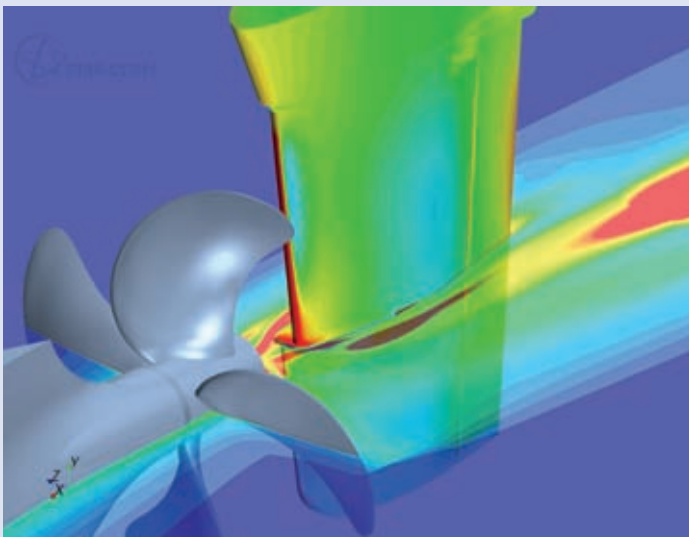
Playa de Ris for PEVASA with 14 m<sup>2</sup> twisted rudder with integrated bulb



*Flow around the rudder without a rudder bulb*



*Improved flow around the rudder with a rudder bulb*



*CFD simulation of energy losses in the water flow without a rudder bulb*

### Better performance with bulb rudders

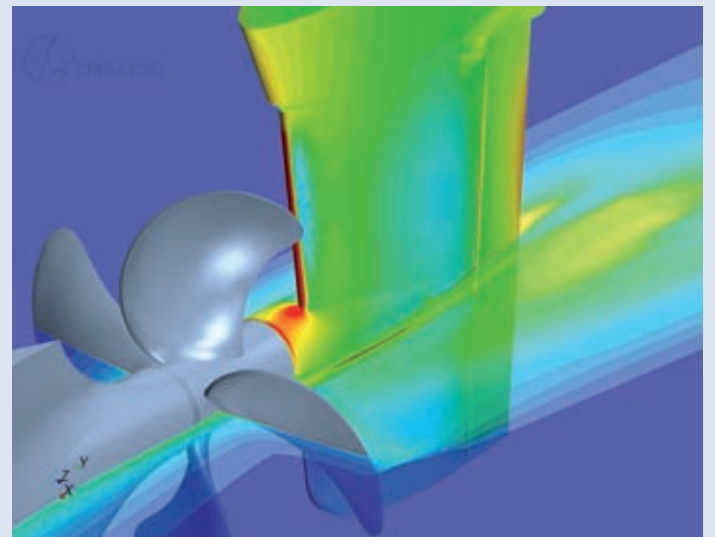
Ship rudders are generally situated in complex, highly turbulent flow fields. This offers opportunities for significant power savings by recovering some of the associated flow energy losses through careful design of the propulsion and steering system. The Becker rudder bulb provides such an optimised solution.

The rudder bulb system consists of a streamlined bulb fixed at the leading edge of the full spade rudder, which is situated aft of the propeller hub. The transition between bulb and propeller hub is bridged by a fairing cap.

The integrated rudder bulb minimises energy losses behind the propeller hub by eliminating flow separation and very effectively reducing wasteful fluid turbulence. In addition, careful design of both the bulb geometry and twisted rudder leading edge ensures optimal energy recovery from the propeller slipstream.

The propeller hub fairing is designed to guide the flow smoothly over the bulb. Thus, the hub fairing and bulb are developed as a single hydrodynamic entity from the outset. The resulting shape and dimensions are dependent on the particulars of the propeller and hull and can therefore vary from case to case.

This rudder bulb system can be applied to virtually every situation, making it suitable for both new-build and retrofit projects alike.



*Same CFD simulation with a rudder bulb showing reduced energy losses*



## Proven performance during model tests

Our research and development department is able to simulate the performance behaviour of the whole vessel prior to model tests or sea trials. Computational Fluid Dynamic (CFD) simulations of propeller/rudder setups with customised rudder bulb and twisted leading edge design have shown a reduction in power requirements of approx. 4% when compared to conventional rudder designs.

Comparative model tests of bulb rudders and conventional full and half spade rudders at different towing tank facilities have revealed propulsion efficiency improvements for different vessel types. For example:

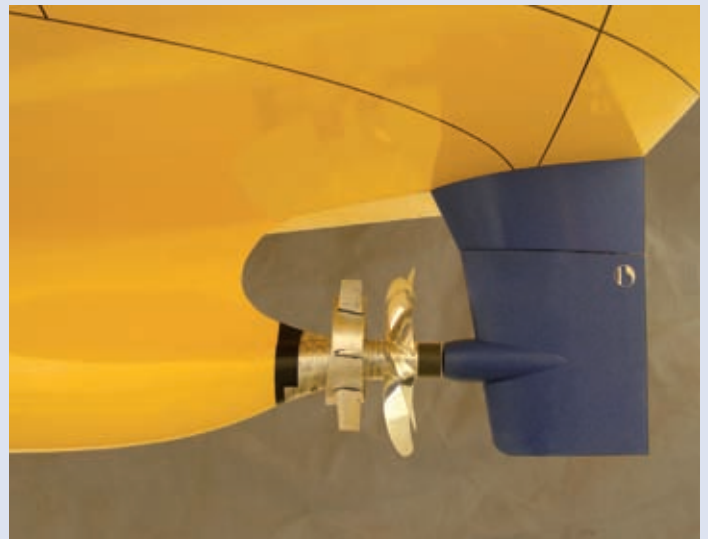
- An approx. 3% reduction of power requirements for a 2,500 TEU container vessel at a speed of 19 knots
- An approx 4% reduction of fuel requirements for a 195 m long RoRo ferry at a speed of 20 knots
- An approx. 3% reduction for a 60k LNG carrier at a speed of 18 knots
- A 6-7% reduction of fuel requirements for a 220 m RoPax ferry at 25 knots

Further tests in the cavitation tunnel have demonstrated the elimination of harmful hub vortex cavitation following installation of a rudder bulb. This makes the overall rudder system a more reliable solution.

**Conclusion: A 2-4% reduction of fuel requirements**



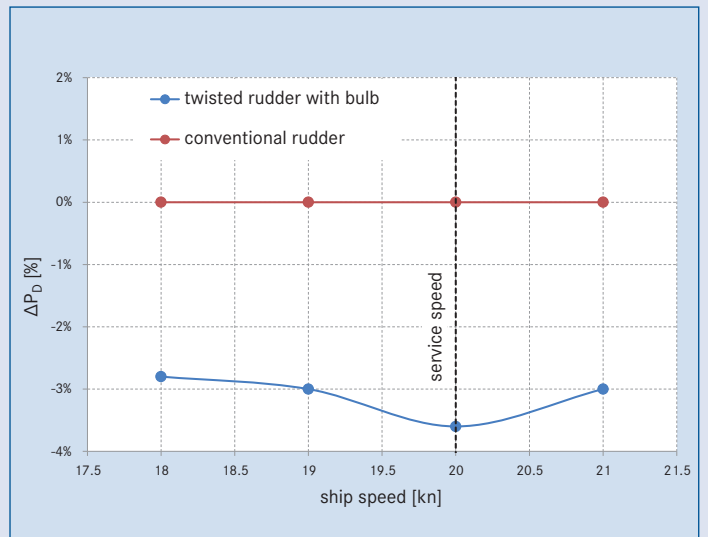
Propulsion test of a 2,500 TEU container vessel



18,000 TEU container vessel with Becker Twisted Fin® and bulb rudder



Becker twisted Fin® and bulb rudder arrangement



Test results of reduced power requirements for a twin screw car ferry



*A 95 m<sup>2</sup> TLKSR<sup>®</sup> (twisted rudder) with rudder bulb will be installed on the new 16,000 TEU MSC container vessel*

## References

Becker bulb rudders installed on several types of ships (container vessels, multi-purpose vessels, RoRo ferries and PCTCs) are showing good results in power savings and reliability.

Our energy saving devices, the Becker Mewis Duct<sup>®</sup> for full-form slower vessels and Becker Twisted Fin<sup>®</sup> for slender, faster vessels, can be combined with bulb rudders and reduce the demand for main engine power by an additional 1-4%.

In order to get the best possible performance from the rudder system Becker offers its Becker Intelligent Monitoring System (BIMS) and the new (optional) Becker Bearing Monitoring System (BBMS).

These systems monitor rudder force and drag and are able to determine the wear of the neck bearing without having to dismount the rudder.



*Multi-purpose vessel with 23 m<sup>2</sup> TLFKSR (twisted flap rudder) with integrated rudder bulb*