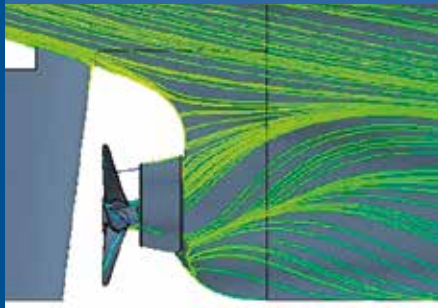


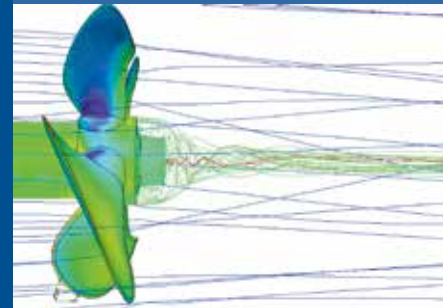
### WAKEFIELD EQUALISATION

The Becker Mewis Duct® straightens and accelerates the hull's wake into the propeller and also produces net forward thrust.



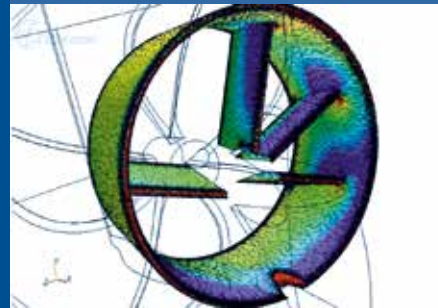
### REDUCTION OF PROPELLER HUB VORTEX

An improved slipstream behind the duct significantly reduces the hub vortex with a corresponding reduction in thrust, leading to improved thrust and inflow to the rudder.



### CONTRA-ROTATING SWIRL

Due to individually placed fins, a pre-swirl counter to the direction of propeller operation is generated, recovering rotational energy from the slipstream.



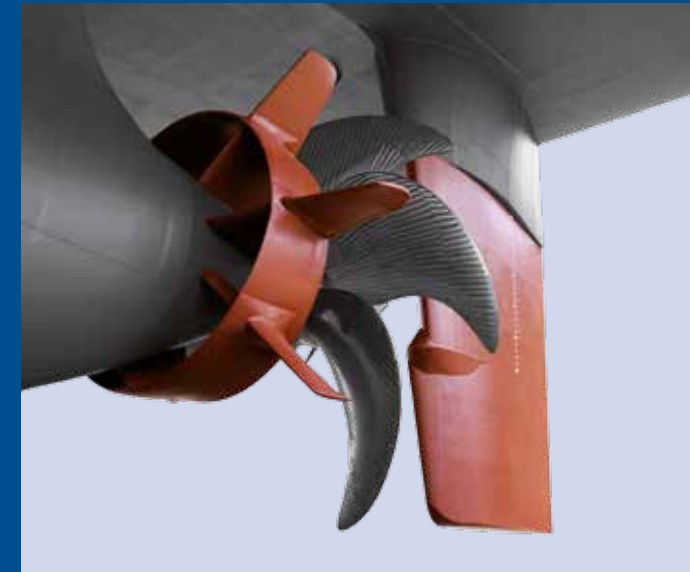
## BECKER PERFORMANCE PACKAGE (BPP)

The combination of a Becker Rudder and Becker Mewis Duct® or Becker Mewis Duct® Twisted enables maximum possible energy savings in front of and behind the propeller. Both products are available from a single company and are thus perfectly harmonised via Computational Fluid Dynamics (CFD) calculations for optimised manoeuvring and maximum energy savings.

The total performance improvement is based on two parts, the active part related to the improvement of flow towards the

propeller, the reduction of losses, the pre-swirl and the passive part for minimising drag and improving course stability.

Becker Marine Systems constantly reviews the best combinations of a Becker Mewis Duct® or Becker Mewis Duct® Twisted with a rudder system such as the Becker Flap, Becker Twist or Becker Schilling® Rudder, resulting in the best combination of manoeuvrability and efficiency.



#### ESPECIALLY SUITED FOR:

- Container feeders
- Container liners
- Tankers
- Shuttle tankers
- LNG/LPG carriers
- Bulk carriers
- General cargo carriers/ Heavy lifters
- Car carriers
- ConRo/RoRo
- Ferries
- Navy ships

#### ADVANTAGES:

- Optimised rudder profile
- Reduced weight
- No cast parts
- Less cavitation
- Reduction of rotational losses
- Improved propulsion efficiency
- Minimised drag
- Improved course keeping
- Power savings
- Reduced wear and tear
- Best propeller coverage
- Reduced vibration

### ALL IN ONE – BECKER MEWIS DUCT®

The Becker Mewis Duct® combines all three of the principles above in a non-linear interaction:

The Becker Mewis Duct® harmonises and stabilises flow and generates a pre-swirl to reduce the rotational losses in the propeller slipstream. The integrated fins have a stator effect by generating a pre-swirl counter to the direction of propeller operation. This generates more thrust. The fins are asymmetrically profiled and arranged to generate a perfectly homogenous flow distribution.

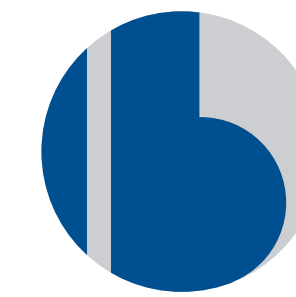
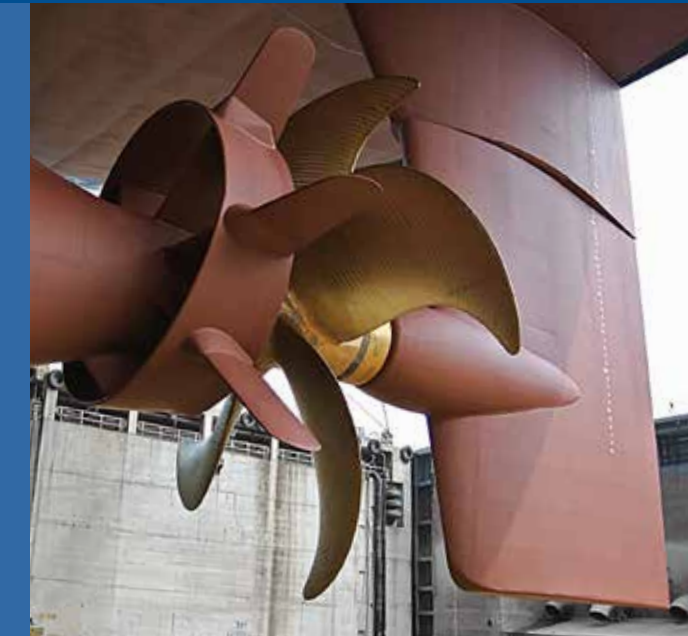
The combination of the Becker Mewis Duct® with a Becker Rudder dramatically increases the efficiency of the system by means of wakefield optimisation and lower rudder resistance with improved manoeuvring performance.



### COMBINED ENERGY SAVINGS

With maximum energy savings resulting from the Becker Rudder and a Becker Mewis Duct® or Becker Mewis Duct® Twisted, the BPP can be applied to almost any hull form as well as virtually any propeller.

With the BPP clients such as shipyards, ship designers and ship owners/managers have the opportunity to apply a tailor-made and advanced energy-saving solution in order to achieve significant efficiency gains for a given hull form and given propeller design and by doing so close a gap in required ship speed or achieve a specific required power savings.



# becker marine systems



## ENERGY-SAVING DEVICES

With a record of improving rudder efficiency as its core mission, Becker Marine Systems began development of a new energy-saving device intended to be better than anything else then available on the market.

Development began in 2008 and shortly thereafter the first Becker Mewis Duct® was produced and installed on an open hatch cargo carrier. The initial idea was to install the duct on tankers and bulkers, but due to its success in achieving average power savings of 6.5%, Becker Marine Systems was approached by the owners of other types of ships (general cargo vessels, multi-purpose vessels, heavy lifters and more) about ordering a Becker Mewis Duct®. Every contract includes a provision with a power-savings guarantee to be verified by a model test. If the model test does not demonstrate the level of agreed power savings, the owner may withdraw from the contract.

Then, in 2012 Becker was asked by the German owner of a container ship fleet to develop an energy-saving device for faster vessels such as container ships. This heralded the birth of the Becker Mewis Duct® Twisted (formerly known as the Becker Twisted Fin®).

Since that time Becker has been supplying the Becker Mewis Duct® and Becker Mewis Duct® Twisted to every major shipowner in the world. Becker Marine Systems has a very strong CFD team that custom designs Becker's energy-saving devices for each specific hull/propeller configuration. This experience enables Becker Marine Systems to offer a complete performance package including a Becker energy-saving device and a Becker rudder, designed and optimised to achieve maximum efficiency combined with the highest level of manoeuvrability.



## BECKER MEWIS DUCT®

The Becker Mewis Duct® is an energy-saving device developed for full-form slower ships enabling either significant power savings at a given speed or, alternatively, the vessel to travel faster at a given power level.

The Becker Mewis Duct® consists of two strong fixed elements mounted on the vessel: a duct positioned in front of the propeller along with an integrated fin system. The duct straightens and accelerates the hull wake into the propeller and also produces a net forward thrust. The fin system provides a pre-swirl to the ship wake which reduces losses in the propeller slipstream, resulting in an increase in propeller thrust at a given

propulsive power. Both effects contribute to one another. The power savings attainable from the Becker Mewis Duct® are strongly dependent on propeller thrust loading, from 3 to 8% depending on individual hull/propeller interaction. The power savings are virtually independent of ship speed. The Becker Mewis Duct® is ideally suited to both new-build and retrofit applications (e.g. tankers, bulkers and MPCs).

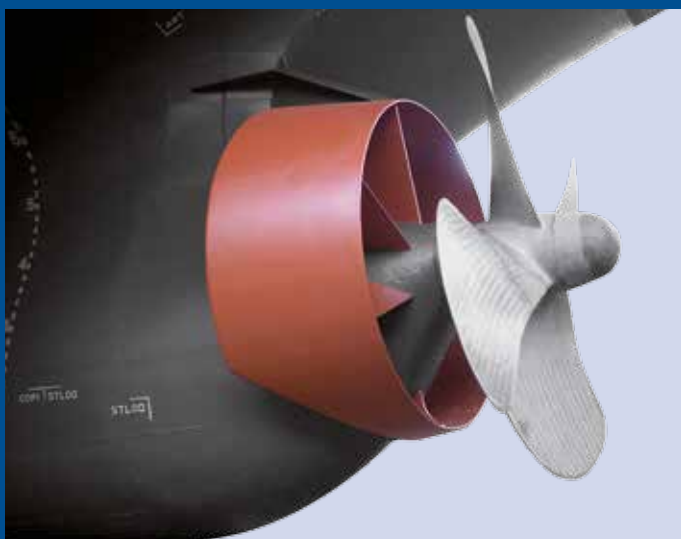
- Energy savings of up to 8%
- Low SO<sub>x</sub> and CO<sub>2</sub> emissions
- No moving parts

### ESPECIALLY SUITED FOR:

- Tankers
- Shuttle tankers
- LNG/LPG carriers
- Bulk carriers
- General cargo carriers/ Heavy lifters
- Car carriers

### ADVANTAGES:

- Optimised profile
- No cast parts
- Less cavitation
- Reduction of rotational losses
- Improved propulsion efficiency
- Improved course keeping
- Power savings
- Reduced vibration



### EASY INSTALLATION FOR NEWBUILDINGS AND RETROFITS

**Newbuildings:** Installation of the Becker Mewis Duct® can easily be performed during the block stage of the stern boss with minimal effort on the part of the shipyard and owner. The yard is able to implement the installation in the production schedule. The Becker design team installs the interfaces of the Becker Mewis Duct® and the ship according to the ship's steel structure and uses standard steel grades to build the Becker Mewis Duct®. Installation takes approx. five days.

**Retrofits:** Becker designed the Becker Mewis Duct® to also improve the efficiency of vessels as a refit option. The Becker Mewis Duct® can be installed during regular dry dockings or even intermediate dry dockings either with the propeller in place or dismantled. Becker's expertise ensures that installation is performed as quickly as possible, taking five days on average. Installation is carried out with Becker's guidance and supervision using standard welding and fitting procedures, making installation possible worldwide. The Becker Mewis Duct® design of the interfaces to the ship provides the highest strength and stiffness in accordance with classification societies.

## BECKER MEWIS DUCT® TWISTED

Becker Marine Systems has responded to the heavy demand of shipping companies for an energy-saving device for faster vessels. After two years of research and based on seven years of operational experience with the Becker Mewis Duct®, a new energy-saving device for container ships and other types of fast vessels with bulbous stern has entered the market – the Becker Mewis Duct® Twisted. In combination with a new propeller, the Becker Mewis Duct® Twisted can be part of a complete hydrodynamic performance package. The Becker Mewis Duct® Twisted is designed in accordance with the existing propeller setup.

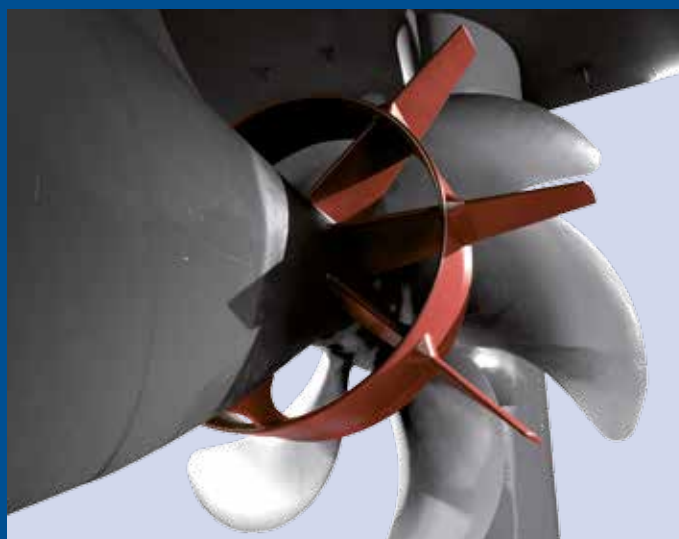
- Average energy savings of 3%
- Reduction of NO<sub>x</sub> and CO<sub>2</sub> emissions
- Guarantee of power savings as verified by model test: "Money saved or money back"
- Suitable for newbuildings and retrofits
- No moving parts, no maintenance required
- Fast installation

### ESPECIALLY SUITED FOR:

- Container vessels
- LNG/LPG carriers
- Car carriers
- ConRo/RoRo
- Ferries
- Navy ships

### ADVANTAGES:

- Optimised profile
- No cast parts
- Less cavitation
- Reduction of rotational losses
- Improved propulsion efficiency
- Improved course keeping
- Power savings
- Reduced vibration



### THE DEVELOPMENT FROM DUCT TO FIN

Because savings from the Becker Mewis Duct® are reduced at speeds above approx. 20 knots, Becker Marine Systems has developed a similar device, but with a smaller nozzle, a special, flat profile with much lower drag and fins which extend outwards beyond the nozzle – the Becker Mewis Duct® Twisted for faster hull optimised ships with speeds above 18 knots.

To prevent the formation of a swirl with cavitation at the ends of the fins Becker has developed special end caps for the fins. The small nozzle ring generates thrust, provides stability to the fins and reduces vibrations.

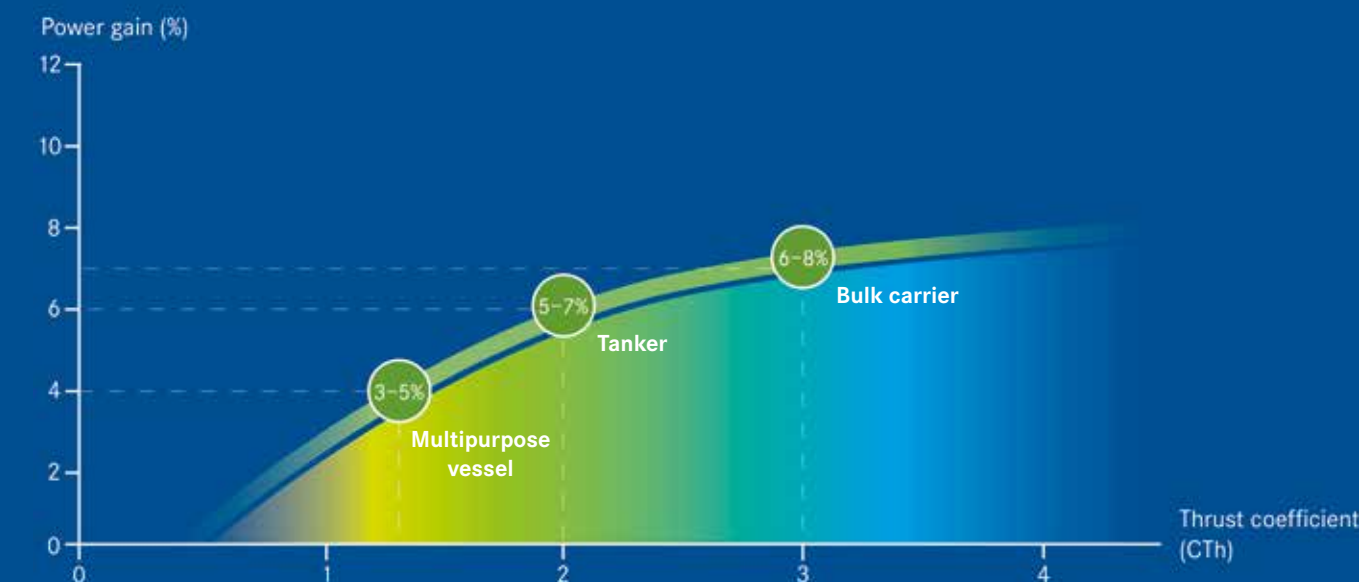
Computational Fluid Dynamics tests, model tests and full scale operation have demonstrated power savings averaging 3% for container ships. Even better results can be obtained with the combination of a Becker Mewis Duct® Twisted and Becker Twist Rudder.

Each Becker Mewis Duct® Twisted is individually designed according to hull geometry, propeller design and engine data. The design takes into account the newest strength, fatigue and vibration requirements from classification societies.

## POTENTIAL SAVINGS

### AND THE CORRELATION BETWEEN POWER SAVINGS AND SHIP SIZE

#### WITH A BECKER MEWIS DUCT®



#### WITH A BECKER MEWIS DUCT® TWISTED

