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Power- and Cost-Savings for Container Vessels by Hydrodynamic Energy Saving Devices

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The requirement for energy efficiency in ship design and operation has been continuously increasing over recent decades. As part of this effort there is a growing interest in Energy Saving Devices (ESDs) that aim to improve the ship propulsive efficiency.

A Hydrodynamic Energy Saving Device (ESD) is a component which is intended to either reduce the losses around the working propeller or around the ship, or a combination of both. ESDs are not a structurally integral part of the ship's hull. They are suited for new-buildings and retrofits. ESDs have a long history; the history starts a few years after the invention of the propeller by Ressel in 1826 and developments continue today.

At present there are not many proven ESD solutions available for large container vessels, the table below gives an overview of what is currently available.

Hydrodynamic Energy Saving Devices for large Container Vessels

Name	Company	Development		Power reduction			Possibility
		Country	Year	Average*	Maximum*	Claimed	to retrofit
				* valid for well designed ship lines and propeller			
Reduction of rotational losses in the propeller slipstream				(maximum loss: 6% at C_{Th}=1)			
Twisted Rudder	BMS and other	Germany	2001	1%	2%	2%	new rudder
Pre-Swirl Stator	DSME	Korea	2002	4%	5%	4%	mostly yes
Thrust Fins	HHI	Korea	2008	2%	3%	5%	yes
Rudder Bulb Fin	DSME	Korea	2011	3%	4%	4%	new rudder
BTF	BMS	Germany	2012	4%	5%	3%	mostly yes
Reduction of propeller hub vortex losses				(maximum loss: 3% at C_{Th}=1)			
Costa-Bulb	Mayer Form / free	Germany	1952	1%	3%		yes
PBCF	Mikado / free	Japan	1987	1%	3%	5%	yes
Reduction of propeller tip vortex losses				(maximum loss: 3% at C_{Th}=1)			
CLT-Propeller**	Sistemar	Spain	1986	2%	3%	7%	new propeller
Tip-Fin Propeller**	MAN/Kappel	Danmark	*1990(?)*	2%	3%	4%	new propeller

***both solutions are no real ESDs, they are new propeller types*

The maximum possible power reduction achievable with ESDs is in the range of 2% - 5%. With the present high fuel prices these levels of savings are sufficient to justify investment into ESDs, assuming payback can be achieved within about one year. The claimed power reductions for several products are higher than the losses. This is only possible if other additional loss sources are used by these devices. In any case, the effect of an ESD should be checked by model tests at an independent towing tank before final purchase and installation.

The newest device on the market for Container Vessels is the Becker Twisted Fin® (BTF), which was introduced by Becker Marine Systems, Hamburg, in 2012. The development of the BTF has been based on the development and experience of the earlier Becker Mewis Duct® (MD) which was introduced in 2008. The MD is only suited for slower-speed full-form vessels such as tankers and bulk carriers. Since its introduction the MD has experienced extraordinary success. At the time of publication (September 2013), over 600 MDs have been ordered, of which over 300 have been delivered and are in service.

The Becker Twisted Fin® is a device for the reduction of the rotational losses in the slipstream of the propeller and for improving the propeller inflow for faster ships, such as Container Vessels and all vessels faster than 18 kts. The BTF is positioned forward of the propeller and consists of two components:

- A duct for improving the propeller inflow and reducing the vibrations of the fins
- A set (4 to 6) of inner and outer fins, twisted and asymmetrically positioned for producing pre-swirl

Fig. 1 shows a drawing of a typical BTF for a large Container Vessel. The BTF is connected (welded) to the ship's hull through 6 inner fins. The BTF has no movable parts.

Each Becker Twisted Fin® is individually designed according to hull geometry, propeller design and engine data. The optimisation is done by using the newest Computational Fluid Dynamics (CFD) methods, which is further improved with the now extensive experience collected from the design and optimisation of over 100 Mewis Ducts®. Model tests are subsequently used to prove the required power reduction and the cavitation behaviour.

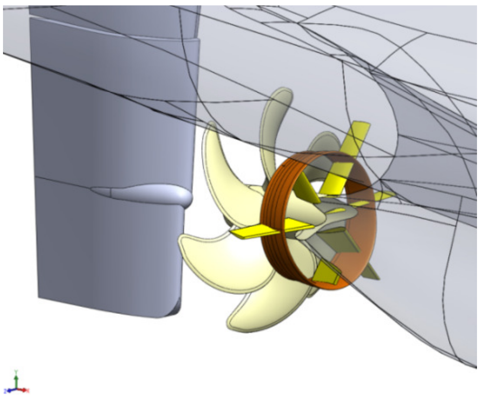

Figure 1 Becker Twisted Fin® designed for a large container vessel

The first installation of a Becker Twisted Fin® at full scale was performed for a 7090 TEU Container Vessel owned by the Hamburg Süd in December 2012. At present BTFs have been retrofitted to 7 of these vessels and eventually all 10 ships will be equipped with the device.

The model tests at HSVA showed a 3.8% power reduction at 19kts with no observed cavitation problems. The installation for the seven ships to date was done at Damen Shipyard Rotterdam with a minimum installation time of 3 days. Figure 2 shows the completed Becker Twisted Fin® installation on the vessel "Santa Theresa".

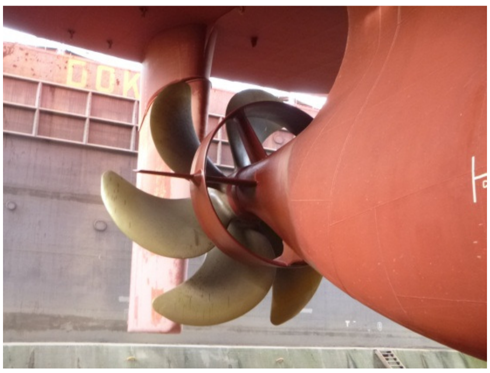

Figure 2 Becker Twisted Fin®, first installation on a 7090 TEU Container Vessel, Hamburg Süd

The vessels already equipped with the BTF have now been in service for nine months. The first measurements and observations show a high correlation to the model test results; the power reduction is on average 3.5% and the cavitation and vibration behaviour is improved in comparison to the vessels not yet fitted with the device. Observations show that the hub vortex disappears completely due to the influence of the BTF. More precise results will be available after a longer period of service. To date the ship owner is very satisfied.