SHIP EFFICIENCY by STG

4th International Conference
Hamburg, September 23-24 2013

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

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Fred Deichmann, Columbus Shipmanagement, Hamburg

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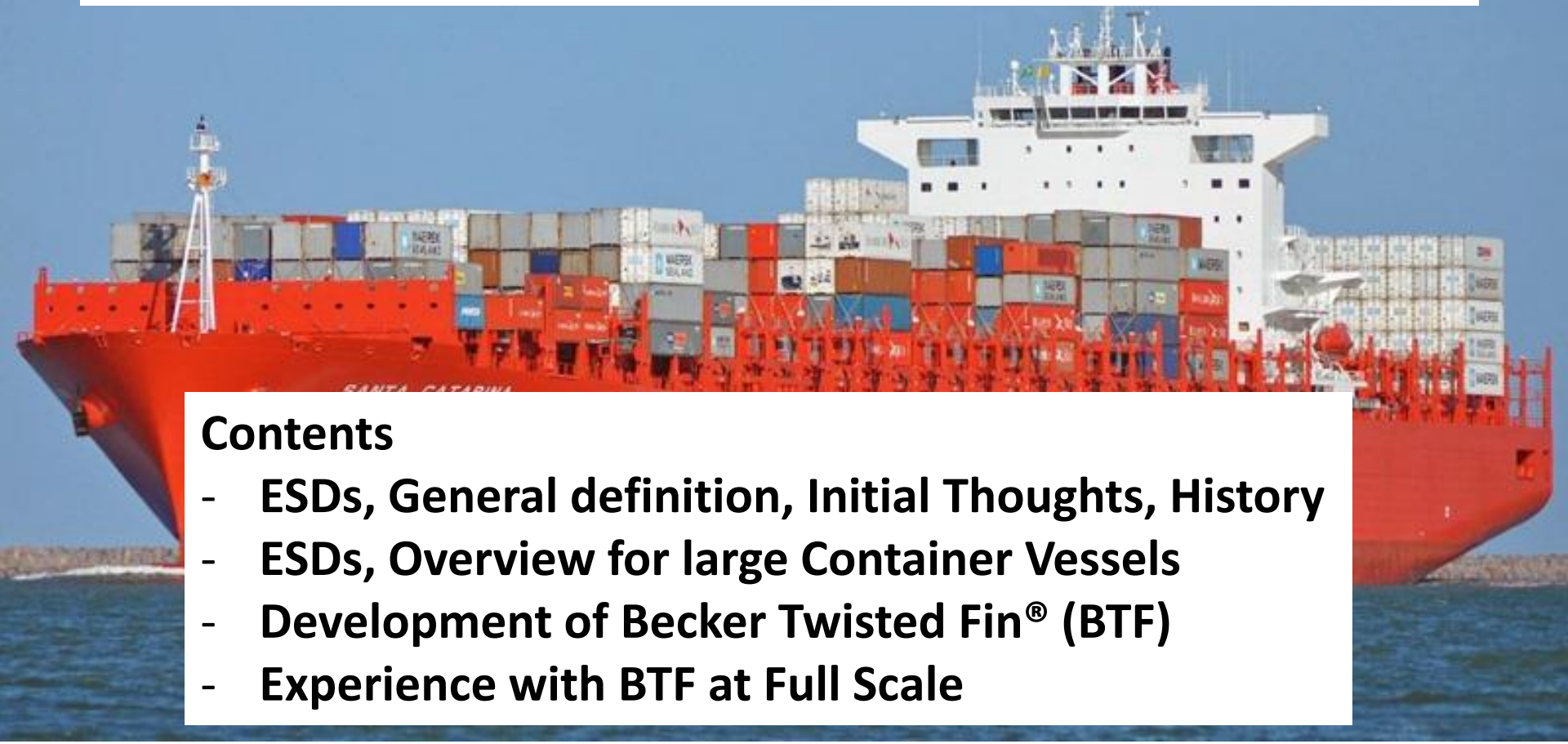
Power- and Cost-Savings for Container Vessels by Hydrodynamic Energy Saving Devices (ESDs)



Contents

- **ESDs, General definition, Initial Thoughts, History**
- **ESDs, Overview for large Container Vessels**
- **Development of Becker Twisted Fin® (BTF)**
- **Experience with BTF at Full Scale**

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

General Definition:

A Hydrodynamic Energy Saving Device
is a component which shall reduce the losses around the working propeller or around the ship; or both.
It is not an inherent part of the ship.
ESDs are suited for both new-buildings and retrofits.

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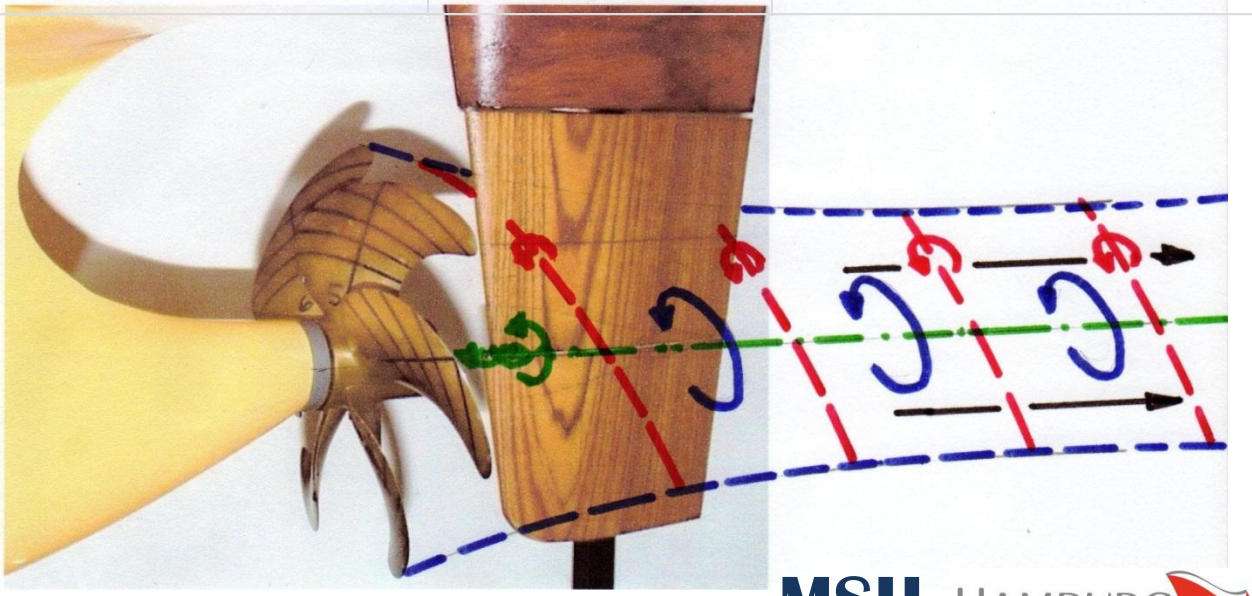
Propeller, Initial Thoughts, Energy Loss Analysis

Large Container Vessels		
Energy losses at a free running propeller (well designed), C_{Th} = 1.0		
Kind of loss	Colour of arrow	Loss in % (accuracy ±1%)
Blade friction	-	7%
Axial momentum	black	16%
Rotation of slipstream	blue	5%
Hub vortex	green	2%
Tip vortex	red	2%
		32%



Mewis/Deichmann, "Cost Savings by ESDs", 4th SEC, Hamburg, Sept. 2013

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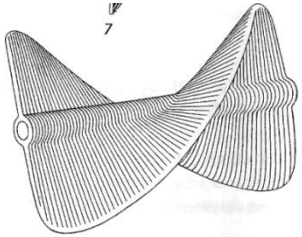
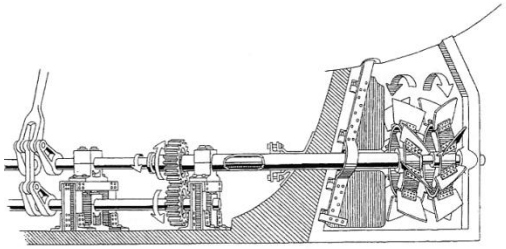
Propeller, History, Early Energy Saving Devices

1826 Ressel "Civetta", 1829

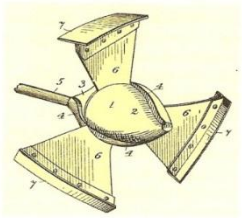


Ressel is generally accepted as the inventor of the propeller



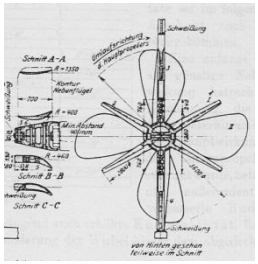
Ericssons *Entwurf 1836 mit zwei gegenläufigen Propellern*

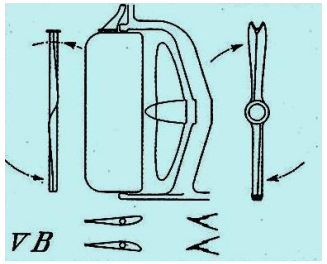
1836 Eriksson CR-Propeller



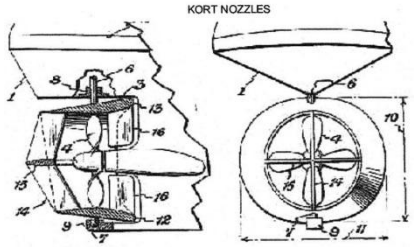
Patent von 1902 über einen Propeller mit Endscheiben, Potter (1905)

1903 Potter Endplates

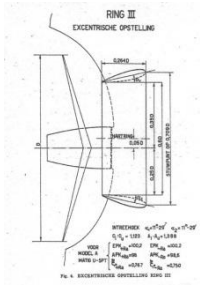




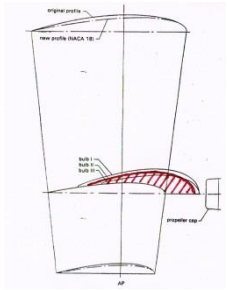
1904/1929 Wagner Contra Propeller Principle



1924/1937 Kort Nozzle

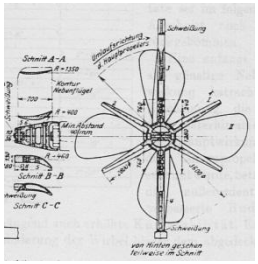


1949 van Lammeren Pre-Duct



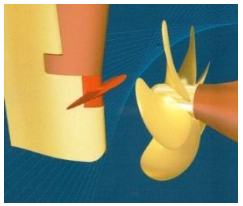
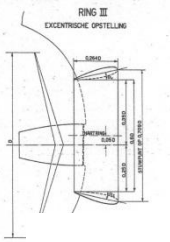
1952 Costa Rudder Bulb

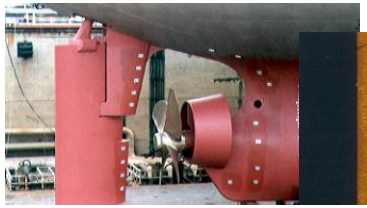
Energy Saving Devices, Overview







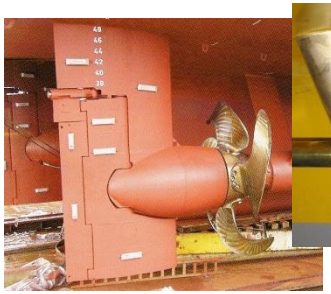
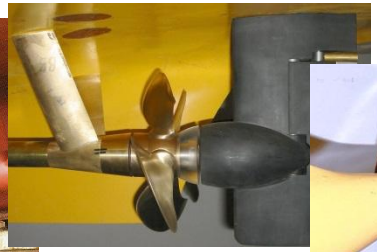


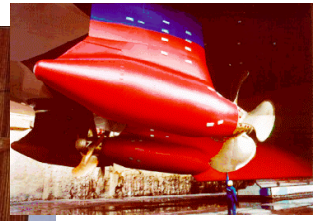
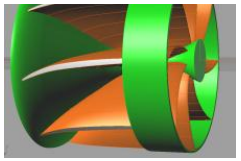


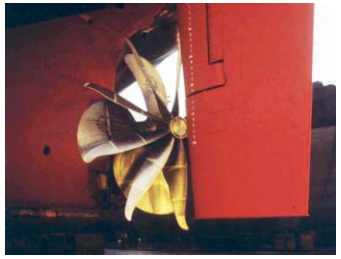
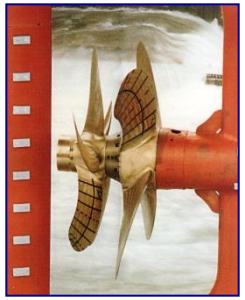
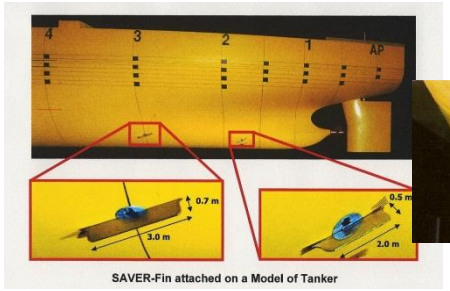
MD

BTF

Hydrodynamic Energy Saving Devices

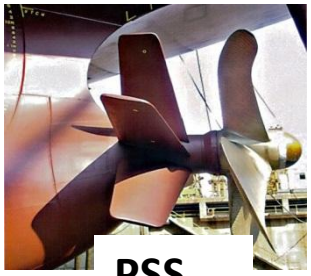



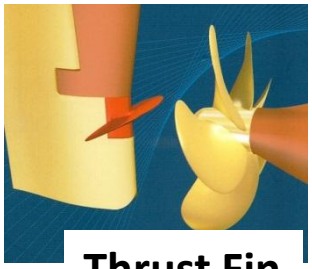
SAVER-Fin attached on a Model of Tanker


Energy Saving Devices, current market status for large Container Vessels

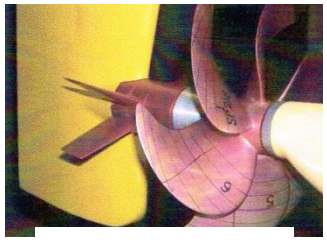
Reduction of rotational losses in the slipstream



PSS
DSME



Thrust Fin
HHI



Post Stator
SHI

BTF
BMS

Twisted Rudder
BMS

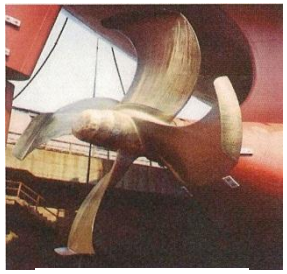
Reduction of hub vortex losses

Costa-Bulb

PBCF
Mitsui

CRP
Ishikawajima-Harima

Reduction of tip vortex losses



CLT
Sistemar

Tip-Fin Propeller
MAN/Kappel

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Mewis/Deichmann, "Cost Savings by ESDs", 4th SEC, Hamburg, Sept. 2013

Energy Saving Devices, current market status for large Container Vessels

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*

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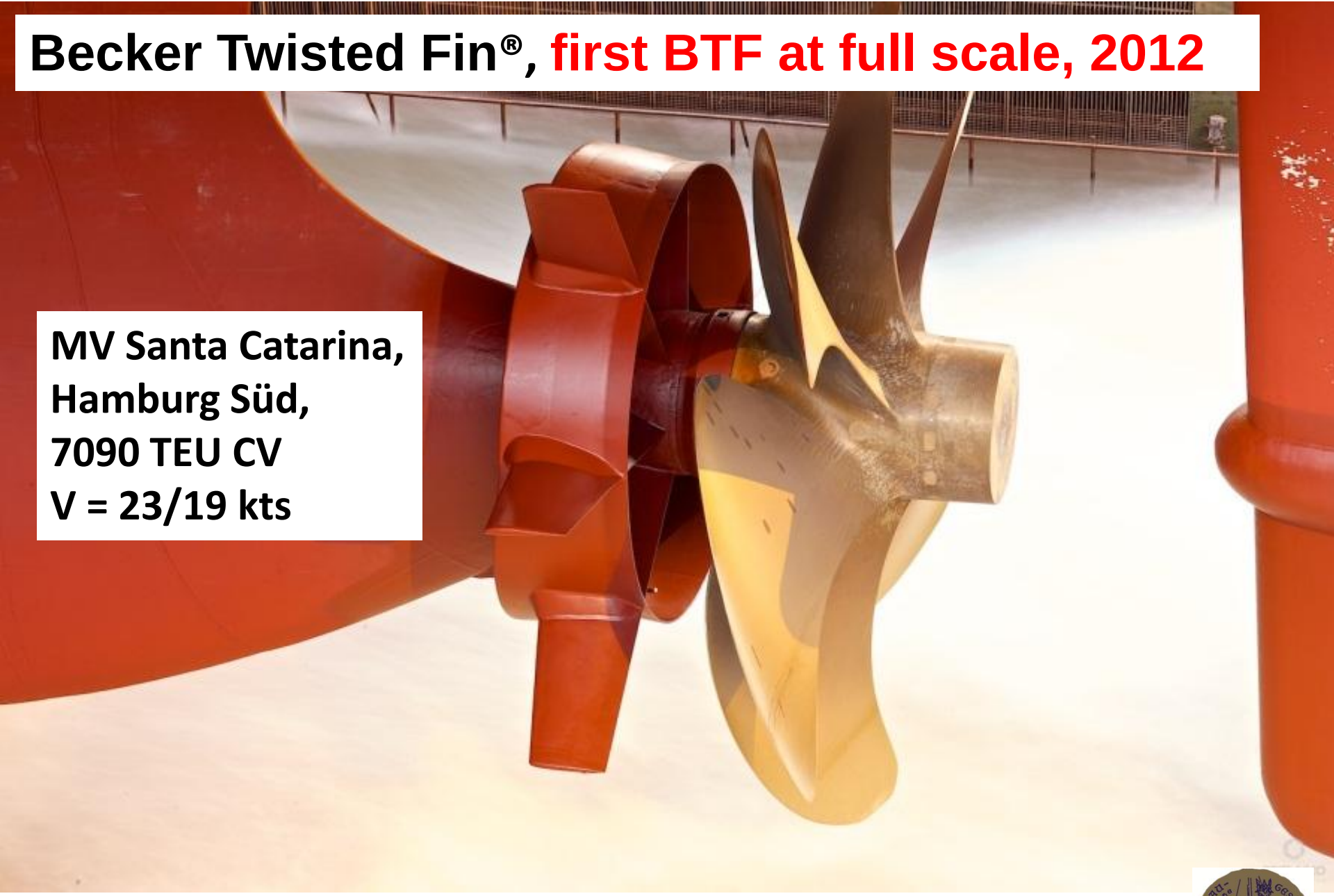
Becker Twisted Fin®, first BTF at full scale, 2012



MV Santa Catarina,
Hamburg Süd,
7090 TEU CV
V = 23/19 kts

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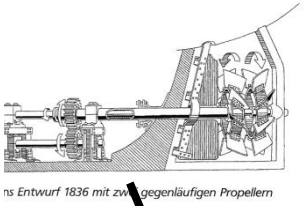
Mewis/Deichmann, “Cost Savings by ESDs”, 4th SEC, Hamburg, Sept. 2013

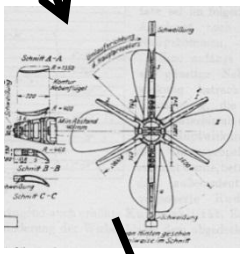
Roots
Mewis Duct®
BTF

Reduction of rotational losses

1838
Contra Propeller
Erikson
UK

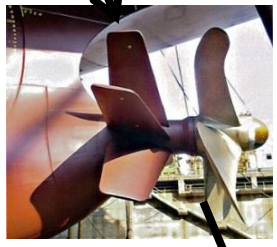


1929
Contra Propeller Princ.
K. Wagner
Germany

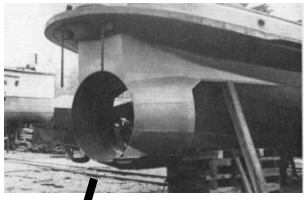


1984
SVA Fin System
H. Peters, F. Mewis
Germany

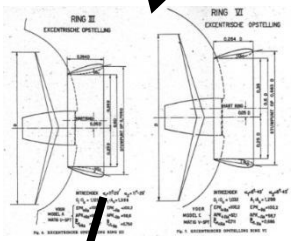
2002
PSS
DSME
Korea



Reduction of wake losses

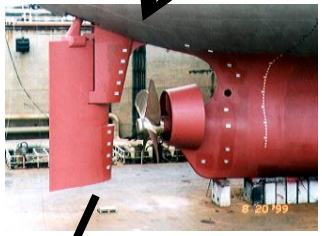


1927
Kort Nozzle
L. Kort
Germany



1949
Lammeren Duct
Van Lammeren
The Netherlands

1982
WED
H. Schneekluth
Germany



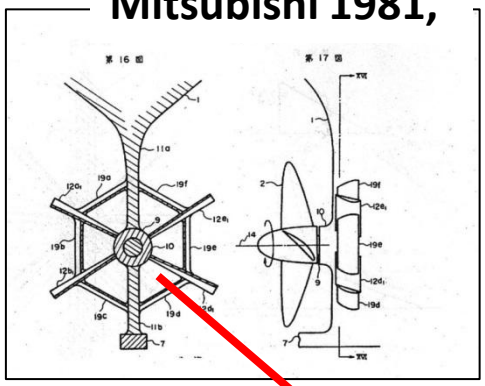
1996
SILD
Sumitomo
Japan

2008
Mewis Duct® (MD)
Becker Marine Systems
Germany

2013 Mewis Duct®
Actual situation:
Deliveries: more than 300
Orders: more than 600

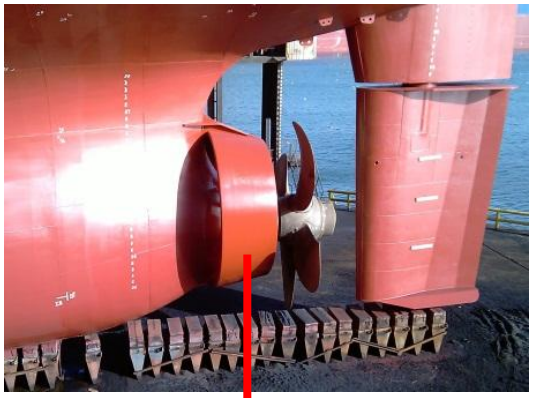
Becker Twisted Fin®, BTF, Roots

Mitsubishi 1981,



Realization(?)

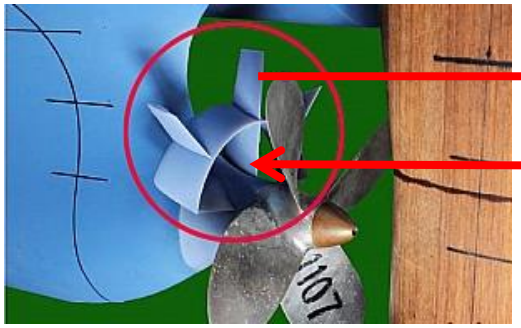
Mewis Duct®, 2009

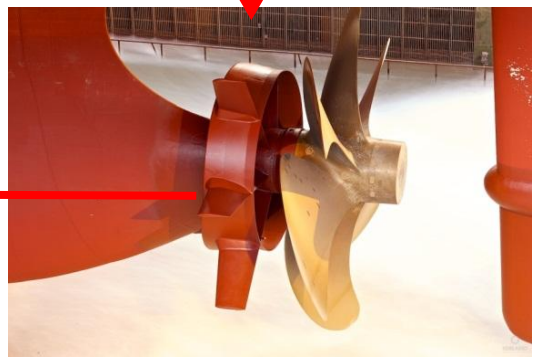


Realization:
delivered: more than 300

Becker Twisted Fin®, 2012

Crown Duct, Korea, 2012





Realization (?)

Realization:
delivered: 7

Mewis/Deichmann, "Cost Savings by ESDs", 4th SEC, Hamburg, Sept. 2013

Becker Twisted Fin®, Difference to the MD

- MD consists of a fin-system situated in a pre-duct
- MD is suited for vessels with V<20 kts and CTh>1.3, this encompasses all full-blocked ships
- MD is suited to both new-build and retrofit applications

What are the differences to the Mewis Duct ®?

- BTF has additional outer fins for generation of more pre-swirl
- All Fins are twisted for minimising the resistance
- BTF is suited for Vessels with V>18 kts and CTh<1.3, this encompasses all container vessels
- BTF is suited to new-buildings and, in exceptional cases, for retrofits too

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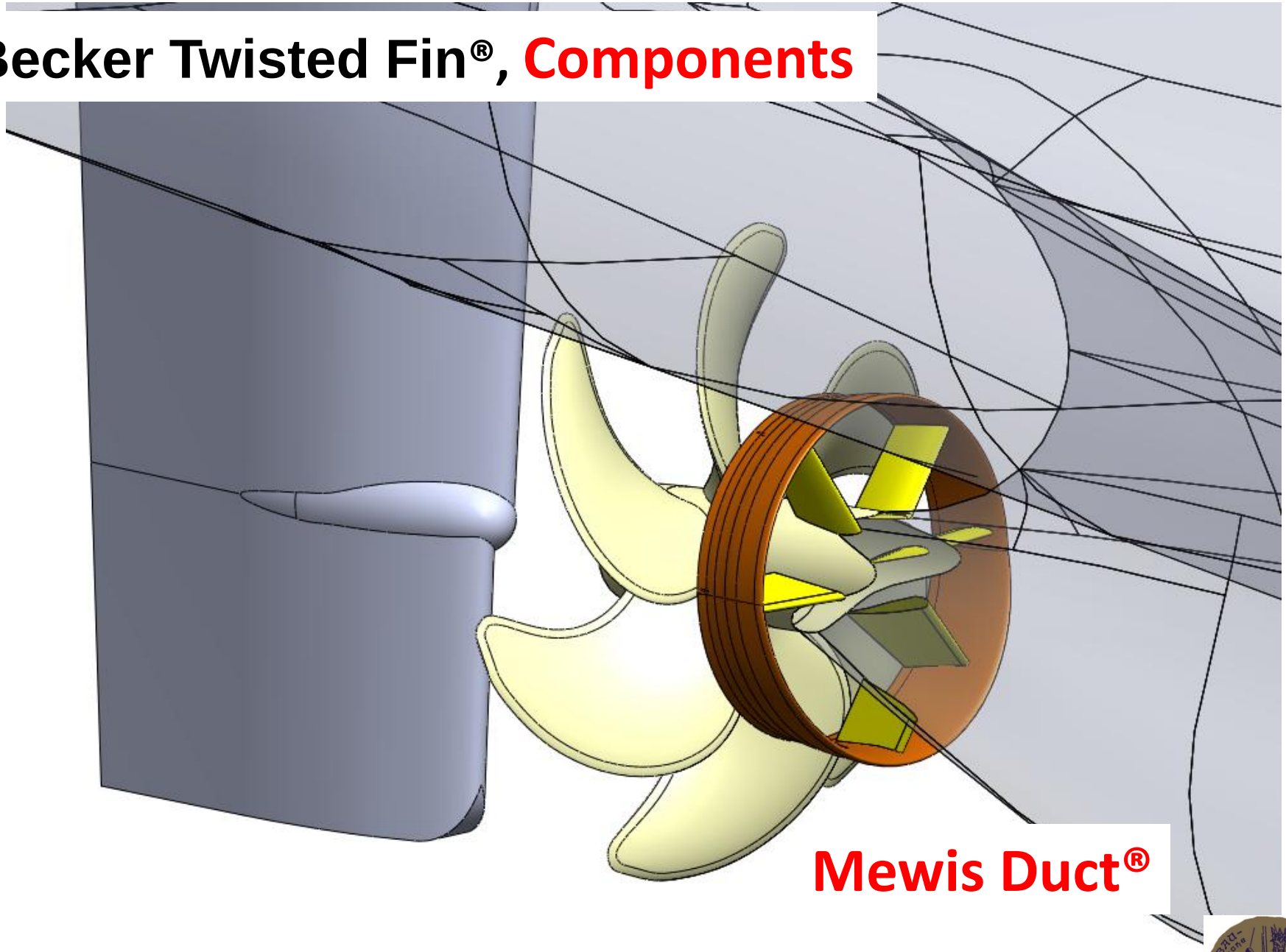
Becker Twisted Fin®, Components



Mewis Duct®

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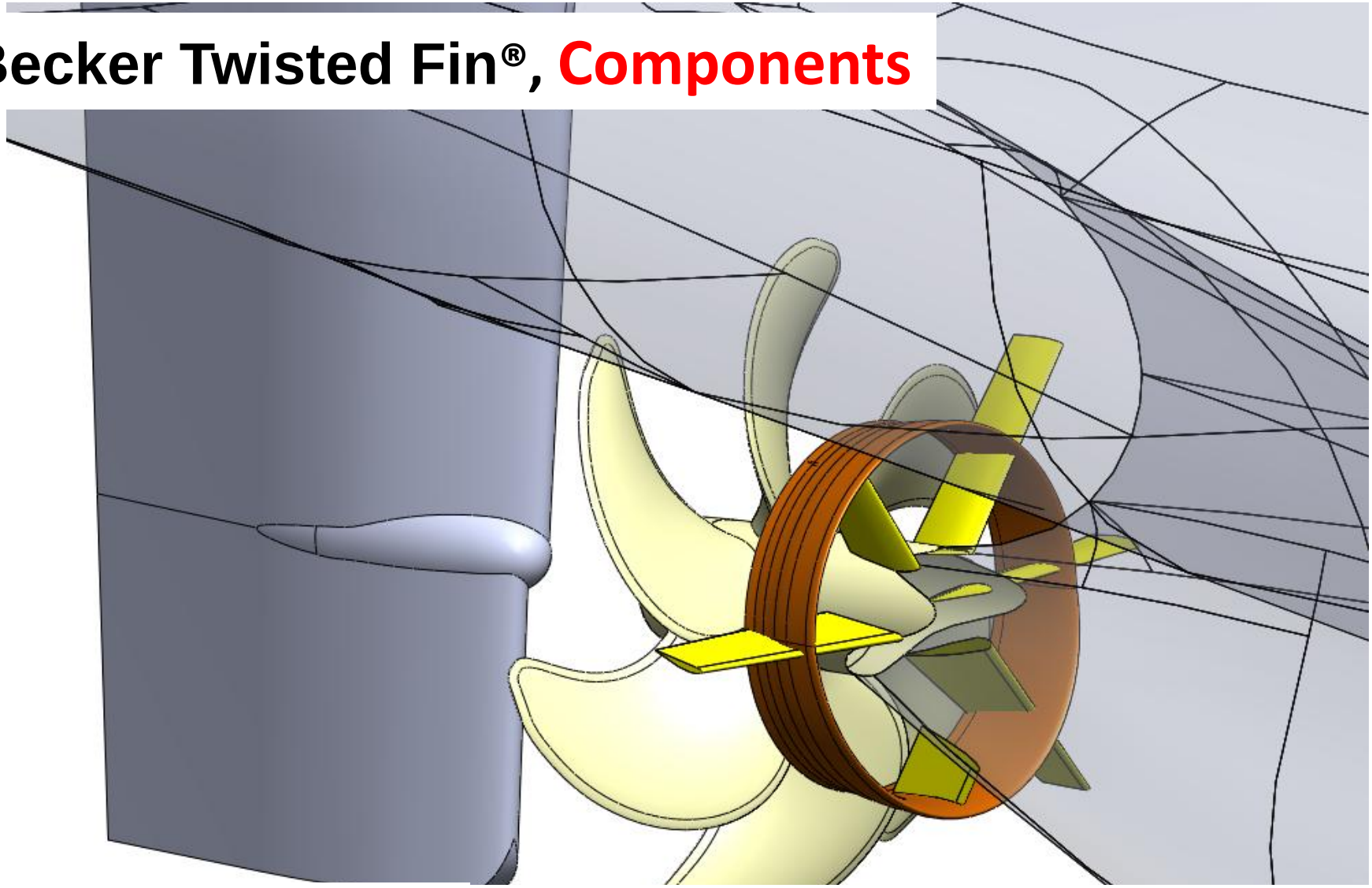
Becker Twisted Fin®, Components



Mewis Duct® + outer fins + fins twisted = BTF

Becker Twisted Fin®, Suitability and main effects

Suitability: For faster ships, speed higher than 18 knots

Main Effects:

- Power reduction up to 5% (average 3.8%),
this means up to 5% lower emissions

- Reduction of propeller induced pressure pulses and tip cavitation,
this means less vibration in the aftship

- Small improvment of course stability,
this gives a small additional power reduction

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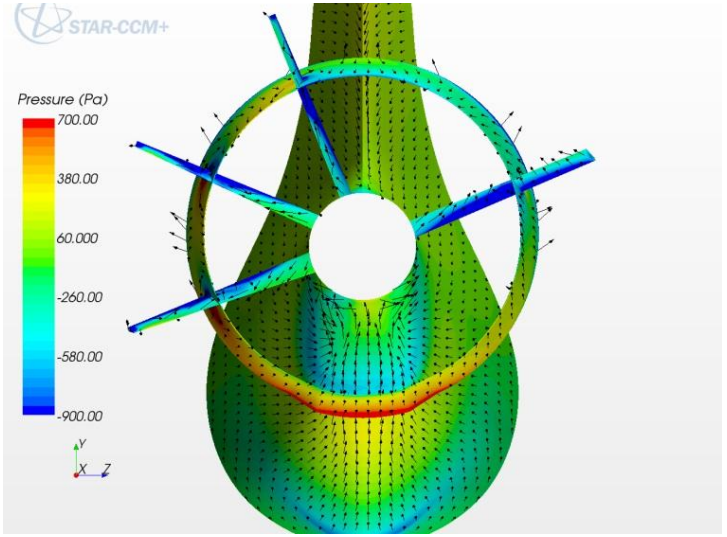
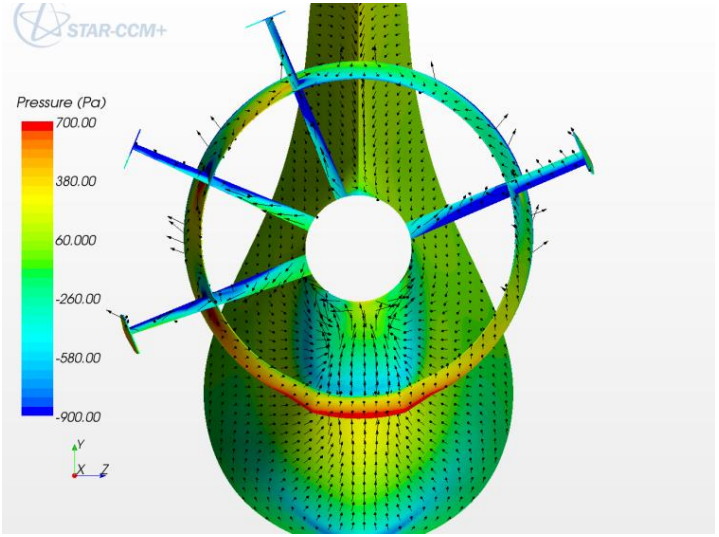
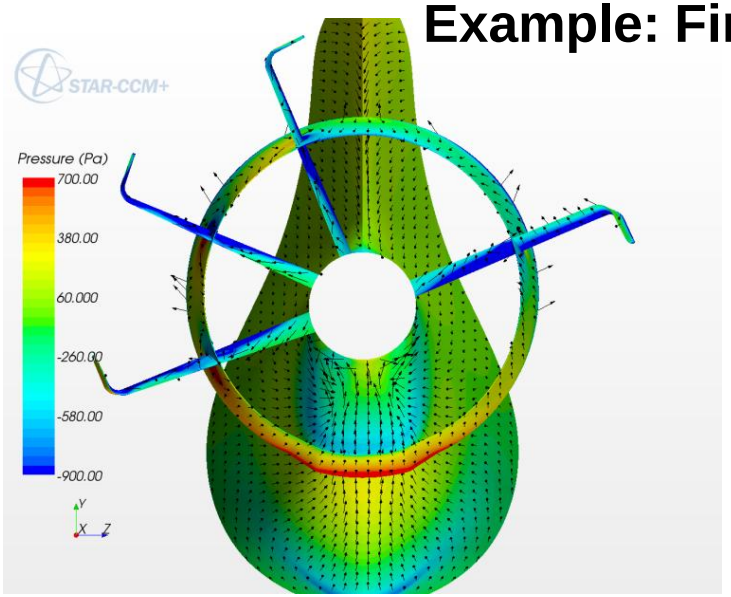
Mewis/Deichmann, “Cost Savings by ESDs”, 4th SEC, Hamburg, Sept. 2013

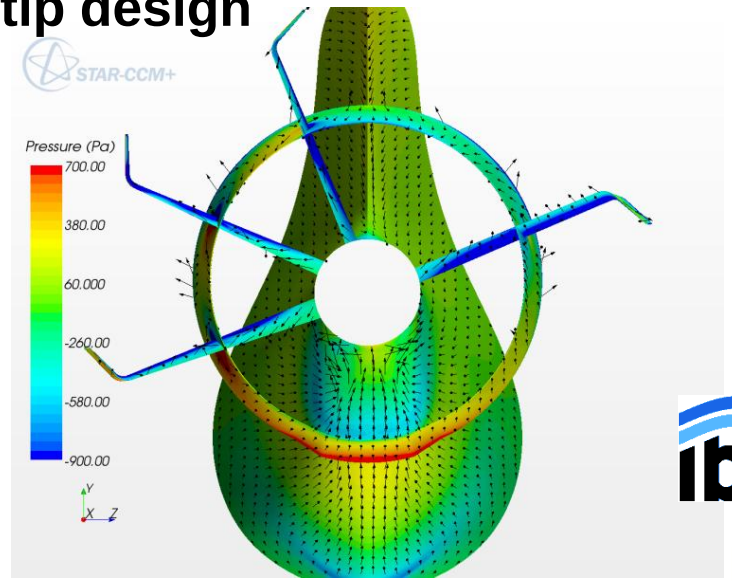
Becker Twisted Fin®, Design and optimisation by CFD





Example: Fin tip design





ibmv

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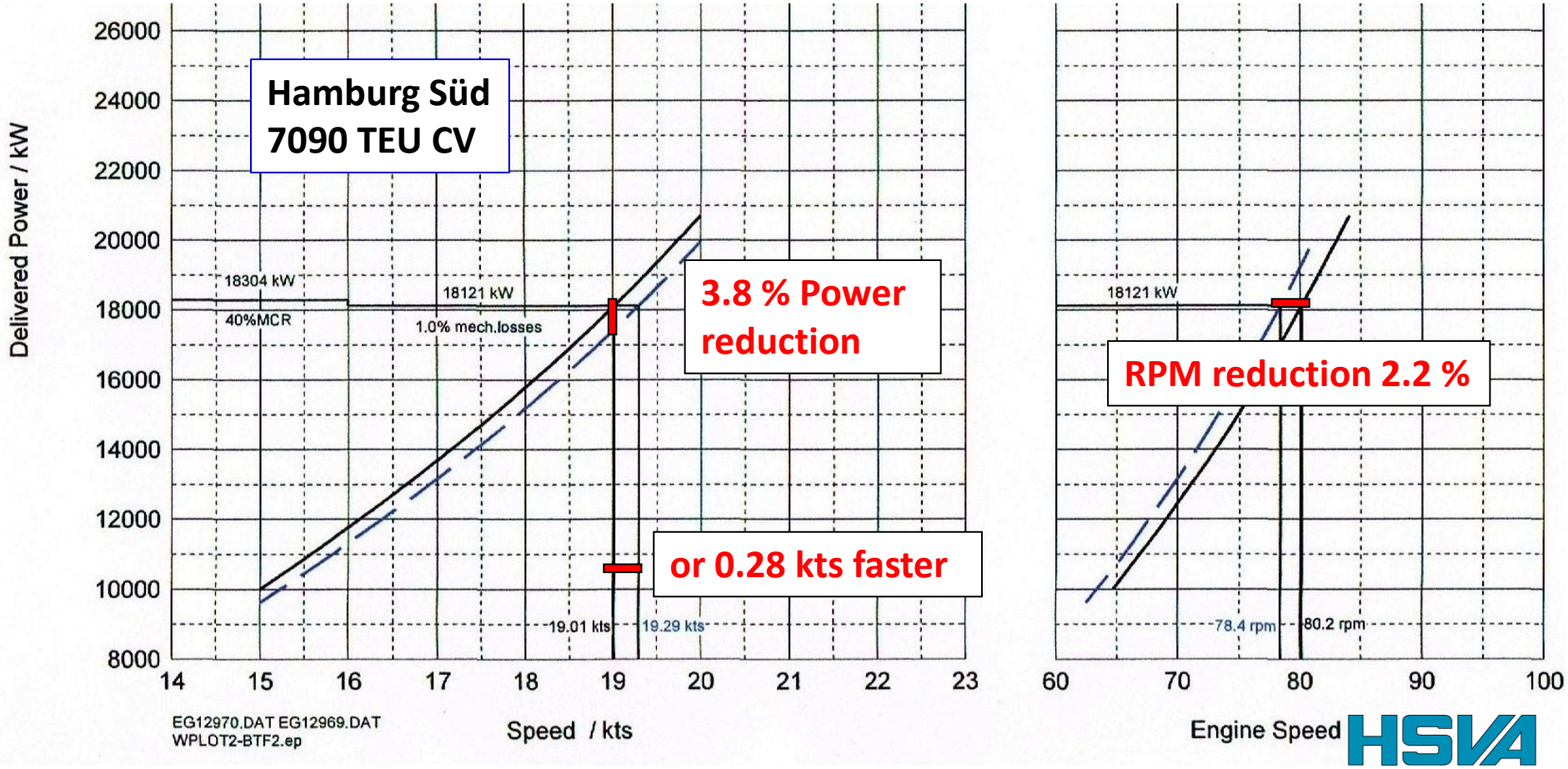
Mewis/Deichmann, “Cost Savings by ESDs”, 4th SEC, Hamburg, Sept. 2013

Becker Twisted Fin®, Examination and optimisation by model tests

Becker Twisted Fin®, Model test results, HSVA



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Mewis/Deichmann, "Cost Savings by ESDs", 4th SEC, Hamburg, Sept. 2013

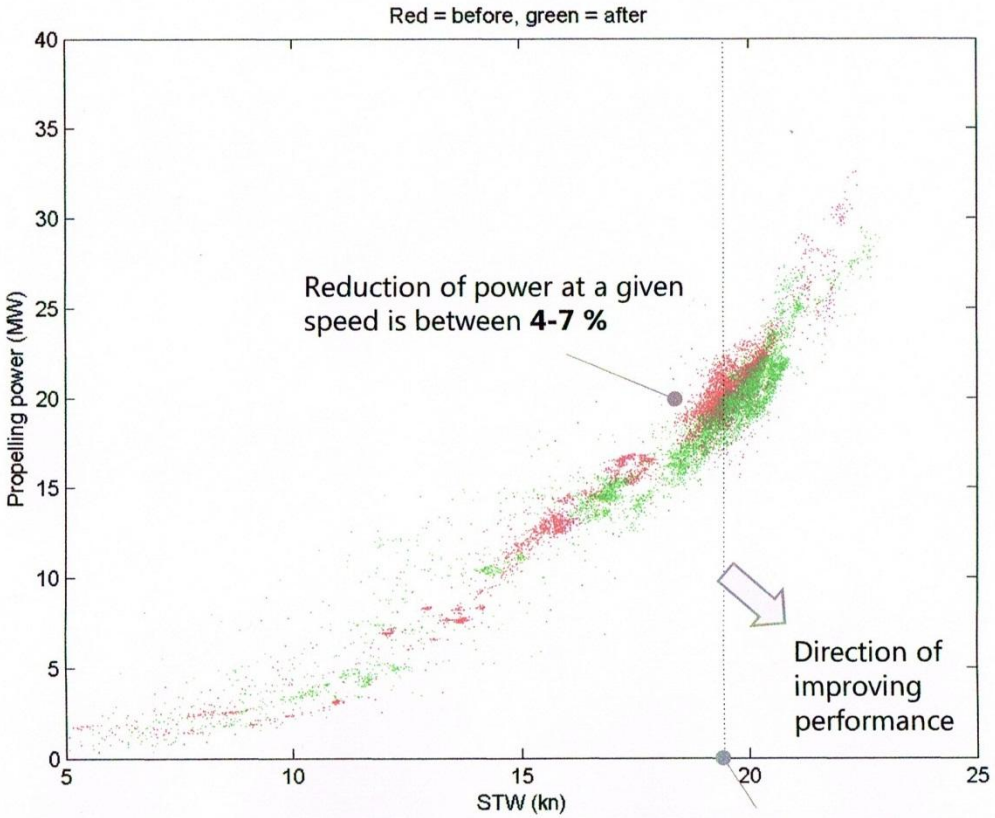
Becker Twisted Fin®, Full scale, Power reduction

Full Scale: **The first comparison after 9 months shows:**
3.5% gain in average over the operational profile
4 - 7% gain in heavier load draught, V>18 kts

Mewis/Deichmann, “Cost Savings by ESDs”, 4th SEC, Hamburg, Sept. 2013

Becker Twisted Fin®, Full scale, Power reduction

IMPACT IN HEAVIER LOAD (DRAFT > 11 M)



- In heavier loading conditions, the improvement in performance can be seen at speeds above 15 knots
- At smaller speeds, there is no remarkable difference in performance before and after the twist fin installation

Speed range	Twist fin impact
Below 15 kn	0 %
15 - 18 kn	1 - 3 %
Above 18 kn	4 – 7 %

ENIRAM

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Mewis/Deichmann, "Cost Savings by ESDs", 4th SEC, Hamburg, Sept. 2013

Becker Twisted Fin®, Cavitation behaviour

Model Scale: Tests at HSVA, very low pressure pulses with BTF
No cavitation on the BTF itself

Full Scale: Observations show no cavitation on the BTF itself, less vibration in the ship's structure than without, the hub vortex disappears completely with BTF

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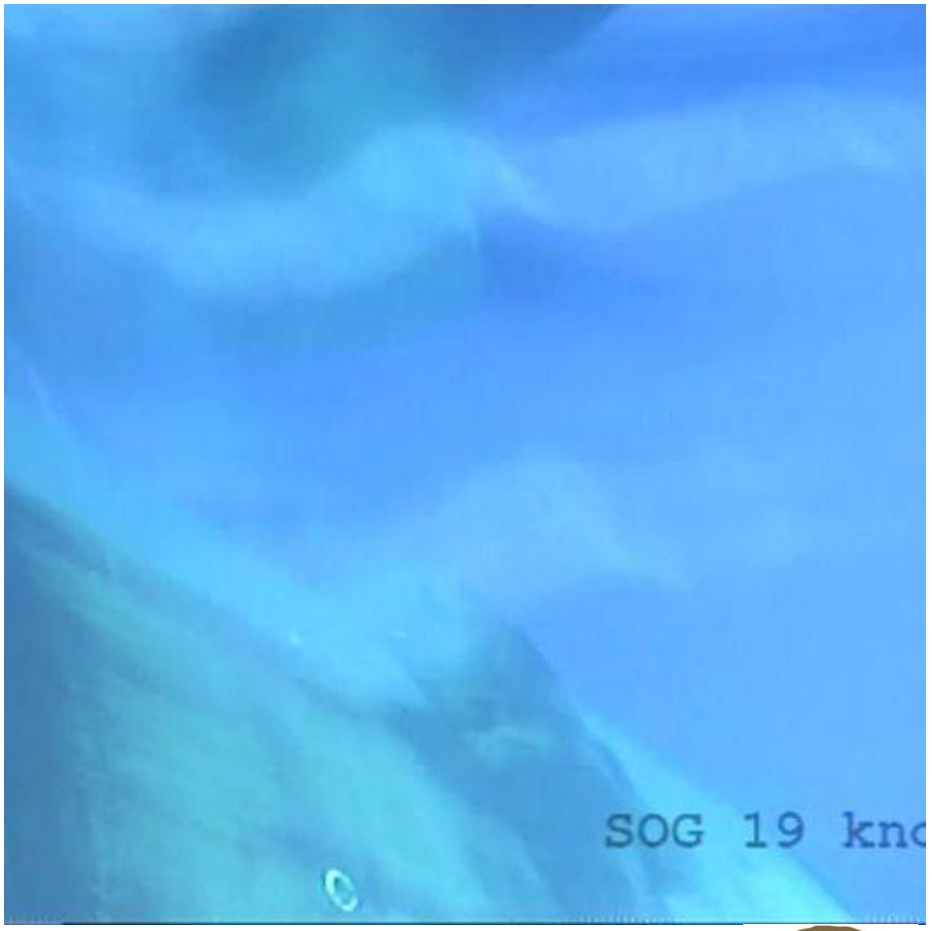
Mewis/Deichmann, "Cost Savings by ESDs", 4th SEC, Hamburg, Sept. 2013

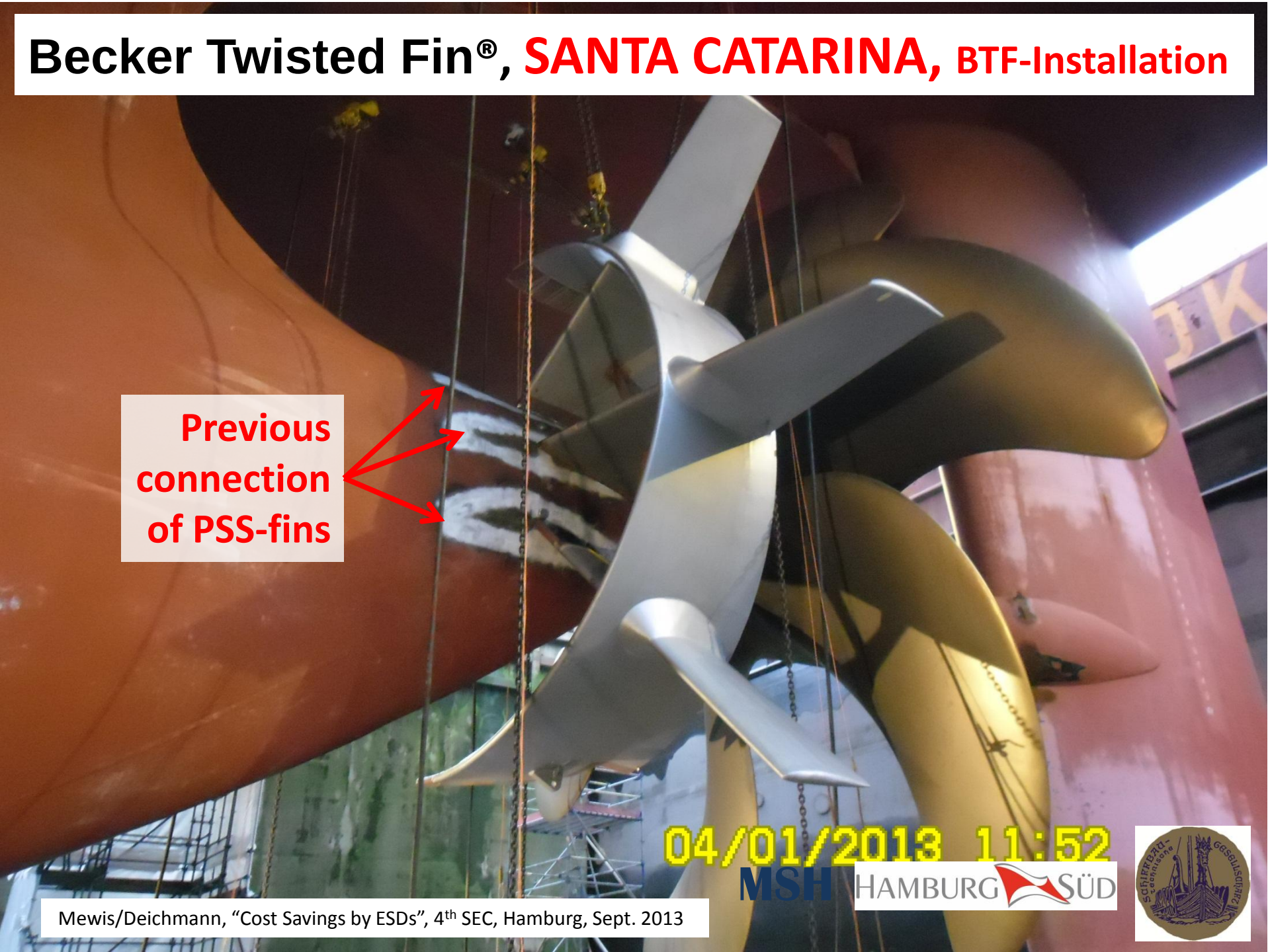
Becker Twisted Fin®, Cavitation behaviour, hub vortex

without BTF

with BTF



Becker Twisted Fin®, SANTA CATARINA, BTF-Installation



Mewis/Deichmann, “Cost Savings by ESDs”, 4th SEC, Hamburg, Sept. 2013

Becker Twisted Fin®, SANTA CRUZ, BTF-Installation

Becker Twisted Fin®, SANTA CRUZ, BTF-Installation

Mewis/Deichmann, “Cost Savings by ESDs”, 4th SEC, Hamburg, Sept. 2013

Becker Twisted Fin®, SANTA CRUZ

Becker Twisted Fin®, SANTA CRUZ

Mewis/Deichmann, “Cost Savings by ESDs”, 4th SEC, Hamburg, Sept. 2013

Summary

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

- For large Container Vessels there are not many proven ESDs on the market.
- The achievable power reductions are maximum 2 to 5%

- The Becker Twisted Fin® is one of the latest and most effective developments in the market
- The average power reduction for the BTF is 4%
- The BTF reduced the pressure pulses and hence the vibrations of the ship
- The payback time is less than one year

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

We thank you very much for your attention

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