

LATEST DEVELOPMENTS ON MAN DIESEL ALPHA PROPELLERS

M. MORTEN, G. RASCH

MAN Diesel - Danemark

SOMMAIRE

Cette conférence présente la gamme de production de MAN Diesel au niveau des ensembles de propulsion tels que réducteurs, lignes d'arbres, hélices. Une présentation rapide de la technologie des hélices est faite : hélices à pales orientables, pales, tuyères. Ensuite cette présentation se recentre sur les outils d'optimisation du rendement propulsif.

Une revue des différents paramètres influents est faite avec des exemples à la fois théoriques et pratiques sur

- Le Bulbe Costa
- Le gouvernail asymétrique
- L'hélice Kappel
- L'hélice avec tuyère
- Les hélices contra-rotatives

ABSTRACT

This paper introduces the range of production of the MAN Diesel propulsion systems, including gear boxes, shaftings and propellers. A quick introduction of the propeller technology is done : CP propellers, blades, nozzles. Then the presentation focuses on improvement tools for better efficiency of the propulsion.

A review of various influencing parameters is done and various examples are shown both on the theoretical as well as on real results for instance on

- Costa Bulb
- Asymmetric rudder
- Kappel Propeller
- Propeller with nozzle
- Contra-rotating propellers

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MAN Diesel Propulsion Systems

Morten G. Rasch

Sales Manager

Propellers & Aft-ship Systems

Introduction

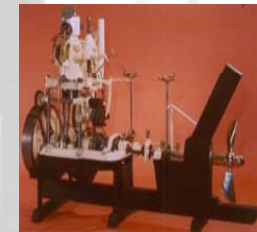
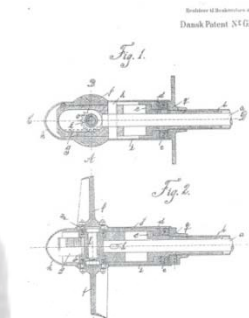


- **MAN Diesel – Propeller Department**
- **Product Port Folio**
- **Propeller Design**
- **Efficiency improving devices**
- **Nozzle design**

MAN Diesel gears and CPP's in brief



- First CP propeller patent received in 1902
i.e. second oldest brand on the market
- First complete propulsion plant delivered in 1902
- In 1969 first reduction gears are developed
- Today approx. 1800 gears and 7000 propeller have
been delivered or are on order



Recent Remarkable Orders



2 x 2xVBS1680 Jan de Nul Dredger
3 x 2xVBS1560 Ro-Pax for Stena
4 x VBS1800 6900 PCTC for Höegh
79 x VBS1380 1100 TEU Feeders
10 x 2xVBS1080 AHTS vsls for Maersk



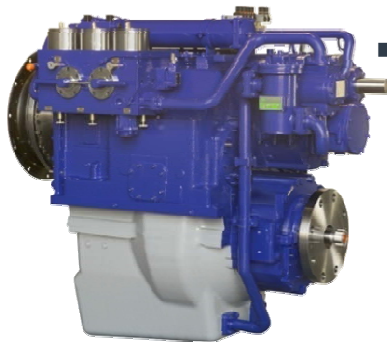
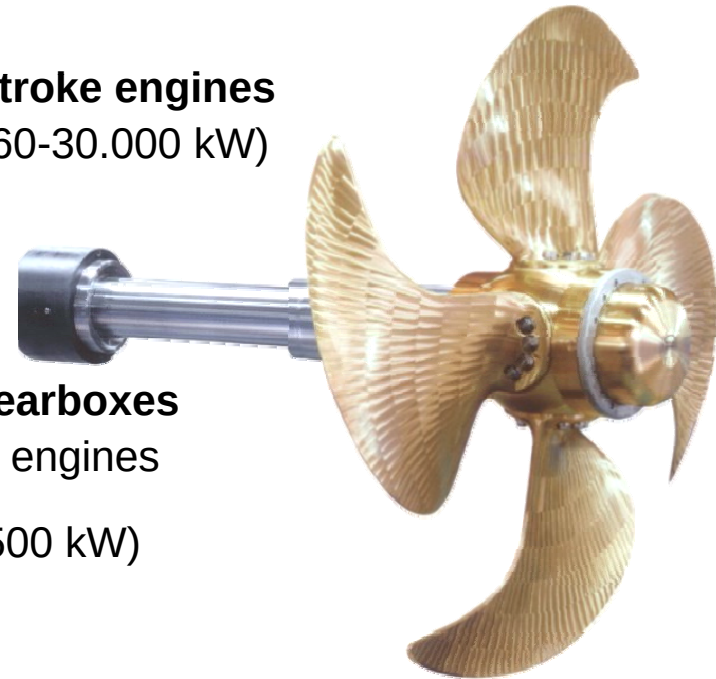
Worlds largest hopper suction dredger
Worlds largest Ro-Pax – 6200 LM
First large car carrier with CPP
Most famous feeder series. 79 CPP sold
MD's (and Aker's) largest offshore order



Propulsion products



- **CP Propellers for two and four-stroke engines**
Propeller diameters up to 9,2 m (960-30.000 kW)



- **Single in/ single out reduction gearboxes**
Four sizes covering 21/31 to 32/44 engines
(Standard power range 1.200 – 4.500 kW)

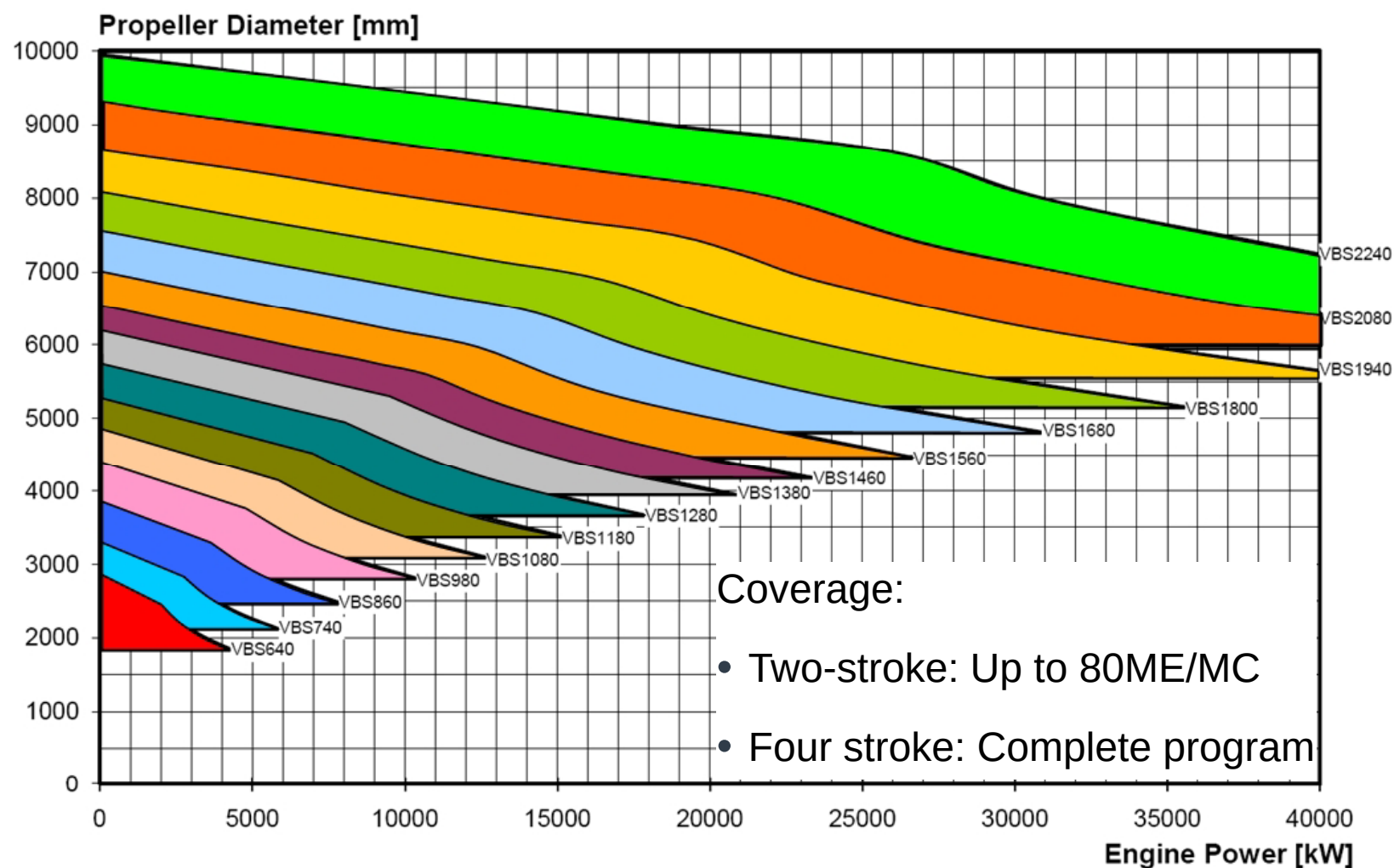
- **Remote control system AT2000**
For all engine types



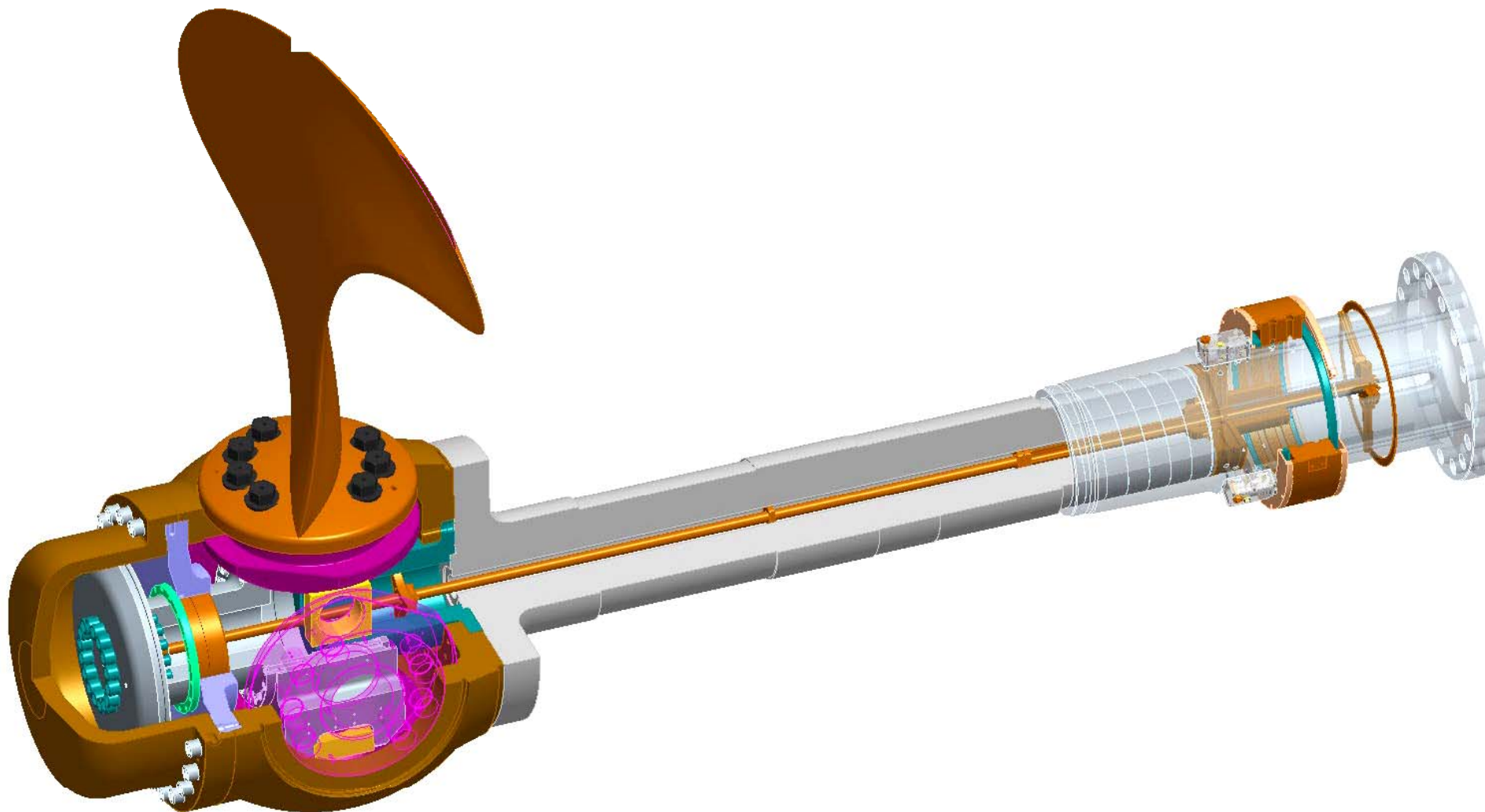
Extended CP Propeller Range VBS Mk. 3



CP Propeller Program



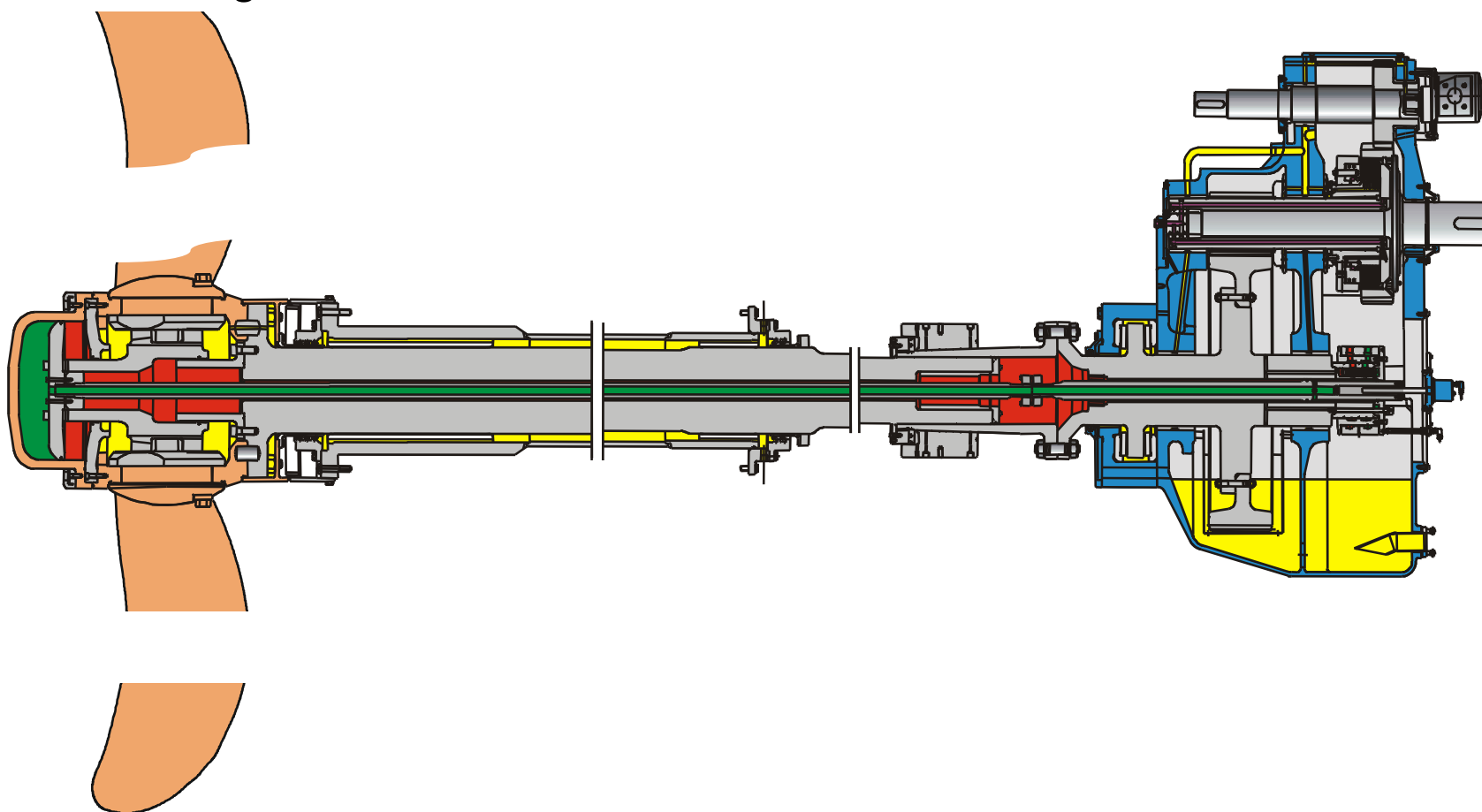
VBS Working principle



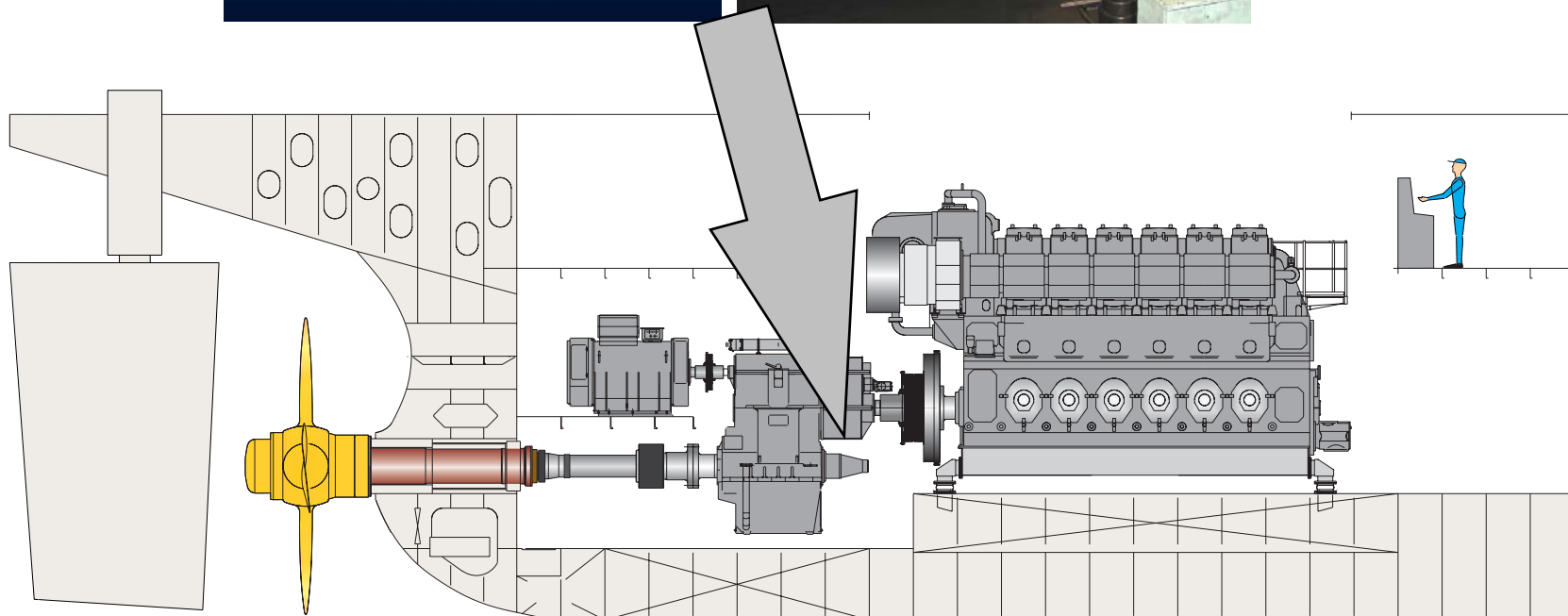
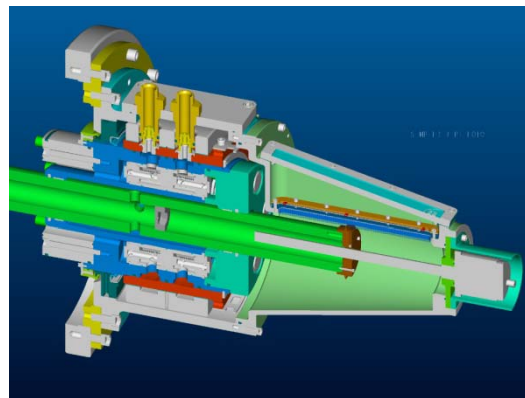
MAN Diesel VBS Propeller & AMG Gearbox



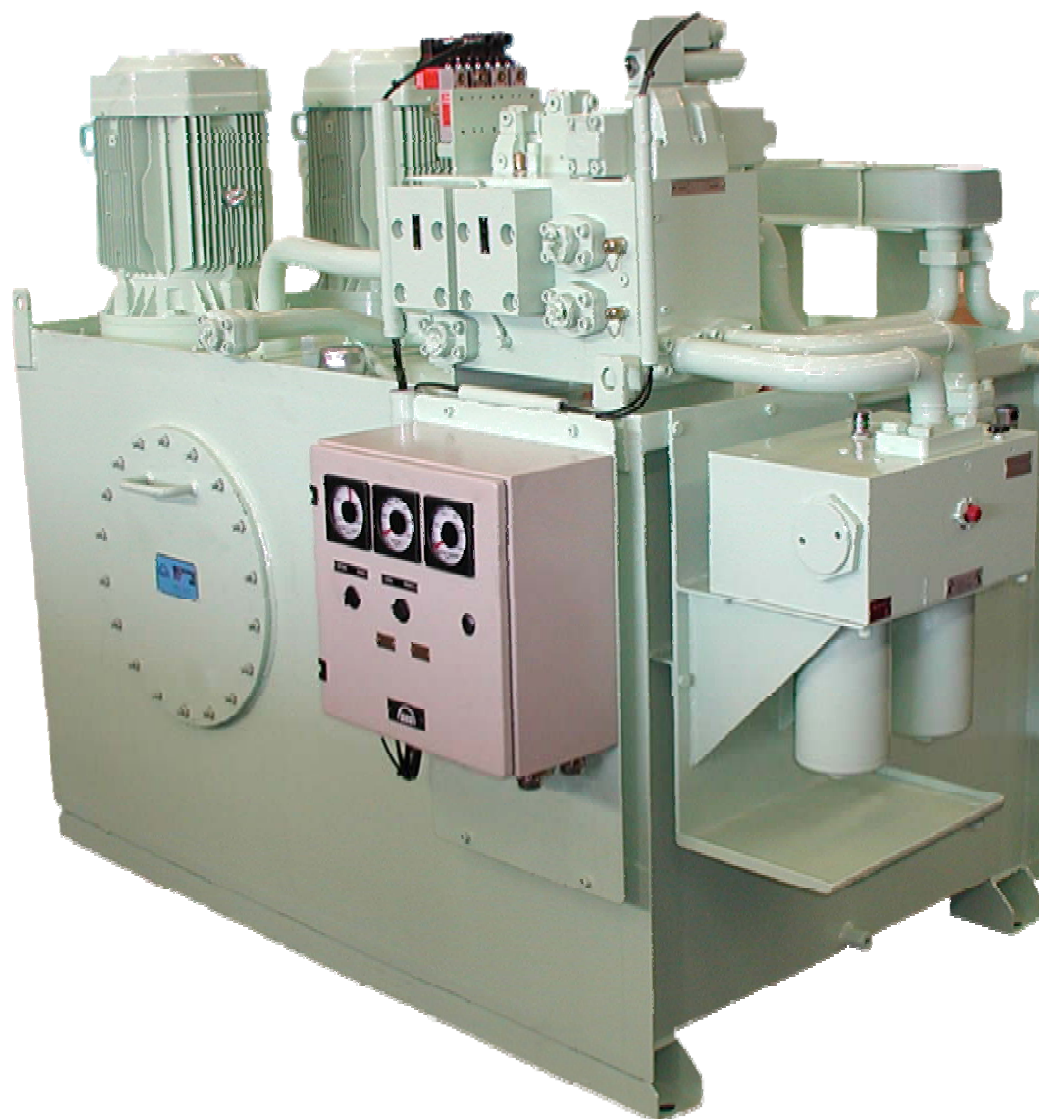
VBS servo oil system integrated in the MAN Diesel gearbox



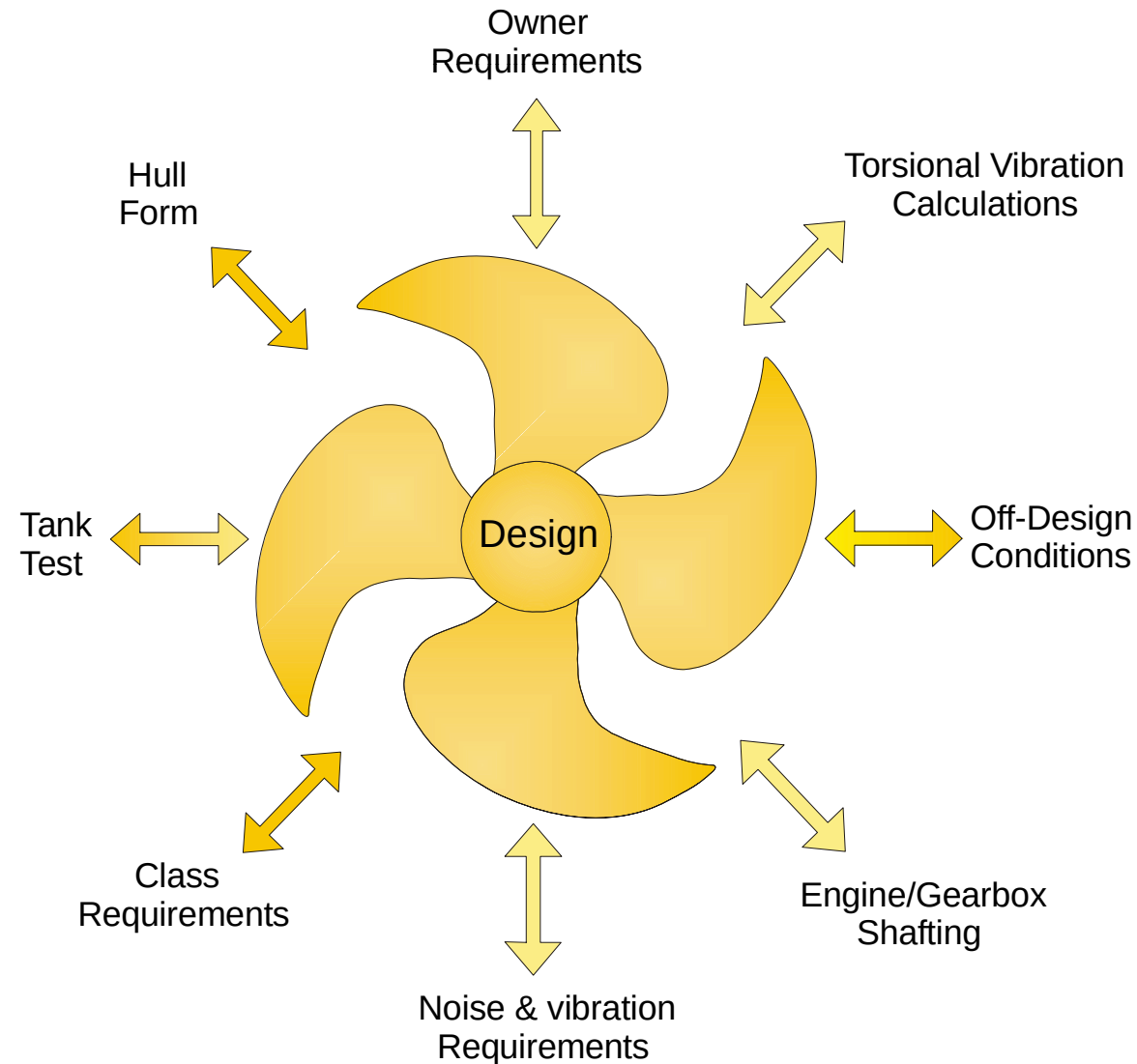
MAN Diesel Four-stroke Propulsion Package



CPP Hydraulic Power Unit



Hydrodynamic Propeller Design Aspects



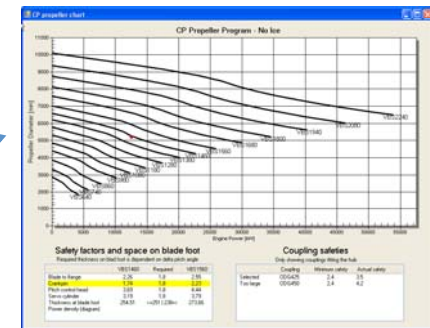
New COPS Tool Developed by MAN Diesel



Computerised Optimisation
of Propulsion Systems

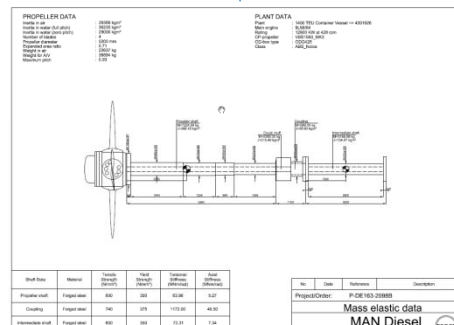
- Better optimization of global parameters
- Integration of several programs into one user interface
- Inclusion of statistical data
- Gearbox selection/calculation
- Drawing / mass elastic data generation
- and more..

The screenshot shows the 'COPS ver. 3.0' main window. It includes sections for 'Ship information' (Project identity, Ship type, Vessel name), 'Propeller information' (Propeller type, Blade count, etc.), 'Engine information' (Engine type, Power, etc.), and 'Optimization parameters' (Ship speed, Design generator power, etc.). A 'Find Optimal Propulsion System' button is at the bottom.



This window shows a table of gear information. The table has columns for Gear type, Ratio, Prop. Speed (RPM), Tooth width (mm), and Unit value. It lists data for AM228 and AM228-SEV228 gears.

Gear type	Ratio	Prop. Speed (RPM)	Tooth width (mm)	Unit value
AM228	54/228	1467	350.0	48.4
AM228-SEV228	5.0	1463	350.0	48.4



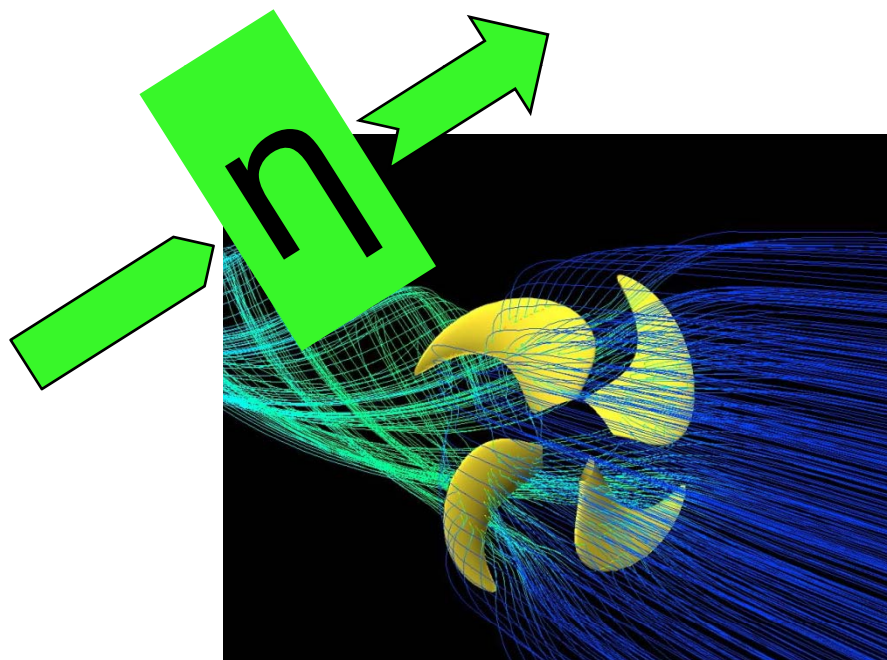
This window displays a detailed technical report for the '1400 TEU Container Vessel => 4301926'. It includes sections for 'General particulars', 'Engine 1 particulars', and 'Propeller particulars'.

General particulars	
Type of vessel	Container
Class society	ABS
Ice class	Noice
Propulsion plant type	Single screw

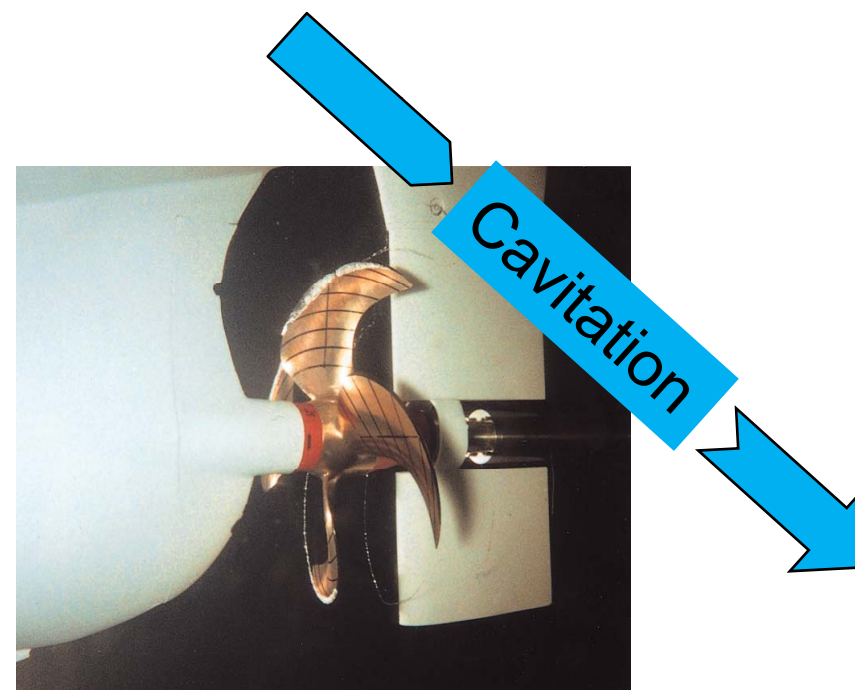
Engine 1 particulars	
Engine type	9L58/84
Rating at 100% MCR	12000 kW
Speed at 100% MCR	428 rpm

Propeller particulars	
Hub type	VBS1560_MK3
Propeller type	Open
Propeller diameter	5200 mm
Area ratio	0.714
Total bollard pull (at ship speed = 0)	133.3 tons
Propeller blade weight	27.4 t

The Balanced Design

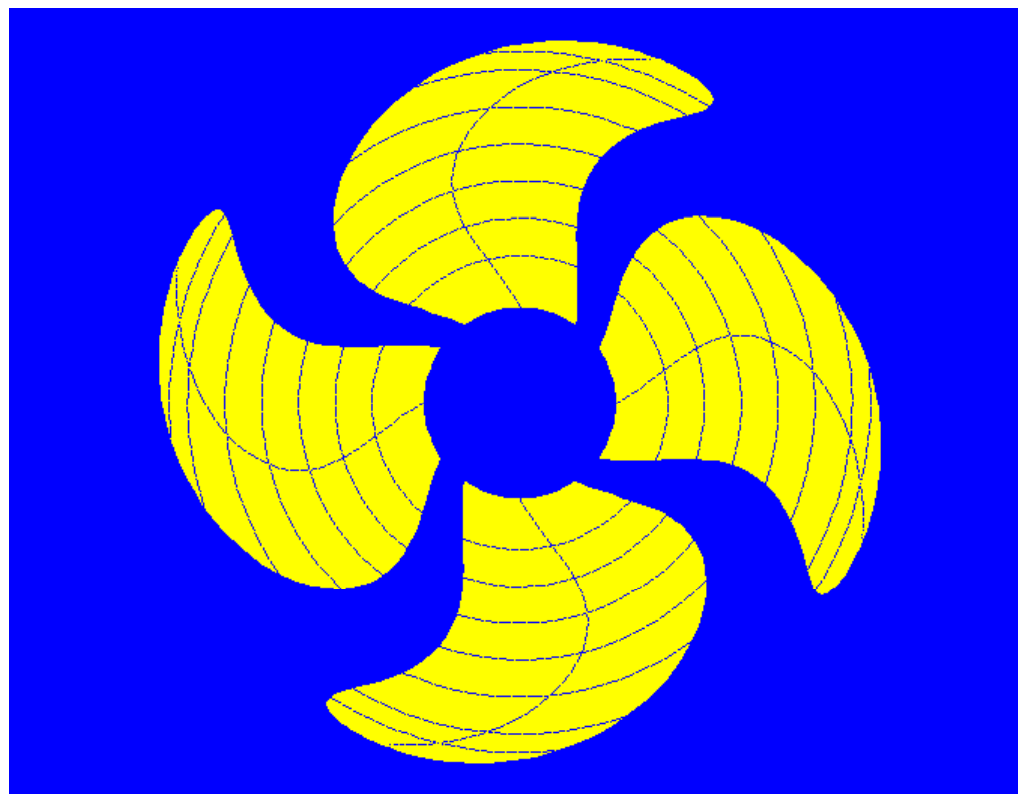


Fuel Consumption

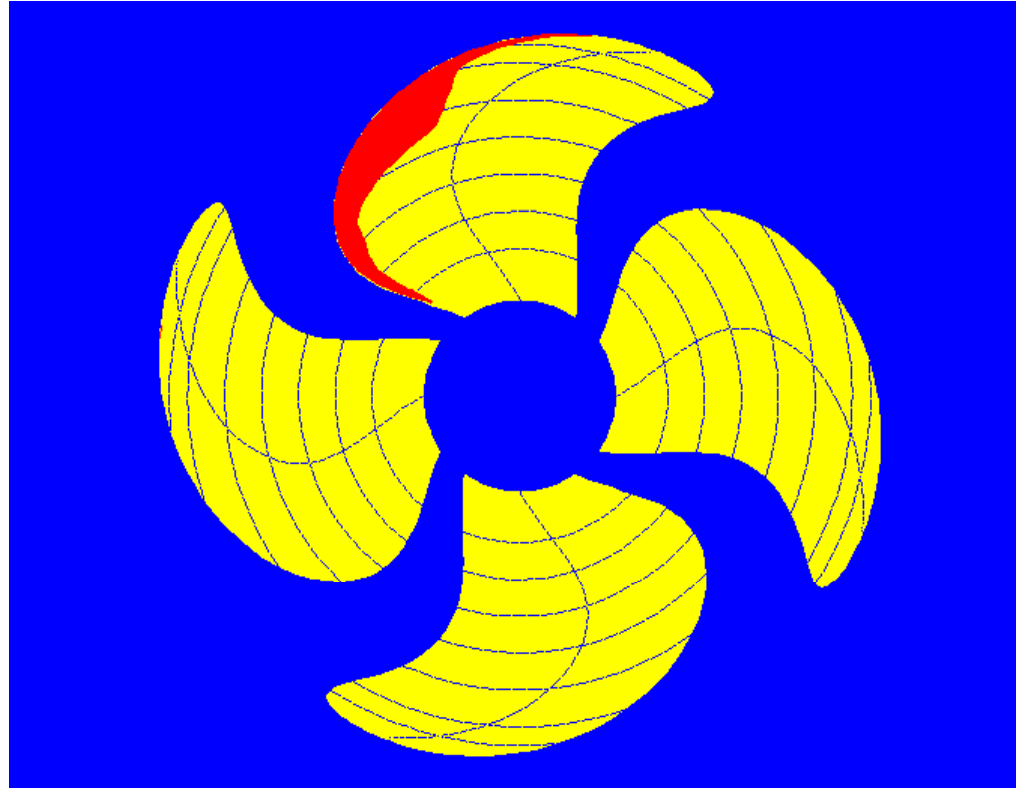


Vibration/Noise/Comfort

High Skew Propeller Blade Design



High Skew Cavitation Pattern



CP Propeller Blades

- Comes in different size and shape

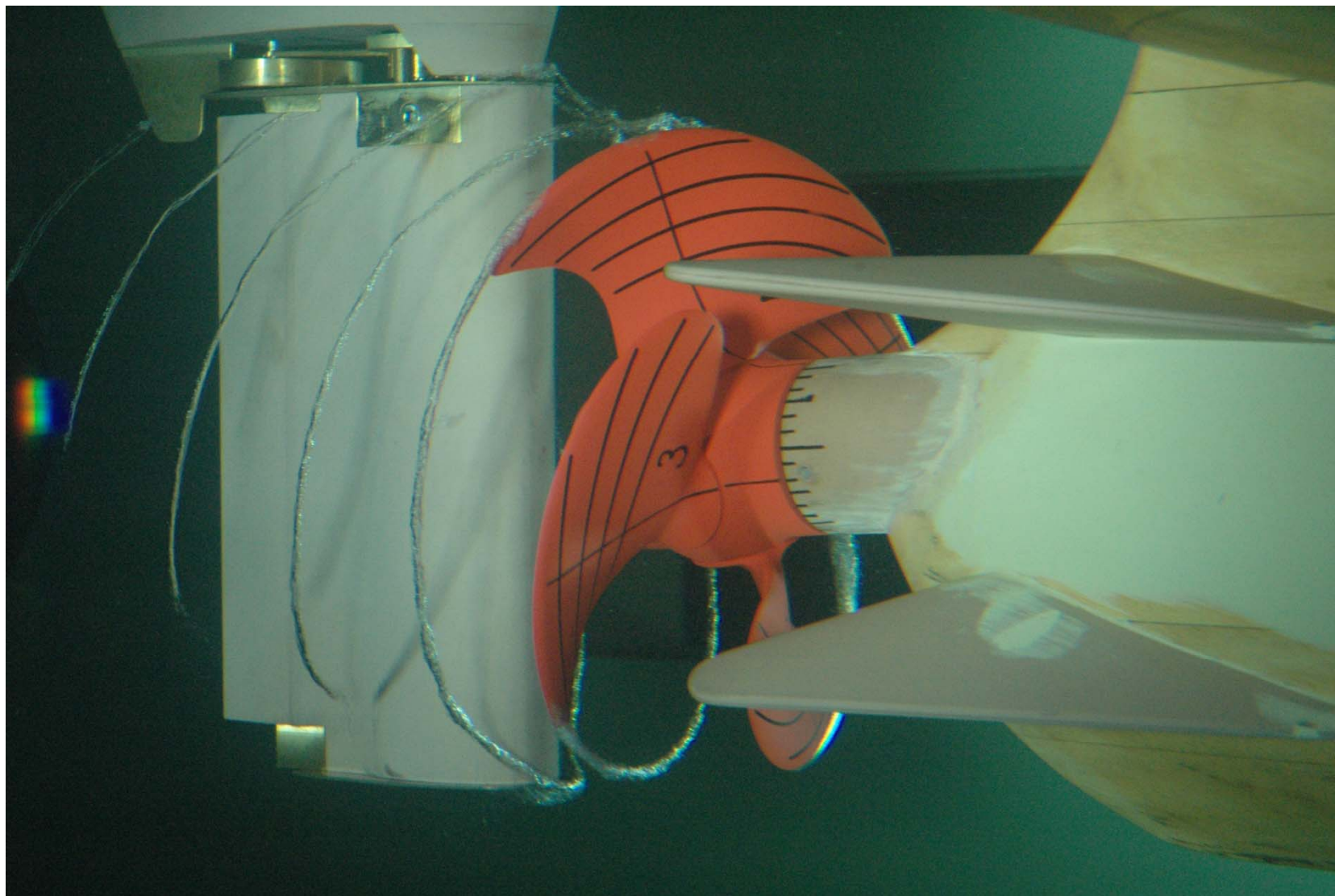


Cavitation Tunnel Testing



Navy Inspection Vessel

Ice class 1A



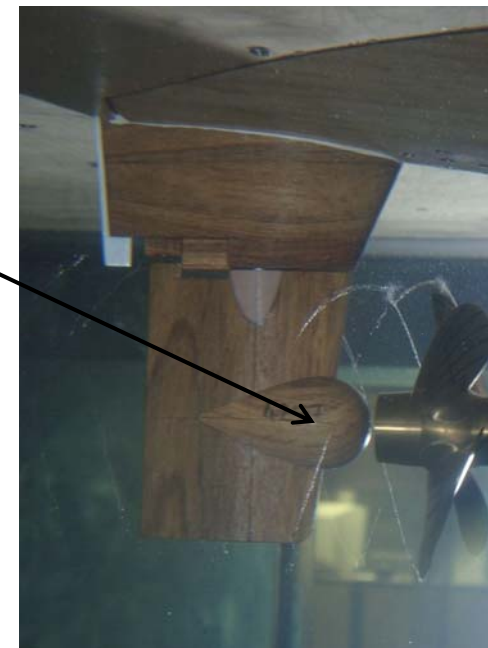
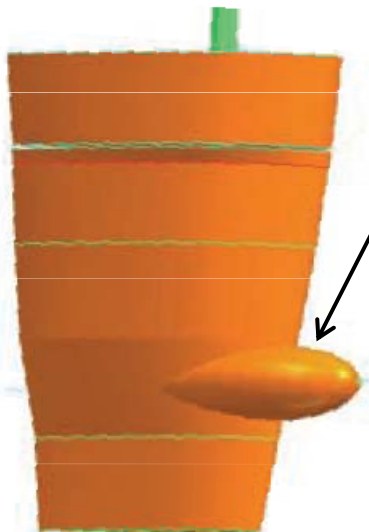
Efficiency improving devices



■ Type	Efficiency
■ Costa Bulb	2-3%
■ Asymmetric Rudder	2-4%
■ Pre-swirl fins	3-5%
■ Tip loaded propeller (Kappel)	3-5%
■ Propeller with nozzle	14%
■ Contra rotating propeller	10-15%

Costa Bulb and Twisted Rudder

Efficiency improvement up to 4%

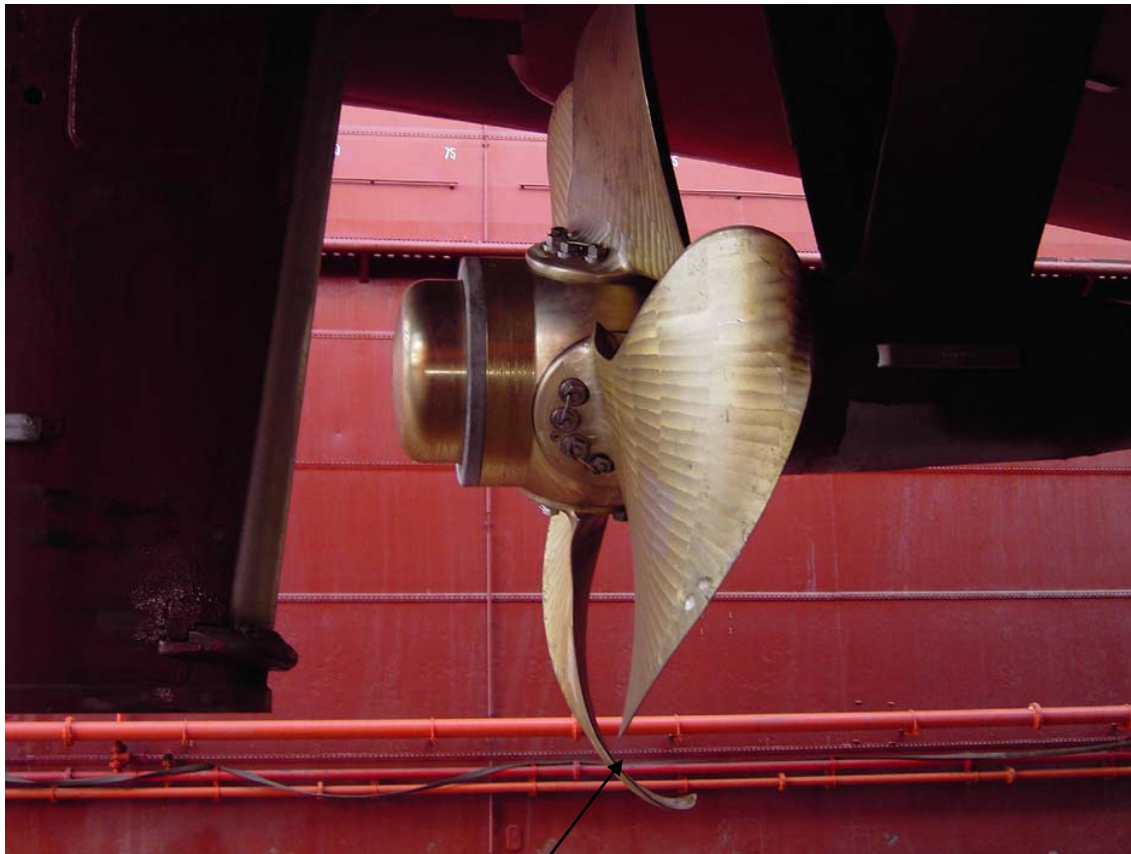


Twisted rudder

Kappel Tip Fin Propellers



**Kappel Tip Fin Propeller
3-5 % efficiency gain**



Non Planer blade shape
Comparable to winglets



CP Propeller with Kappel Blade Design

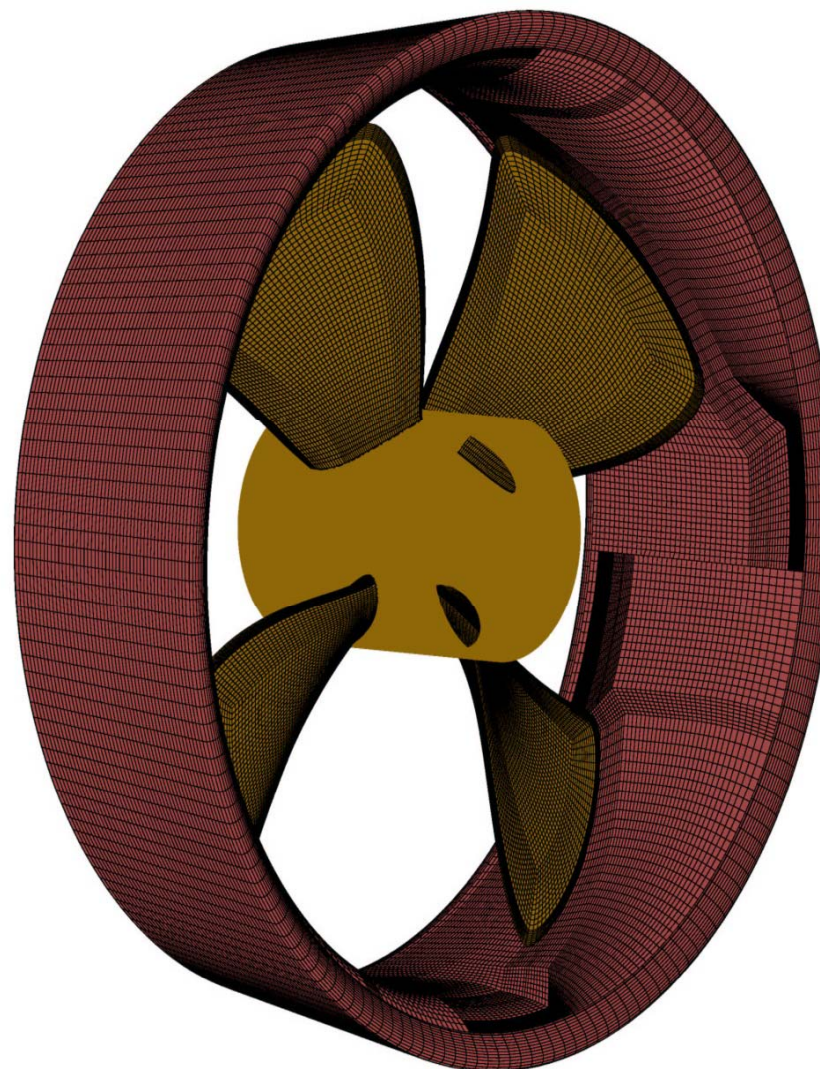
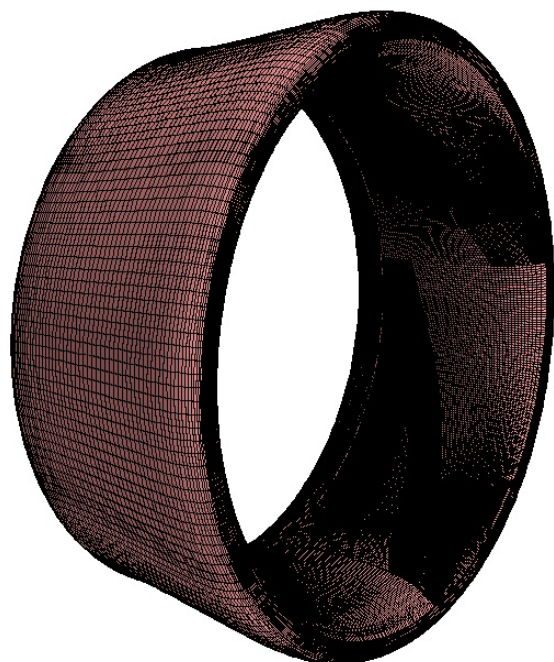
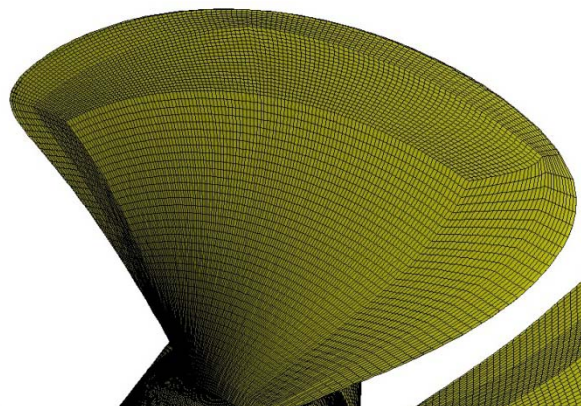


M/F Kronprins Frederik

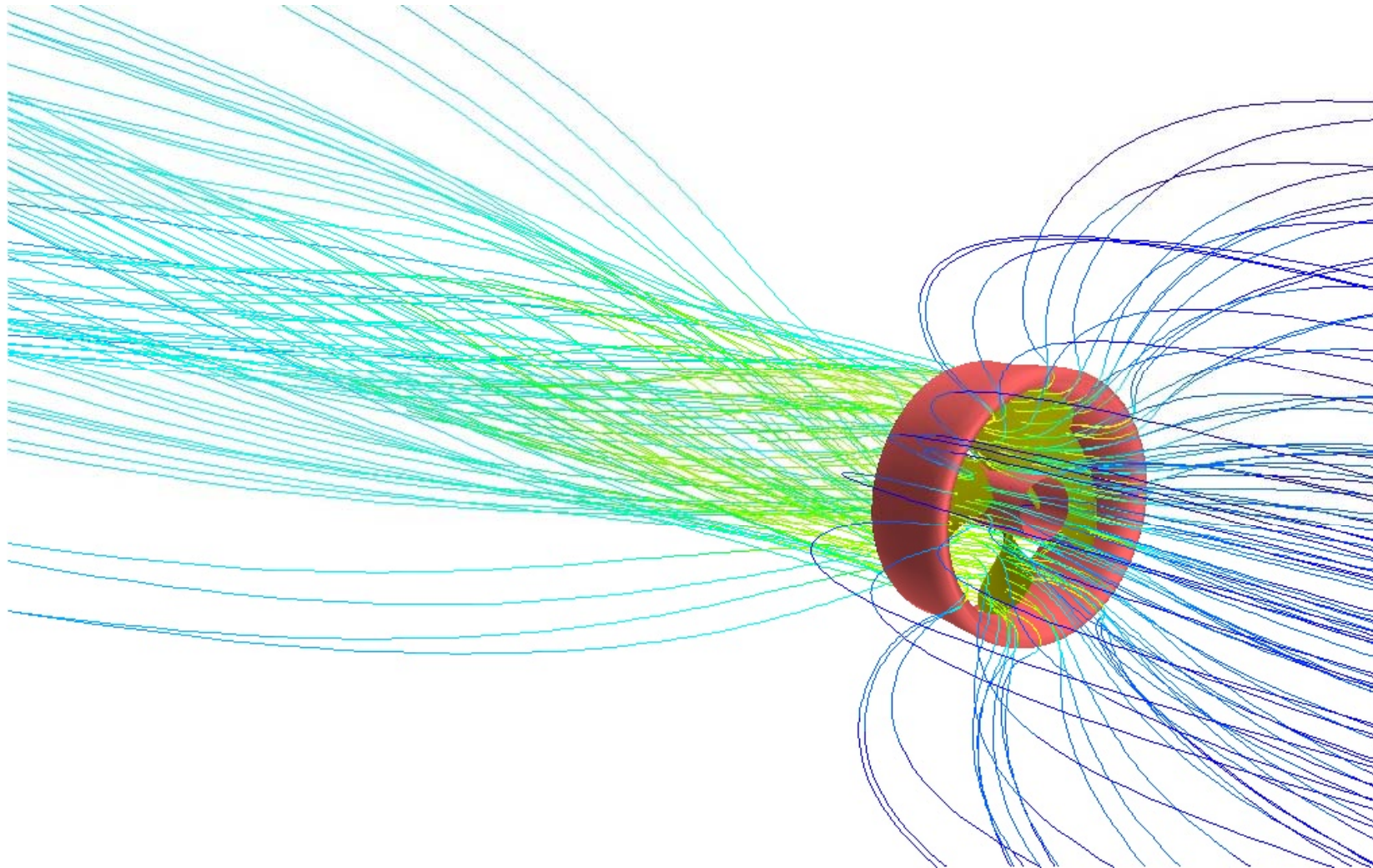


M/F URD

New AHT Nozzle Designs CFD Optimised for Bollard Pull



Computational Fluid Dynamics Streamlines – Bollard Pull Condition



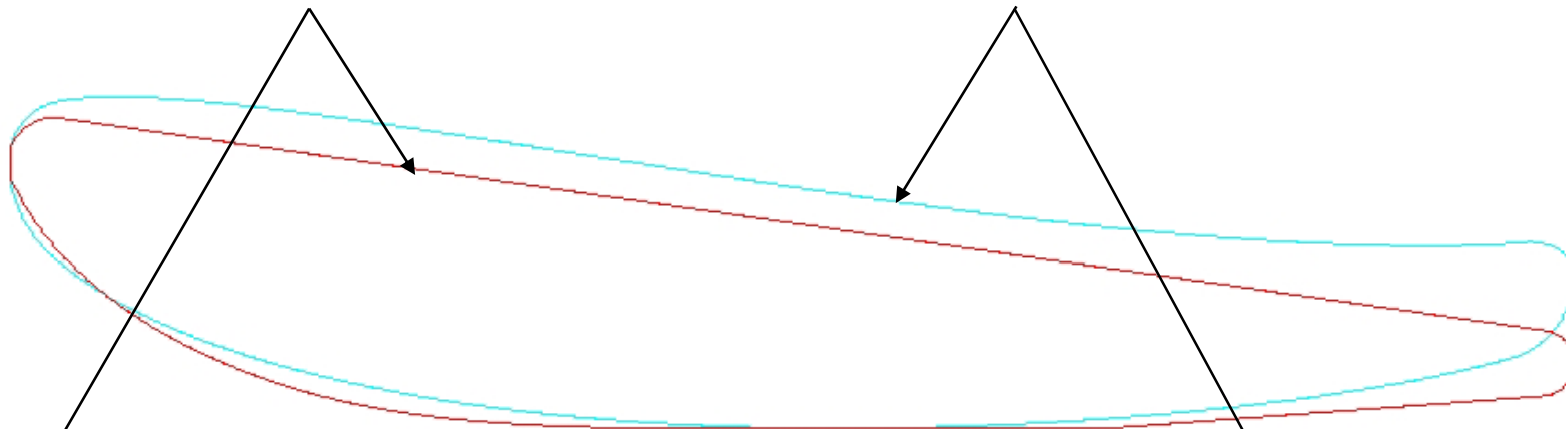
New AHT Nozzle Designs



6-8% Increase in Bollard Pull

Wageningen 19A

New MAN Diesel AHT Design



AHT nozzles have double curvature on both in and outside

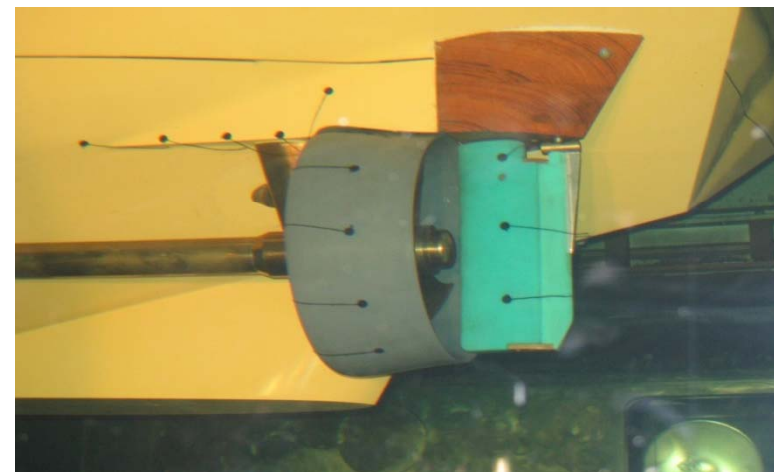
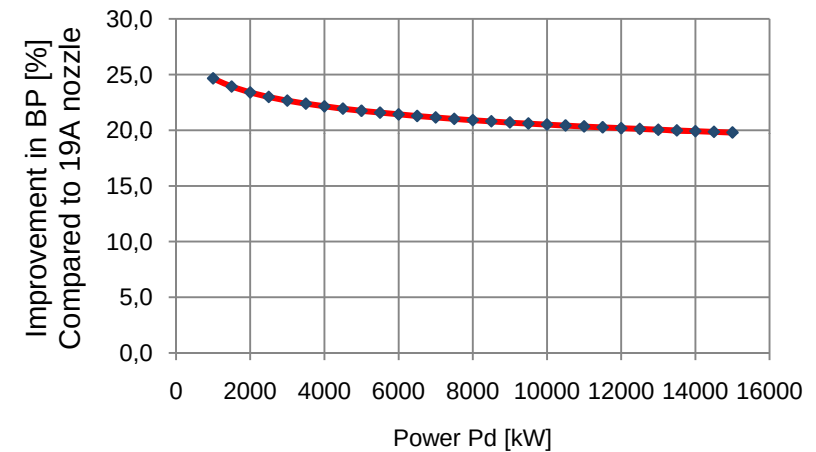


AHT Nozzles (Alpha High Trust)

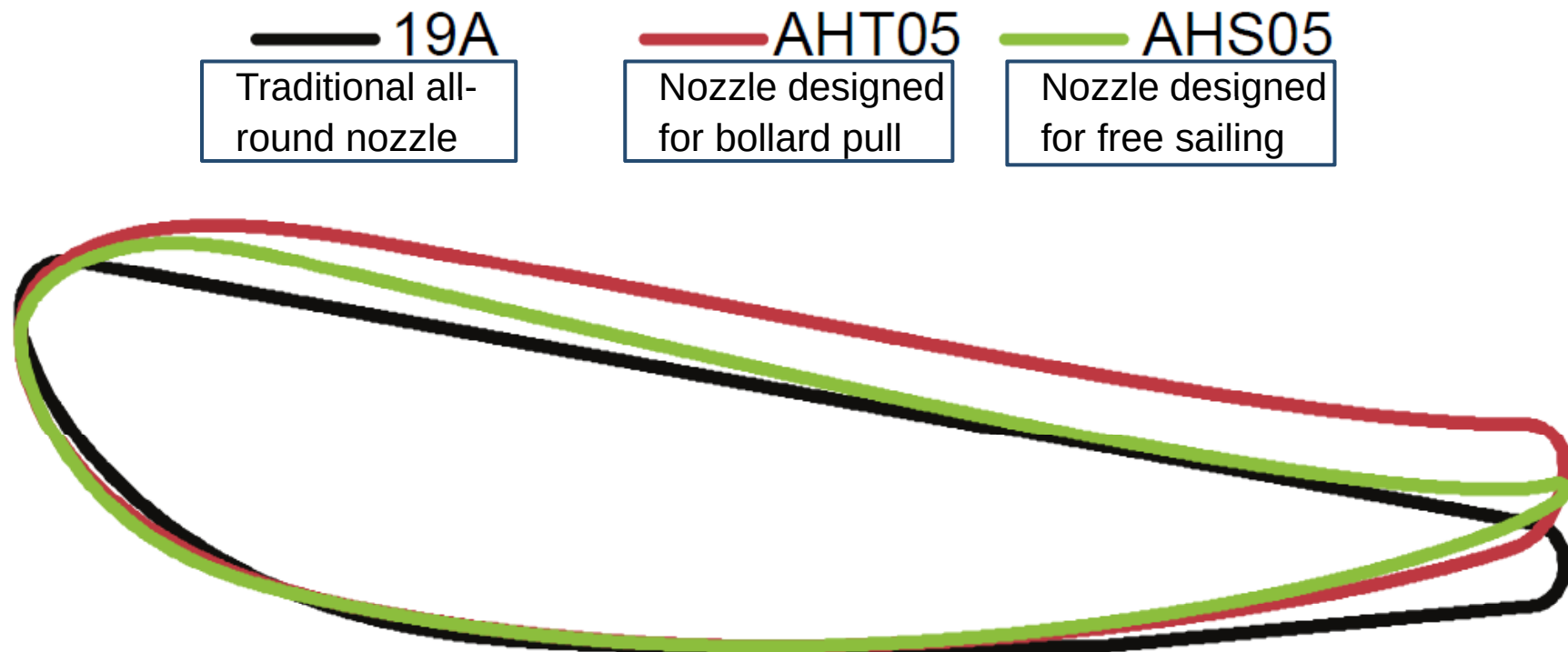


- Not just a nozzle
 - but a concept solution
- The AHT nozzle is customized to the specific project
- Increased astern thrust
 - for DP and station keeping
- Verified in model testing
- Proven in full scale

Bollard Pull Astern
Wageningen 19A Versus AHT



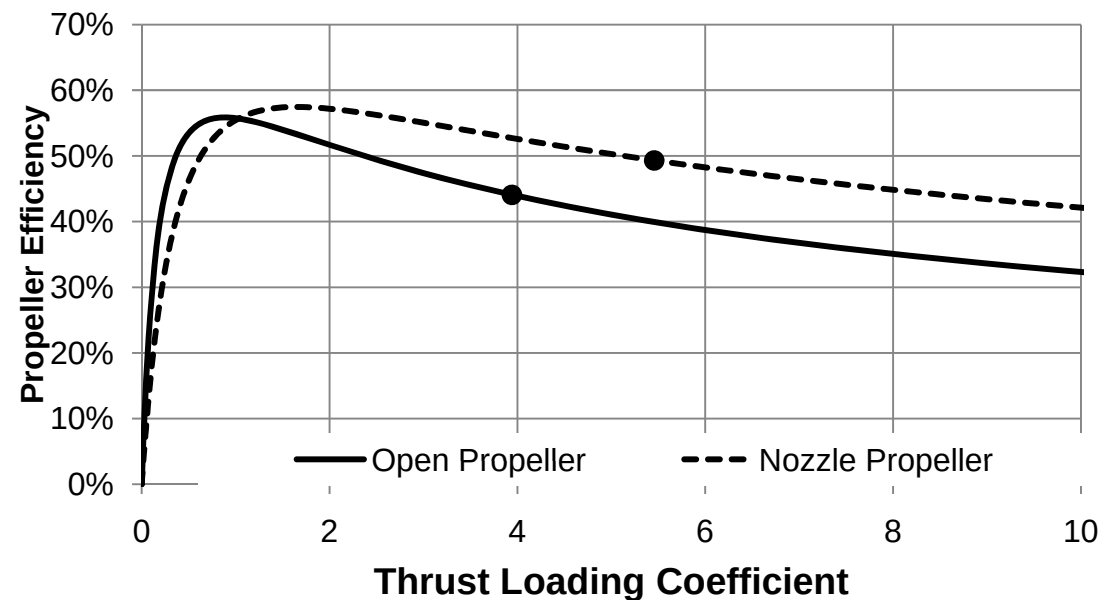
Comparison of nozzle profiles



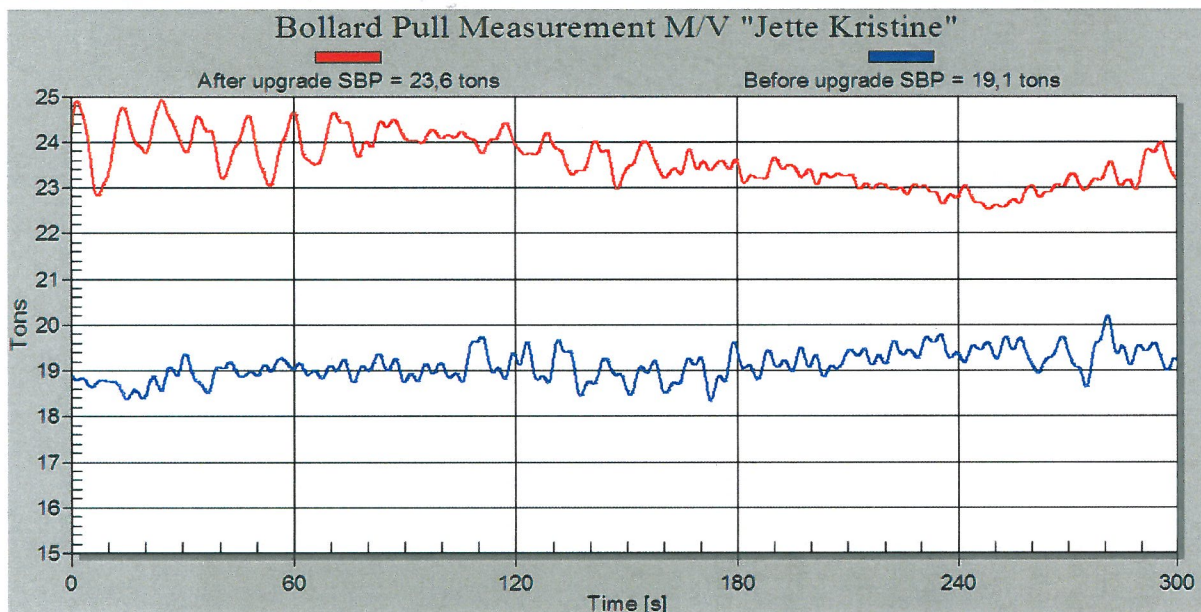
Tool for evaluation speed nozzles



Optimisation point	Open	Nozzle
Propulsion Power (Engine)	2160 kW	1930 kW
Propeller Shaft Speed	250,0 Rpm	250,0 Rpm
Propeller Diameter	3000 mm	2550 mm
Blade Area Ratio	0,700 -	0,674 -
Ship Speed	12,00 kn	12,00 kn
Wake Coefficient	0,350 -	0,350 -
Total Thrust	230,2 kN	230,2 kN
Pitch/Diameter at $r/R=0.70$	0,6337 -	0,9819 -
Thrust Loading Coefficient	3,94 -	5,46 -
Propeller Efficiency	44,08 %	49,33 %
Reduction in Propulsion Power		10,6 %
Increase in propeller efficiency		11,9 %



M/V "Jette Kristine" – Propeller upgrade



Bollard Pull Measurement in Frederikshavn

Technical Data M/V "Jette Kristine"

Engine type: MAN 8L23/30-DKV-39KV11

Engine power: 1080 kW at 825 rpm

Propeller: MAN Alpha VB740 / $\varnothing$ 2650 / 214 rpm

Measured Bollard Pull – before upgrade: 19,1 tons

Measured Bollard Pull – after upgrade: 23,6 tons



Old MAN Alpha
propeller & nozzle



New MAN Alpha propeller & AHT nozzle



Thank you for your attention

