LATEST DEVELOPMENTS ON MAN DIESEL
ALPHA PROPELLERS

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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: Worlds largest hopper suction dredger
- 3 x 2xVBS1560 Ro-Pax for Stena: Worlds largest Ro-Pax – 6200 LM
- 4 x VBS1800 6900 PCTC for Höegh: First large car carrier with CPP
- 79 x VBS1380 1100 TEU Feeders: Most famous feeder series. 79 CPP sold
- 10 x 2xVBS1080 AHTS vsls for Maersk: 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

Coverage:
• Two-stroke: Up to 80ME/MC
• Four stroke: Complete program
VBS Working principle
VBS servo oil system integrated in the MAN Diesel gearbox
CPP Hydraulic Power Unit
Hydrodynamic Propeller Design Aspects

Design

Owner Requirements

Hull Form

Torsional Vibration Calculations

Tank Test

Off-Design Conditions

Class Requirements

Engine/Gearbox Shafting

Noise & vibration Requirements

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New COPS Tool
Developed by MAN Diesel

- 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 optimum design

The Balanced Design

Fuel Consumption

Vibration/Noise/Comfort

Cavitation
High Skew Cavitation Pattern
CP Propeller Blades
- Comes in different size and shape
Navy Inspection Vessel
Ice class 1A
### Efficiency improving devices

<table>
<thead>
<tr>
<th>Type</th>
<th>Efficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Costa Bulb</td>
<td>2-3%</td>
</tr>
<tr>
<td>Asymmetric Rudder</td>
<td>2-4%</td>
</tr>
<tr>
<td>Pre-swirl fins</td>
<td>3-5%</td>
</tr>
<tr>
<td>Tip loaded propeller (Kappel)</td>
<td>3-5%</td>
</tr>
<tr>
<td>Propeller with nozzle</td>
<td>14%</td>
</tr>
<tr>
<td>Contra rotating propeller</td>
<td>10-15%</td>
</tr>
</tbody>
</table>
Costa Bulb and Twisted Rudder
Efficiency improvement up to 4%
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
Comparison of nozzle profiles

- 19A: Traditional all-round nozzle
- AHT05: Nozzle designed for bollard pull
- AHS05: Nozzle designed for free sailing
Tool for evaluation speed nozzles

<table>
<thead>
<tr>
<th>Optimisation point</th>
<th>Open</th>
<th>Nozzle</th>
</tr>
</thead>
<tbody>
<tr>
<td>Propulsion Power (Engine)</td>
<td>2160 kW</td>
<td>1930 kW</td>
</tr>
<tr>
<td>Propeller Shaft Speed</td>
<td>250.0 Rpm</td>
<td>250.0 Rpm</td>
</tr>
<tr>
<td>Propeller Diameter</td>
<td>3000 mm</td>
<td>2550 mm</td>
</tr>
<tr>
<td>Blade Area Ratio</td>
<td>0.700 -</td>
<td>0.674 -</td>
</tr>
<tr>
<td>Ship Speed</td>
<td>12.00 kn</td>
<td>12.00 kn</td>
</tr>
<tr>
<td>Wake Coefficient</td>
<td>0.350 -</td>
<td>0.350 -</td>
</tr>
<tr>
<td>Total Thrust</td>
<td>230.2 kN</td>
<td>230.2 kN</td>
</tr>
<tr>
<td>Pitch/Diameter at r/R=0.70</td>
<td>0.6337 -</td>
<td>0.9819 -</td>
</tr>
<tr>
<td>Thrust Loading Coefficient</td>
<td>3.94 -</td>
<td>5.48 -</td>
</tr>
<tr>
<td>Propeller Efficiency</td>
<td>44.00 %</td>
<td>46.03 %</td>
</tr>
<tr>
<td>Reduction in Propulsion Power</td>
<td>10.6 %</td>
<td></td>
</tr>
<tr>
<td>Increase in propeller efficiency</td>
<td>11.9 %</td>
<td></td>
</tr>
</tbody>
</table>

Graph showing propeller efficiency vs. thrust loading coefficient for Open Propeller and Nozzle Propeller.
M/V "Jette Kristine" – Propeller upgrade

Technical Data M/V "Jette Kristine"

Engine type: MAN 8L23/30-DKV-39KV11
Engine power: 1080 kW at 825 rpm
Propeller: MAN Alpha VB740 / ø2650 / 214 rpm

Measured Bollard Pull – before upgrade: 19,1 tons
Measured Bollard Pull – after upgrade: 23,6 tons

Bollard Pull Measurement in Frederikshavn

Old MAN Alpha propeller & nozzle

New MAN Alpha propeller & AHT nozzle

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Thank you for your attention