Three Years of Experience with the Mewis Duct®
- A Contribution to Ship Efficiency

by

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3rd International Conference
Hamburg, 26 – 27 September 2011
Three Years of Experience with the Mewis Duct®
– A Contribution to Ship Efficiency

Contents

1. Experience with the STAR ISTIND and other vessels, after two years in service with Mewis Duct®

2. Achieved power savings by Mewis Duct®, model scale/full scale

3. Observation of Cavitation, Pressure pulses, Manoeuvrability

4. Case study and summary
Mewis Duct® - How it works

1. Improving the wake by the pre-duct,
   - reducing the axial losses
   - the duct generates thrust
   - the duct flow is stabilising the fin flow
   - the duct works as endplates to the fins

2. Reducing the rotational losses by the pre-fin-system

3. Reduction of the hub vortex losses
   by concentration the pre-swirl to the inner radii

4. Reduction of the blade tip vortex losses

Each component contributes to a power reduction!
## Mewis Duct® - History

**First thoughts to a novel Energy-Saving Device for full form vessels**  
2007

**Patent pending**  
March 2008

**Launching of Mewis Duct® at SMM 2008**  
September 2008

**First Installation in full scale**  
September 2009

<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>In service</td>
<td>3</td>
<td>12</td>
<td>25</td>
<td>30</td>
</tr>
<tr>
<td>Orders, total</td>
<td>12</td>
<td>70</td>
<td>118</td>
<td>140</td>
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</table>
STAR ISTIND
Grieg Star Shipping
first vessel
with MD in full scale
September 2009

Svardal/Mewis, Experience with Mewis Duct®, 3rd Ship Efficiency Conference, Hamburg 2011
Mewis Duct® - STAR ISTIND, Model tests

45,000 tdw MPC

Grieg I-class
T = 12 m

RPM reduction 0.7 % only

6 % Power reduction or 0.27 kts faster

P_D = 8151 kW

w/o MD

with MD

15.42 kts
15.69 kts

HSVA

Svardal/Mewis, Experience with Mewis Duct®, 3rd Ship Efficiency Conference, Hamburg 2011
Mewis Duct® - STAR ISTIND, Model scale / Full scale

Model test
0.24 kts
5.6 %

Trial result
0.28 kts
6.0 %

T = 8.5/9.5 m

45,000 tdw MPC
Average speed gain
0.28 kts
Average power reduction
6.0 %

T = 5.25/6.5 m; 5.68/7.22)

Svardal/Mewis, Experience with Mewis Duct®, 3rd Ship Efficiency Conference, Hamburg 2011
The duct is inspected by divers in connection with propeller polishing every 6 months – no cracks detected so far.

Crew report generally better course stability in practice. No measurements available to back up this statement.

Some of the challenges in practice are how the estimated savings should be used:

- By utilising the speed gain in transit and hence arrive earlier at destination? Fuel consumption per day will then be about same as before, except that you will arrive slightly earlier and save some steaming time (and fuel).

- Should we give a lower rpm order for those sister vessels with MD compared to vessels without MD? Thus the speed and theoretical arrival time should be same for all sister vessels, but power savings will than occur daily for the vessels with MD.
**Mewis Duct® - Experience after two years in service**

**Main effect: Power saving**
- It is very difficult to measure the power savings reliably during practical ship service; it needs fixed long-time rules.
- The most reliable method is to undertake trial trips with and without the MD fitted to a newbuilding within a short period of time.
- *Crew reports:* The ship is faster than before.

**Side effects:**
- Better course stability; *full scale measurements and crew report*
- Lower vibration level; *crew report and model measurements*
- More stable propeller rotation at heavy sea; *crew report*
STAR ISTIND
Grieg Star Shipping first vessel with MD in full scale September 2009

Main particulars:
- Lpp: 187.00 m
- B: 31.00 m
- Tdesign: 12.00 m
- CB: 0.802
- DP: 7.00 m
- Vdesign: 16 kts
Mewis Duct® - Experience in using CFD

- CFD calculations are very well suited for design and optimisation of passive Energy-Saving Devices like Mewis Duct®

- The result of CFD usage is about 2% additional power saving

- The global optimisation of the MD design parameters is possible with a high accuracy

- The accuracy in determination of power savings by CFD-methods is abt. +/- 1.5%

- The accuracy in determination of power savings by model tests is abt. +/- 0.5%
There are three types of nominal transversal wake fields.

<table>
<thead>
<tr>
<th>Bilge Vortex</th>
<th>large</th>
<th>small</th>
<th>medium</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ship’s Resistance</td>
<td>high</td>
<td>low</td>
<td>medium</td>
</tr>
<tr>
<td>Losses at wake field</td>
<td>high</td>
<td>low</td>
<td>medium</td>
</tr>
<tr>
<td>Power reduction by MD</td>
<td>5%-10%</td>
<td>2%-5%</td>
<td>3%-8%</td>
</tr>
<tr>
<td>Course Stability</td>
<td>sufficient</td>
<td>not sufficient</td>
<td>medium</td>
</tr>
<tr>
<td>Improvement by MD</td>
<td>low</td>
<td>high</td>
<td>medium</td>
</tr>
<tr>
<td>Reduction of pressure pulses by MD</td>
<td>high</td>
<td>low</td>
<td>medium</td>
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</tbody>
</table>
Mewis Duct® - Experience Model tests

HSVA  SVA  SSPA

MARINTEK  HMRI  MARIN
<table>
<thead>
<tr>
<th>No.</th>
<th>Towing Tank</th>
<th>Ship Type</th>
<th>DWT</th>
<th>V kts</th>
<th>CB</th>
<th>CTh</th>
<th>Power reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Design T</td>
</tr>
<tr>
<td>1</td>
<td>HSVA</td>
<td>BC</td>
<td>118k</td>
<td>14,5</td>
<td>0,847</td>
<td>2,27</td>
<td>6,9</td>
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<tr>
<td>2</td>
<td>SVA</td>
<td>BC</td>
<td>12k</td>
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<td>0,794</td>
<td>1,88</td>
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<td>BC</td>
<td>45k</td>
<td>16,0</td>
<td>0,802</td>
<td>1,43</td>
<td>6,0</td>
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<tr>
<td>4</td>
<td>SSPA</td>
<td>BC</td>
<td>41k</td>
<td>15,2</td>
<td>0,795</td>
<td>2,10</td>
<td>6,0</td>
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<tr>
<td>5</td>
<td>SSPA</td>
<td>VLCC</td>
<td>318k</td>
<td>16,0</td>
<td>0,813</td>
<td>2,24</td>
<td>6,4</td>
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<tr>
<td>6</td>
<td>HMRI</td>
<td>VLCC</td>
<td>318k</td>
<td>16,0</td>
<td>0,813</td>
<td>2,24</td>
<td>6,2</td>
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<tr>
<td>7</td>
<td>SSPA</td>
<td>BC</td>
<td>180k</td>
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<tr>
<td>8</td>
<td>HSVA</td>
<td>COT</td>
<td>158k</td>
<td>14,6</td>
<td>0,821</td>
<td>1,40</td>
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<tr>
<td>9</td>
<td>HSVA</td>
<td>HLC</td>
<td>20.5k</td>
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<td>1,83</td>
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<td>BC</td>
<td>57k</td>
<td>14,4</td>
<td>0,848</td>
<td>2,05</td>
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<tr>
<td>11</td>
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<td>BC</td>
<td>163k</td>
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<td>0,817</td>
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<td>RoRo</td>
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<td>0,687</td>
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<td>15</td>
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<td>8,7</td>
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<td>17</td>
<td>SVA</td>
<td>BC</td>
<td>45k</td>
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<td>0,800</td>
<td>1,98</td>
<td>6,5</td>
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<td>BC</td>
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<td>0,815</td>
<td>2,24</td>
<td>5,3</td>
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<tr>
<td>19</td>
<td>MARINTEK</td>
<td>BC</td>
<td>35k</td>
<td>14,2</td>
<td>0,830</td>
<td>2,31</td>
<td>6,5</td>
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<td>SVA</td>
<td>COT</td>
<td>74.7k</td>
<td>15,0</td>
<td>0,856</td>
<td>1,74</td>
<td>4,9</td>
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<td>21</td>
<td>SVA</td>
<td>BC</td>
<td>82k</td>
<td>16,8</td>
<td>0,876</td>
<td>2,00</td>
<td>5,1</td>
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<tr>
<td>22</td>
<td>HSVA</td>
<td>BC</td>
<td>286k</td>
<td>15,4</td>
<td>0,850</td>
<td>2,14</td>
<td>7,6</td>
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<tr>
<td>23</td>
<td>HSVA</td>
<td>MPC</td>
<td>31k</td>
<td>18,0</td>
<td>0,755</td>
<td>1,16</td>
<td>3,6</td>
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<tr>
<td>24</td>
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<td>MPV</td>
<td>47,8</td>
<td>15,5</td>
<td>0,795</td>
<td>1,37</td>
<td>2,4</td>
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<td>25</td>
<td>SSPA</td>
<td>BC</td>
<td>82k</td>
<td>14,5</td>
<td>0,870</td>
<td>1,79</td>
<td>5,7</td>
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<tr>
<td>26</td>
<td>FORCE</td>
<td>BC</td>
<td>35k</td>
<td>14,0</td>
<td>0,818</td>
<td>1,43</td>
<td></td>
</tr>
</tbody>
</table>

Average Design / Ballast: 5,6 / 7,5

Average all tests: 6,4
Mewis Duct® - Model test results

Power reduction by Mewis Duct® - Model test results

- Model tests, design draught
- Model tests, ballast draught
- Calculated possible reduction
### Mewis Duct® - Model test results

One very interesting side result:

<table>
<thead>
<tr>
<th>Example:</th>
<th>40,000 tdw BC, Design draught,</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Resistance tests:</strong></td>
<td></td>
</tr>
<tr>
<td>Duct only</td>
<td>-3.0%</td>
</tr>
<tr>
<td>Duct and Fins</td>
<td>-3.5%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CFD-calculation results</th>
</tr>
</thead>
<tbody>
<tr>
<td>-3.5% (Resistance. red.)</td>
</tr>
<tr>
<td>-4.5%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Self-propulsion test:</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Duct only</td>
</tr>
<tr>
<td>Duct and fins</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>-7.0% (Power reduction)</th>
</tr>
</thead>
<tbody>
<tr>
<td>-10.5%</td>
</tr>
</tbody>
</table>
Mewis Duct® - Model tests / Full scale trial

AS VINCENTIA; 57,000 tdw - Supramax-Bulker

Model test

0.27 kts
7.1%

T = 4.8/6.5 m

Trial result

Speed gain at 14.4 kts
0.25 kts

Power reduction at 14.4 kts
6.5%

T = 4.8/6.5 m

Svardal/Mewis, Experience with Mewis Duct®, 3rd Ship Efficiency Conference, Hamburg 2011
Mewis Duct® - Experience Pressure pulses

Preliminary Results

without Mewis Duct®

Fig. 1: Hull Pressure Amplitudes (Full Scale)
Condition 2 - without Mewis Duct - without Saver Fins

158,000 tdw COT
Mewis Duct® - Experience Pressure pulses

Preliminary Results

with Mewis Duct®

Fig. 1: Hull Pressure Amplitudes (Full Scale)
Condition 4 - with Mewis Duct - without Saver Fins

158,000 tdw COT
Mewis Duct® - Experience Cavitation Behavior

without Mewis Duct®

with Mewis Duct®

158,000 tdw COT
Mewis Duct® - Experience Hub Vortex

without MD

31,000 tdw MPV

with MD
### Mewis Duct® - Experience

#### Course Stability

<table>
<thead>
<tr>
<th>Model test:</th>
<th>46,000 tdw Tanker, SSPA</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Zig-Zag-Tests 10°/10°</strong></td>
<td><strong>IMO-Criterion</strong></td>
</tr>
<tr>
<td>1st overshoot (°)</td>
<td>17,2</td>
</tr>
<tr>
<td>2nd overshoot (°)</td>
<td>31,8</td>
</tr>
<tr>
<td><strong>Tactical diameter/Lpp</strong></td>
<td>5,00</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Full Scale trial:</th>
<th>163,000 tdw Bulker</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st overshoot (°)</td>
<td>20,0</td>
</tr>
<tr>
<td>2nd overshoot (°)</td>
<td>35,0</td>
</tr>
</tbody>
</table>
Mewis Duct® - Case Study

Installation of a Mewis Duct® on a 45,000 tdw Multi Purpose Carrier

Costs

- Price, ship set price, based on three vessels  abt. 220,000 $
- Installation  abt. 30,000 $
- Capital costs  abt. 25,000 $

Sum of costs  abt. 275,000 $

Saving in costs by MD

- 6% power reduction abt. 1,300 $ / day*
- 220 days / year abt. 286,000 $ / year

ROI (Return of Investment) about 1 year!

* at an actual bunker price of 600 $/t
Mewis Duct® - Summary I

- Power reduction up to 8%,
  that means up to 8% less emissions

- Reduction of propeller induced
  pressure pulses and tip cavitation,
  that leads to less vibration in the aft ship

- Small improvement of course stability,
  that leads to a small additional power reduction
Mewis Duct® - Summary II

- The Mewis Duct® is a new Energy-Saving Device which has been developed for full-form slower ships, allowing fuel savings of up to 8%.
- The Mewis Duct® is ideally suited for both new-build and retrofit applications.
- The Return of Investment (ROI) is about 1 year.

Invention and design:
Friedrich Mewis, Dresden

Calculations:
IBMV, Rostock

Model tests:
HSVA, Hamburg; SVA, Potsdam; SSPA, Göteborg; MARINTEK, Trondheim; HMRI, Ulsan; MARIN, Wageningen; FORCE, Brøndby

Financing, development, construction and marketing:
Becker Marine Systems, Hamburg
Three Years of Experience with the Mewis Duct® - A Contribution to Ship efficiency

We thank you very much for your attention

STAR ISTIND
Grieg Star Shipping
first vessel
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Mewis Duct® - Experience Duct Thrust

Main goal: Improvement of wake, and thrust generation

Horizontal cut through the flow field at height of the propeller shaft line

Additional resistance, created by the duct

Lift of the duct profile

Thrust component from the lift