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

by

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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!

GRIEG MSH becker marine systems

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

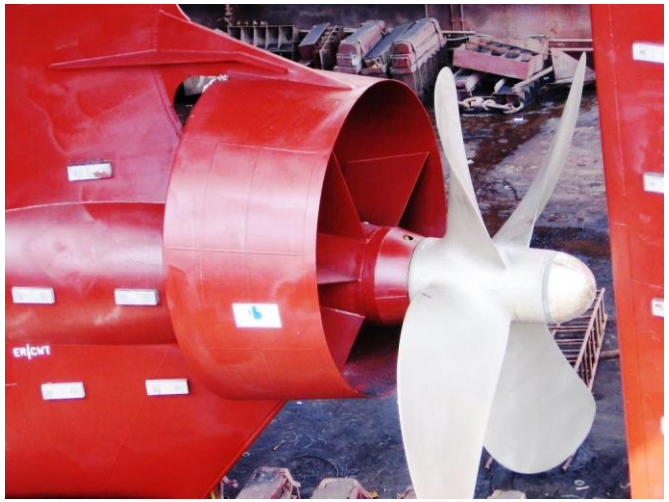
Actual state:	Dec. 2009	Dec. 2010	June 2011	Sept. 2011
In service	3	12	25	*30*
Orders, total	12	70	118	*140*

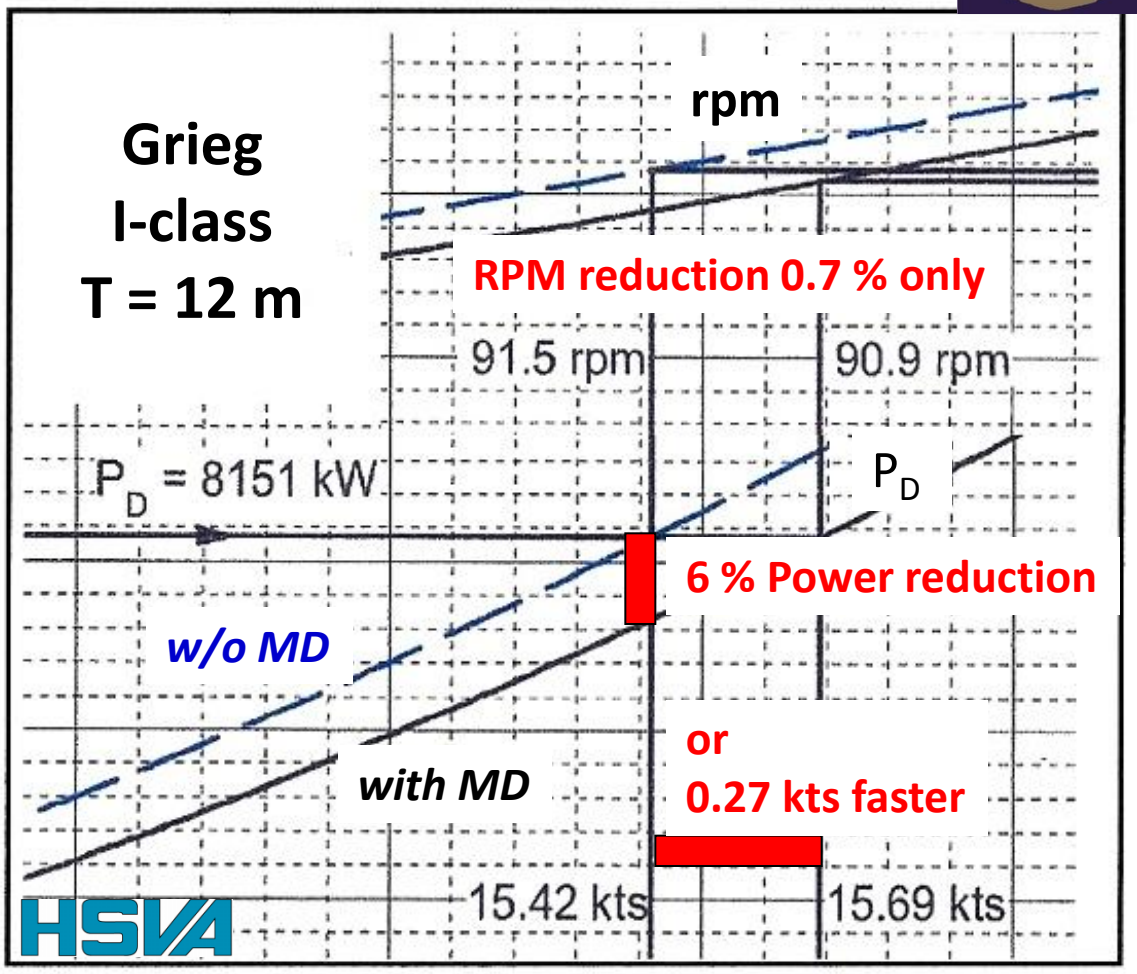
Mewis Duct® - STAR ISTIND

STAR ISTIND
Grieg Star Shipping
first vessel
with MD in full scale
September 2009

Mewis Duct® - STAR ISTIND, Model tests

45,000 tdw MPC





Mewis Duct® - STAR ISTIND, Model scale/ Full scale

Model test

0.24 kts

5.6 %

45,000 tdw MPC

Average speed gain

Average power reduction

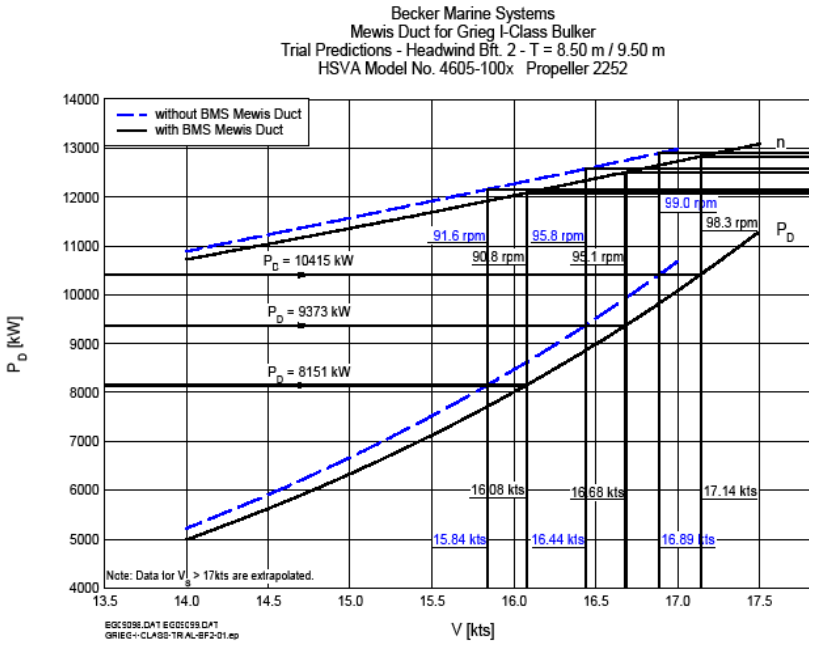
Trial result

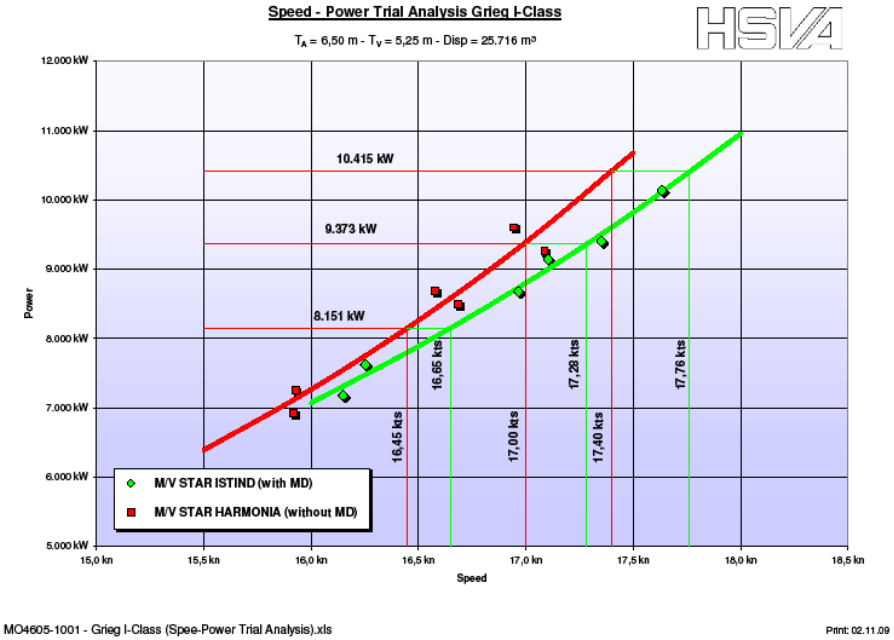
0.28 kts

6.0 %

T = 8.5/9.5 m

T = 5.25/6.5 m; 5.68/7.22)





Mewis Duct® - STAR ISTIND,
Experience after two years in service

- 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 challanges 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 pr day will than be about same as before, exept 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*

Mewis Duct® - STAR ISTIND

STAR ISTIND
Grieg Star Shipping
first vessel
with MD in full scale
September 2009

Main particulares:

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%

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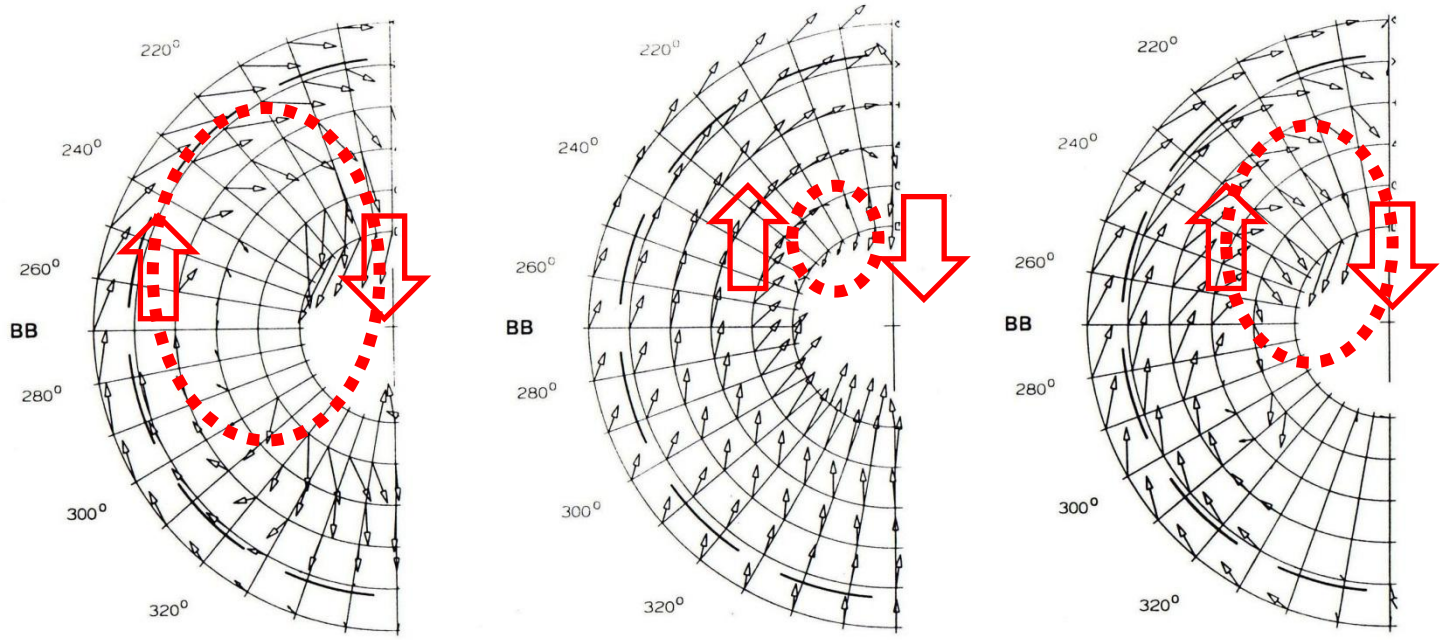
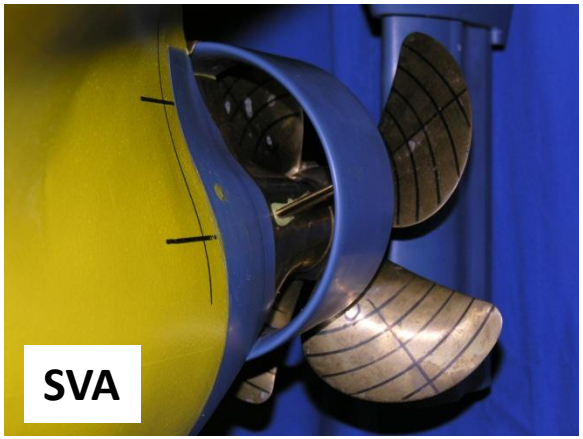
Mewis Duct® - Experience Influence of wake field

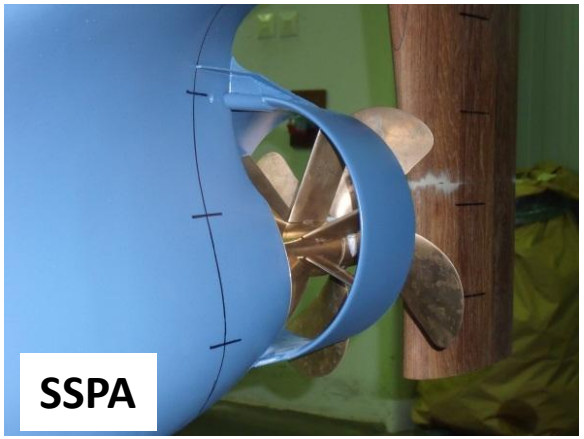
There are three types of nominal transversal wake fields

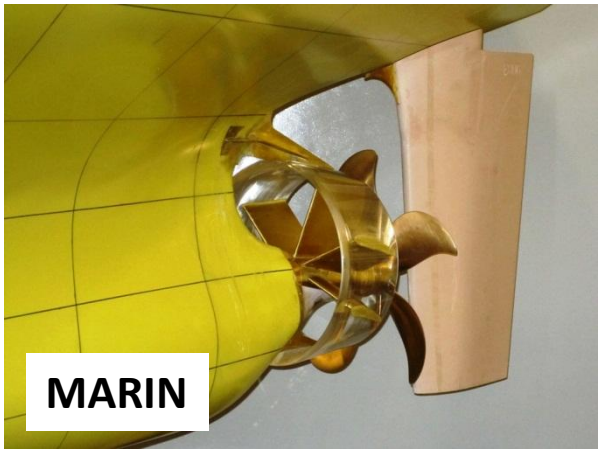


Bilge Vortex	*large*	*small*	*medium*
Ship's Resistance	high	low	medium
Losses at wake field	high	low	medium
Power reduction by MD	5%-10%	2%-5%	3%-8%
Course Stability	sufficient	not sufficient	medium
Improvement by MD	low	high	medium
Reduction of pressure pulses by MD	high	low	medium

Mewis Duct® - Experience Model tests







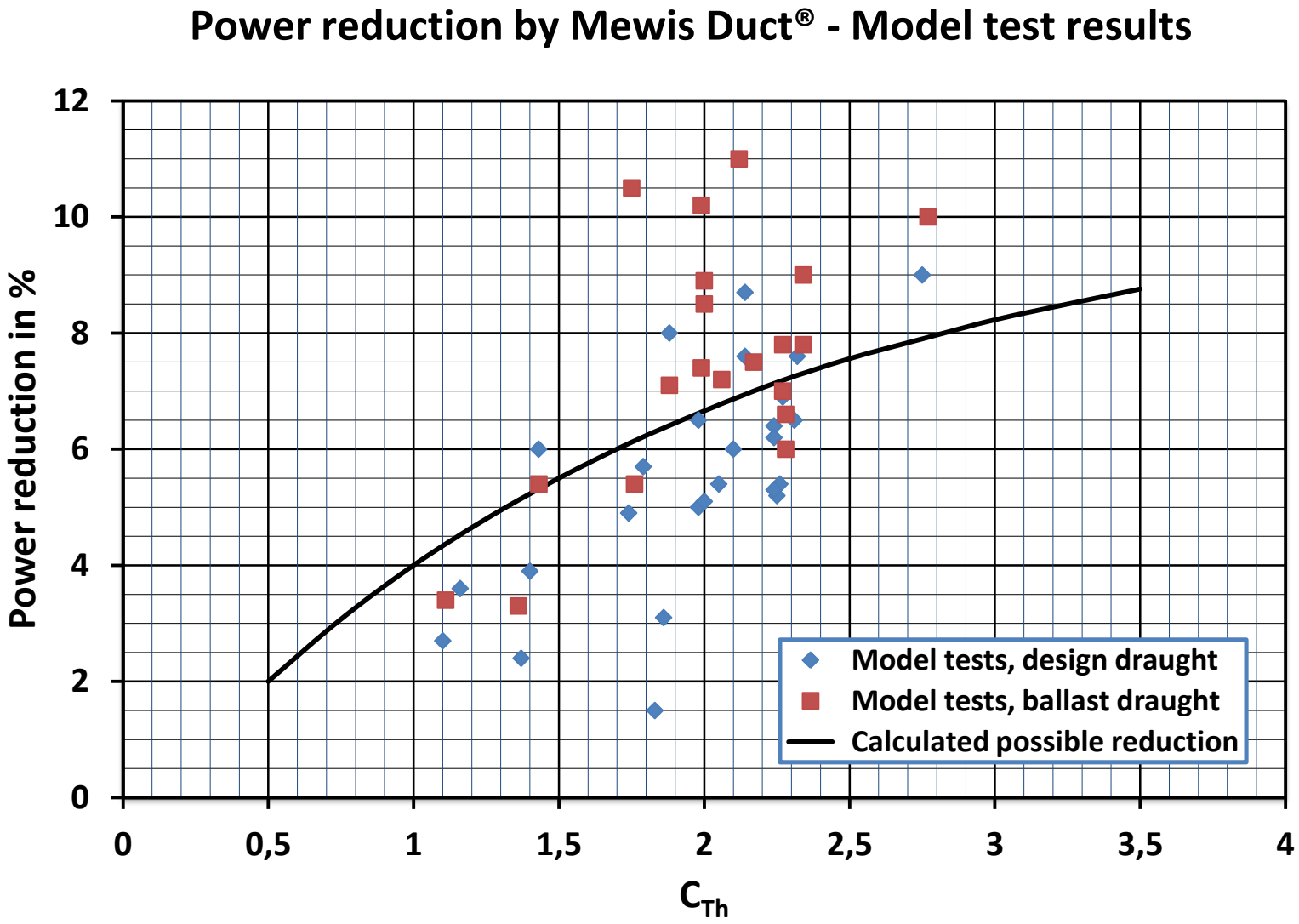
Mewis Duct® - Model test results

No.	Towing Tank	Ship Type	DWT	V kts	CB	CTh	Power reduction Design T	Power reduction Ballast T
1	HSVA	BC	118k	14,5	0,847	2,27	6,9	6,0
2	SVA	BC	12k	15,5	0,794	1,88	8,0	7,4
3	HSVA	BC	45k	16,0	0,802	1,43	6,0	5,4
4	SSPA	BC	41k	15,2	0,795	2,10	6,0	11,0
5	SSPA	VLCC	318k	16,0	0,813	2,24	6,4	7,8
6	HMRI	VLCC	318k	16,0	0,813	2,24	6,2	7,0
7	SSPA	BC	180k	15,2	0,847	1,98	5,0	8,5
8	HSVA	COT	158k	14,6	0,821	1,40	3,9	-
9	HSVA	HLC	20.5k	17,5	0,765	1,83	1,5	-
10	HSVA	BC	57k	14,4	0,848	2,05	5,4	7,2
11	HSVA	BC	163k	14,5	0,817	2,25	5,2	6,6
12	HSVA	BC	75k	16,0	0,879	1,86	3,1	7,1
13	SVA	RoRo	38.5k	20,2	0,687	1,10	2,7	3,4
14	MARINTEK	BC	37.5k	15,0	0,776	2,32	7,6	7,8
15	MARINTEK	BC	40k	15,0	0,808	2,75	9,0	10,0
16	MARIN	VLCC	306k	15,3	0,821	2,10	8,7	7,6
17	SVA	BC	45k	15,6	0,800	1,98	6,5	8,9
18	HSVA	BC	151k	15,6	0,815	2,24	5,3	-
19	MARINTEK	BC	35k	14,2	0,830	2,31	6,5	9,0
20	SVA	COT	74.7k	15,0	0,856	1,74	4,9	5,4
21	SVA	BC	82k	16,8	0,876	2,00	5,1	-
22	HSVA	BC	286k	15,4	0,850	2,14	7,6	10,2
23	HSVA	MPC	31k	18,0	0,755	1,16	3,6	3,3
24	HSVA	MPV	47,8	15,5	0,795	1,37	2,4	-
25	SSPA	BC	82k	14,5	0,870	1,79	5,7	10,5
26	FORCE	BC	35k	14,0	0,818	1,43		
		Average Design / Ballast					5,6	7,5
		Average all tests					6,4	

STAR ISTIND

XXX

Mewis Duct® - Model test results



Mewis Duct® - Model test results

One very interesting side result:

Example:	**40,000 tdw BC,**	
	Design draught,	
Resistance tests:		**CFD-calculation results**
Duct only	**-3.0%**	**-3.5% (Resistance. red.)**
Duct and Fins	**-3.5%**	**-4.5%**
Self-propulsion test:		
Duct only	**-6.0%**	**-7.0% (Power reduction)**
Duct and fins	**-9.0%**	**-10.5%**

Mewis Duct® - Model tests / Full scale trial

AS VINCENTIA; 57,000 tdw - Supramax-Bulker

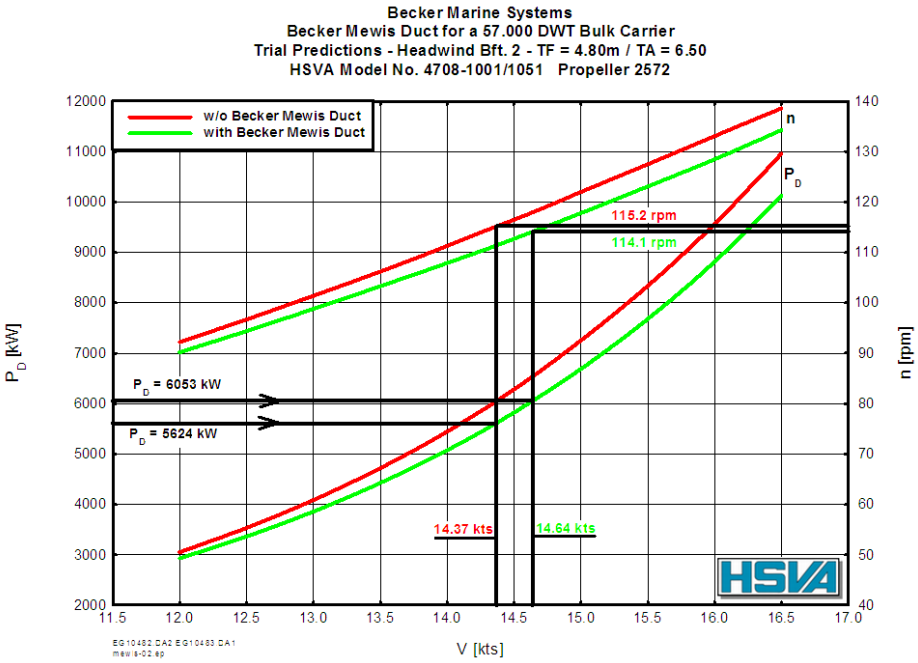
Model test

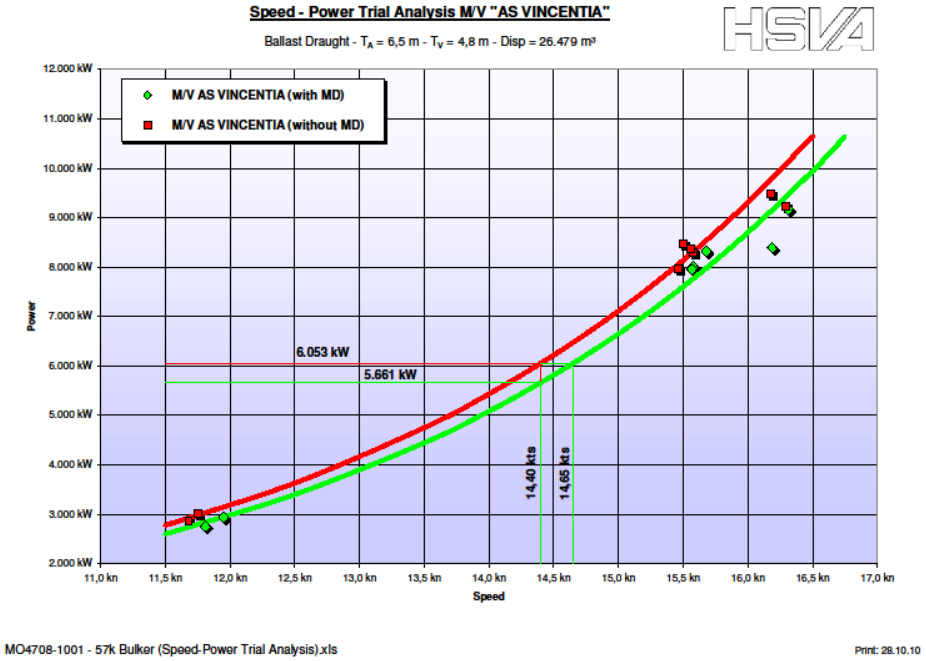
0.27 kts
7,1 %
T = 4.8/6.5 m

Speed gain at 14.4 kts
Power reduction at 14.4 kts

Trial result

0.25 kts
6.5 %
T = 4.8/6.5 m





Mewis Duct® - Experience Pressure pulses

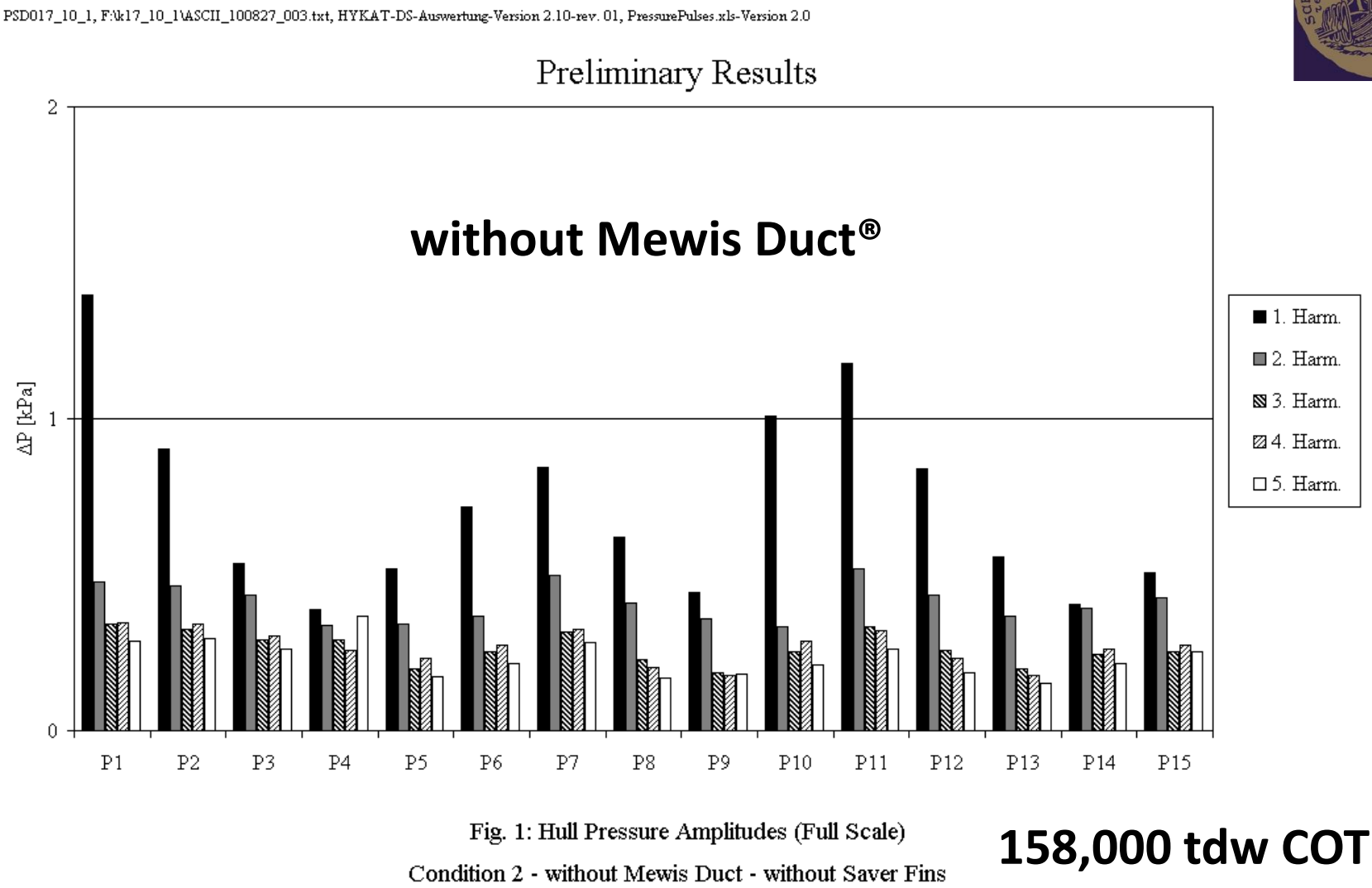


Fig. 1: Hull Pressure Amplitudes (Full Scale)

Condition 2 - without Mewis Duct - without Saver Fins

158,000 tdw COT

Mewis Duct® - Experience Pressure pulses

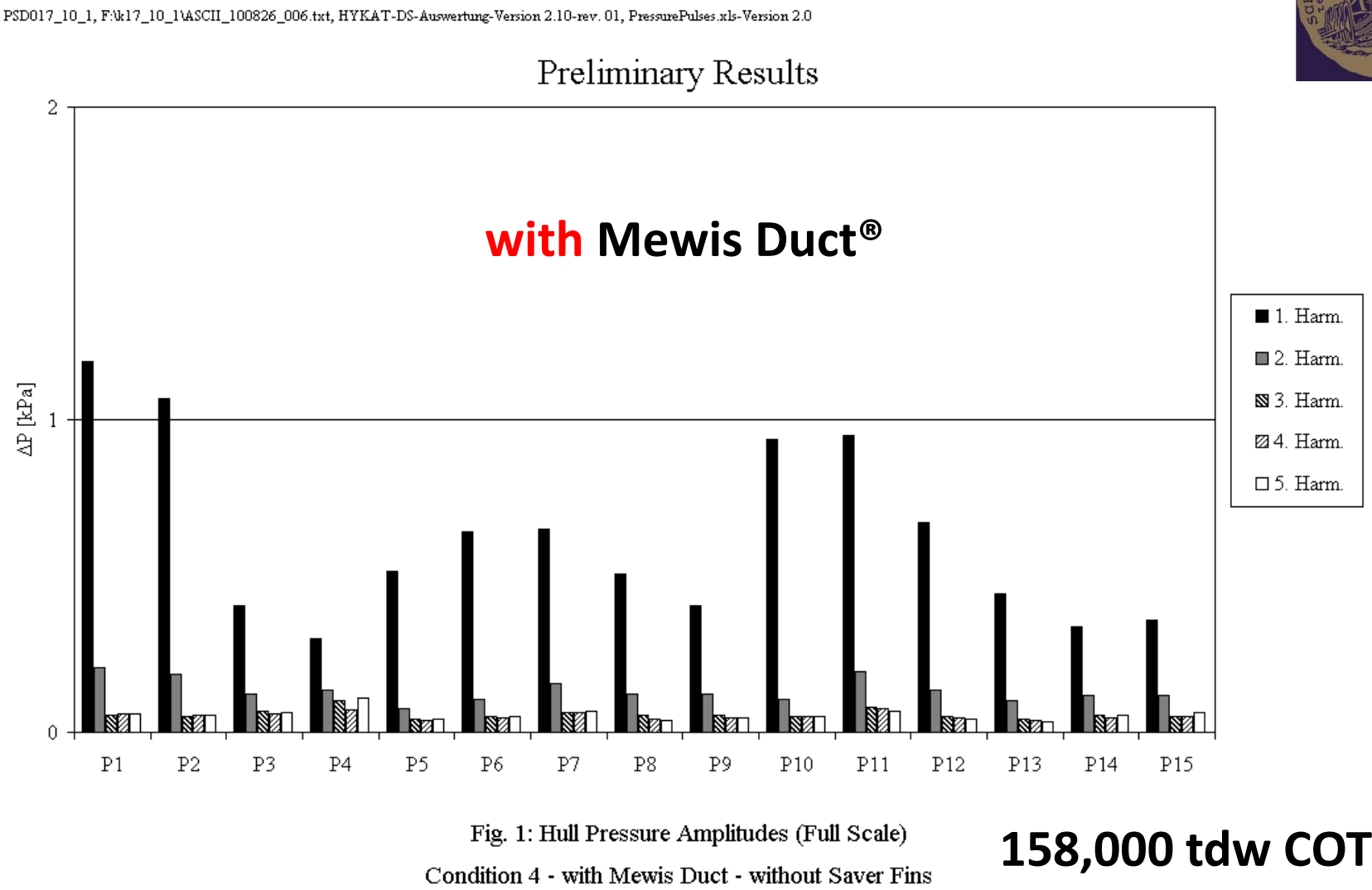


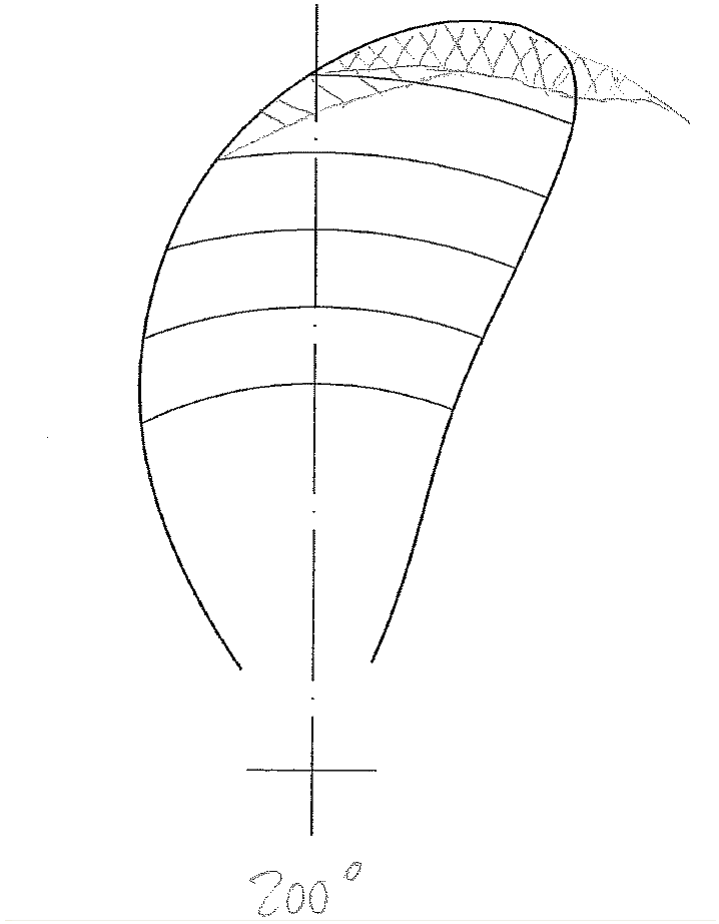
Fig. 1: Hull Pressure Amplitudes (Full Scale)

Condition 4 - with Mewis Duct - without Saver Fins

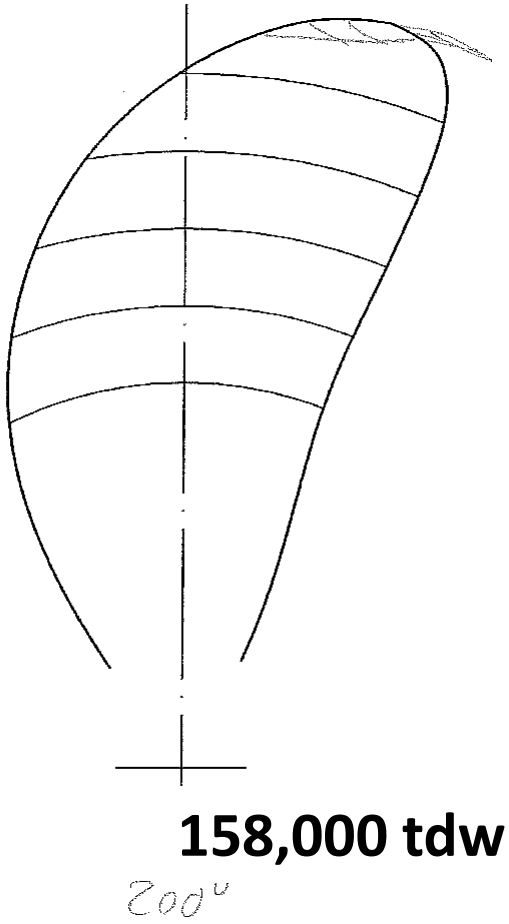
158,000 tdw COT

Mewis Duct® - Experience Cavitation Behavior

without Mewis Duct®



with Mewis Duct®

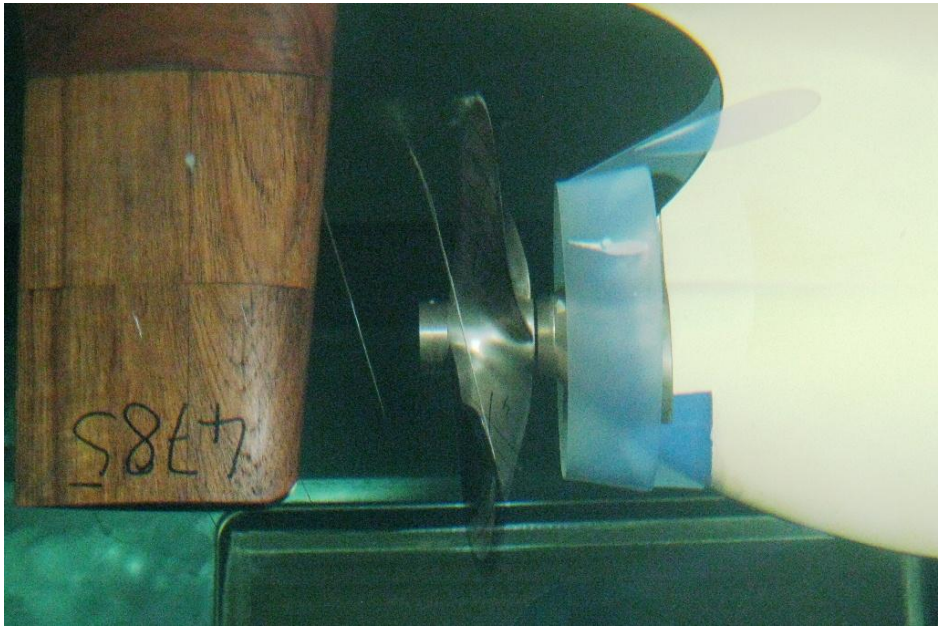


158,000 tdw COT

Mewis Duct® - Experience Hub Vortex

without MD

31,000 tdw MPV



with MD

Mewis Duct® - Experience Course Stability

Model test:	46,000 tdw Tanker, SSPA			
Zig-Zag-Tests 10°/10°	IMO-Criterion	w/o MD	with MD	MD/without
1st overshoot (°)	17,2	17,0	14,5	-15%
2nd overshoot (°)	31,8	40,6	31,4	-23%
Tactical diameter/Lpp	5,00	2,75	2,84	3%

Full Scale trial:	163,000 tdw Bulker			
1st overshoot (°)	20,0	10,5	9,0	-14 %
2nd overshoot (°)	35,0	26,9	22,0	-18 %

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

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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 improvment 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

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STAR ISTIND
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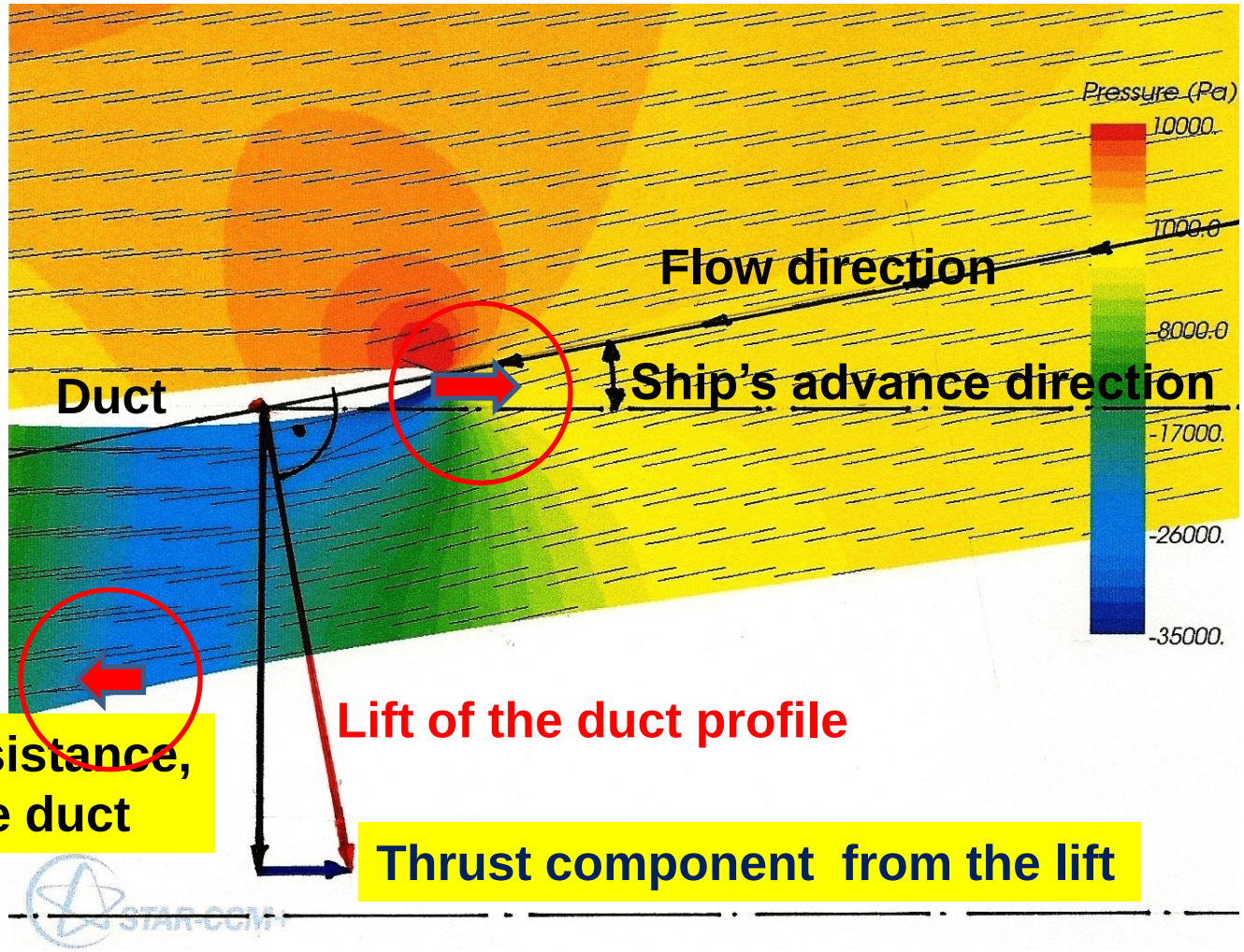
We thank you very much for your attention

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