Energy Saving Devices

A cost-effective solution to meet the regulations and improve ship efficiency can be to equip them with Energy saving devices (ESDs) or highly efficient propellers and rudders.

ESDs provide a direct increase in vessel propulsion efficiency by reducing hull resistance and improving propeller thrust. ESDs may include a range of devices. Many kinds of ESDs have been developed, which can be retrofitted to existing vessels or installed in new buildings.

There are many ESDs, such as ducts, pre-swirl fins, fin on hulls, rudders, etc. These devices reduce fuel consumption by improving the flow around the hull or propeller. Modifications must be done either in front of the propeller or behind the propeller.

In the next few pages, we provide a description of some of the key energy-saving devices installed on our vessels.

Pre-Swirl Devices (Ducts & Stators)

Pre-swirl devices aim to improve the propeller inflow conditions; ducts may improve propulsion efficiency by improving the propeller inflow.

Energy Saving Devices

- CMES Tech PSV (Pre-Shrouded Vanes)

Post-Swirl Devices

Post-swirl devices are used to recover parts of the rotational energy in the propeller slip stream.

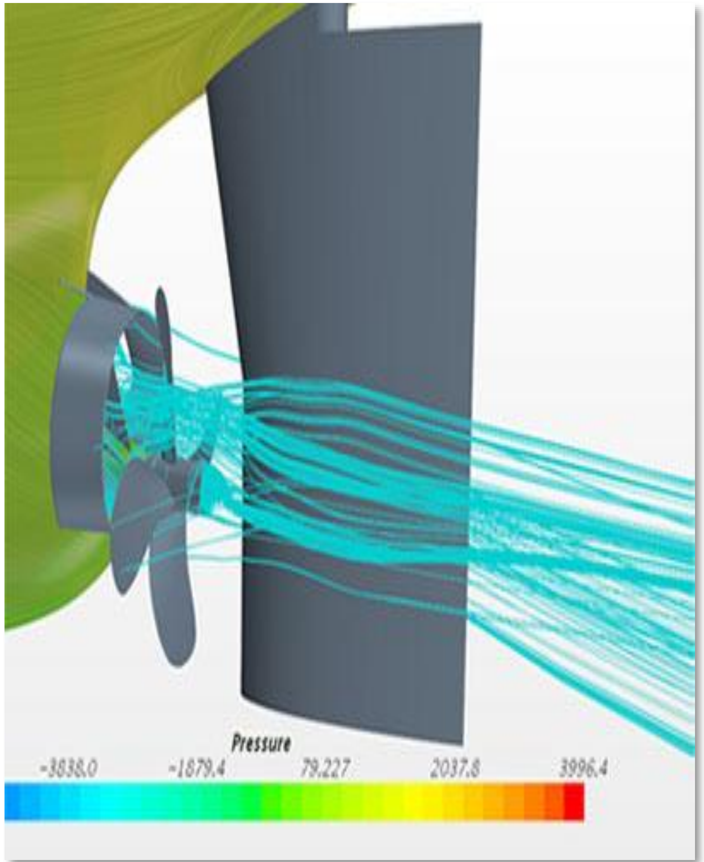
Energy Saving Devices

- PBCF (Propeller Boss Cap Fins) / HVAF (Hub Vortex Absorbed Fins)
- Grim Vane Wheel

Source – CMES Tech

What is a PSV (Pre-shrouded Vanes)?

PSV consists of a wake improving duct combined with several pre-swirl vanes positioned ahead of propeller; PSV can correct the flow into the propeller which essentially reduces the rotational losses in the propeller slipstream and increase the flow velocity towards the inner radius of the propeller. It is an energy-saving device developed for full-form slower ships enabling either significant power savings at a given speed or, alternatively, the vessel to travel faster at a given power level.



Source – CMES Tech

Benefits of PSV

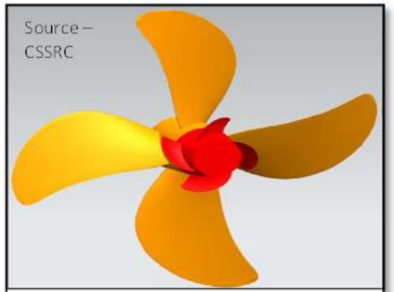
- Improved efficiency: The pre-shrouded design helps reduce turbulence and increase water flow efficiency, which can lead to improved performance and energy savings.
- Increased durability: The shrouding protects the vanes from damage and wear, helping to extend their lifespan.
- Enhanced safety: The shrouding can prevent accidental contact with the spinning vanes, reducing the risk of injury to marine life.
- Reduced noise: The shrouding can help to reduce noise levels.

Power Savings

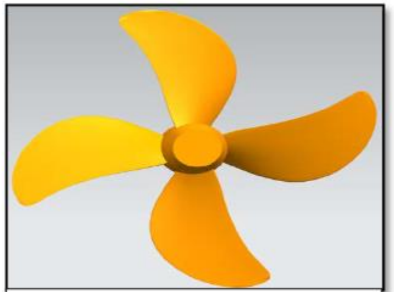
No.	Vessel Type	DWT	Energy Saving
1	Oil Tanker	320,000	7.00%
2	Bulk Carrier	53,000	5.10%
3	Bulk Carrier	57,000	5.40%
4	Chemical Tanker	33,000	5.00%

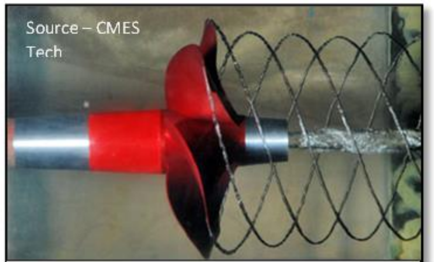
What is HVAF (Hub Vortex Absorbed Fins)?

HVAF (Hub Vortex Absorbed Fins) or PBCF (Propeller Boss Cap Fins) is attached, with small fins on the boss cap, at the hub of the ship propeller, which generates countering swirls that offset the swirls (Hub Vortex) generated by the propeller, and thus improves propulsion efficiency. It is installed as the original boss cap, which rotates together with the propeller. The HVAF or PBCF is an energy-saving device attached to the propellers of a vessel. It breaks up the hub vortex or swirls generated behind the rotating propeller, resulting in a reduction in fuel consumption.

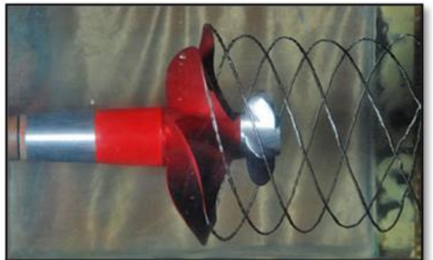


With HVAF


Without HVAF



Before HVAF installation


Post HVAF installation

Mechanism

The HVAF or PBCF is an energy-saving device attached to the propellers of a vessel. It breaks up the hub vortex or swirls generated behind the rotating propeller, resulting in a reduction in fuel consumption.

Power Savings

Pre-shrouded vanes

The expected power reduction of PSV is in the range of 3% to 7%.

Hub Vortex Absorbed Fins

The efficiency gain by the HVAF is between 1.9% and 2.4%.

Summary

No.	Device Name	Energy Saving/Device Type	Energy Saving Effect for 30K DWT Bulk Carrier
1	PSV	Pre-Swirl Duct	3 - 5%
2	HVAF/PBCF	Post-Swirl	1.9 - 2.4%
3	PSV+HVAF	Combined ESD	5 - 7%

Savings Analysis

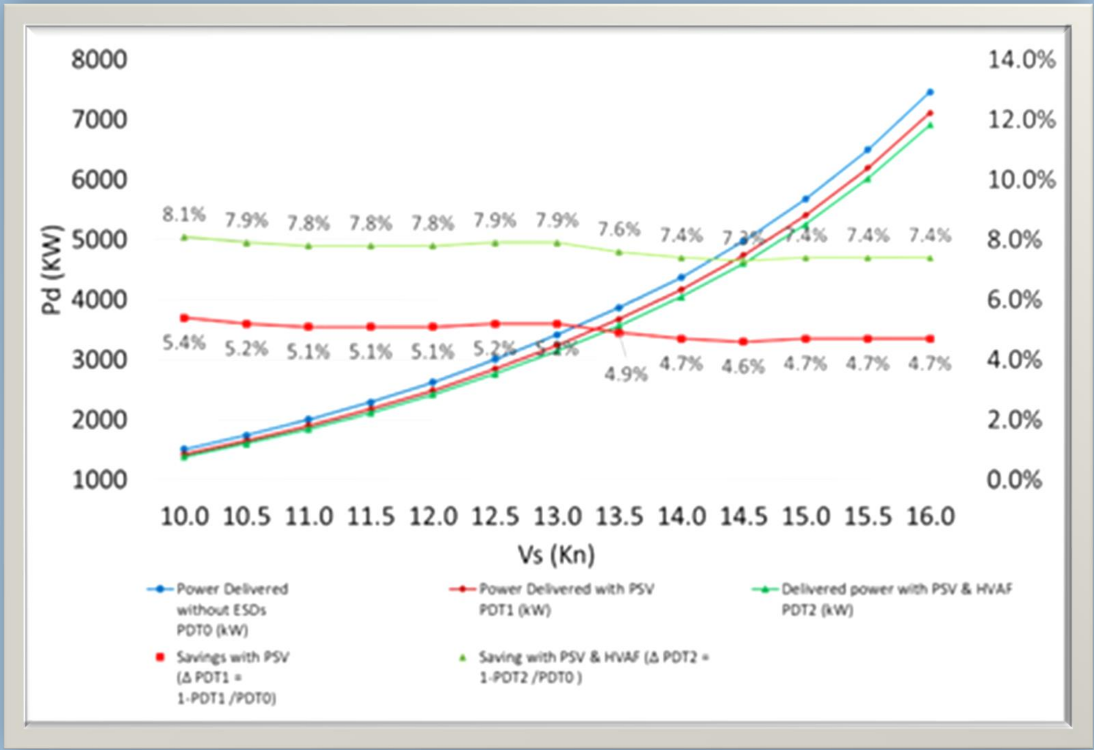
Based on the assumption that a 30,000DWT Bulk Carrier vessel always operates 350 days a year, and consumes about 21tons of fuel oil per day, i.e., about 7,350 tons/year, the savings are as shown in the table below.

Particulars	PSV+HVAF
Energy Saving %	6%
Reduction in fuel consumption (tons/year)	441
Low sulfur fuel cost saving ($/year) *	308,700

Power prediction for a 30k dwt Bulk Carrier under given ship speeds:

Load Condition	Speed V_s (kn)	Delivered power without ESDs P_{DT0} (kW)	Delivered power with PSV P_{DT1} (kW)	Savings with PSV (ΔP_{DT1} = 1-P_{DT1} /P_{DT0})	Delivered power with PSV&HVAF P_{DT2} (kW)	Savings with PSV & HVAF (Δ PDT2 = 1-PDT2 /PDT0)
Scantling Draft	10.50	1506	1425	5.4%	1384	8.1%
	11.00	1742	1651	5.2%	1604	7.9%
	11.50	2003	1900	5.1%	1846	7.8%
	12.00	2294	2177	5.1%	2115	7.8%
	12.50	2625	2490	5.1%	2419	7.8%
	13.00	3004	2847	5.2%	2766	7.9%
	13.50	3418	3241	5.2%	3149	7.9%
	14.00	3866	3675	4.9%	3571	7.6%
	14.50	4372	4166	4.7%	4048	7.4%
	15.00	4970	4739	4.6%	4605	7.3%
	15.50	5674	5408	4.7%	5255	7.4%
	16.00	6497	6192	4.7%	6017	7.4%
	16.50	7462	7114	4.7%	6913	7.4%

Source – CSSRC Model Test Report



At PSL, the management understood its business implications, evaluated the efficiency of potential designs, and took a leap forward. As part of the strategy, it was decided to retrofit some of the vessels with Hydrodynamic Energy Saving Devices (ESDs), such as THE MEWIS DUCT, PSV, and HVAFs, analysis indicates energy savings in the range of 3% to 6%. Older vessel's, which were considered less-fuel efficient were replaced with 'Eco' vessels between the years 2013 and 2017. The "Eco" vessels have offered more economical machinery, very efficient electronically controlled engines, lower lightship, better hull-form, and optimized use of waste heat from the engines.

Target

By installing these energy-saving devices on 18 vessels, we were able to achieve energy savings of 3-5%. Future technological developments will be monitored and studied to assess their feasibility and viability for further reducing our emissions.