

PROPULSION DYNAMICS

The CASPER[®] Service

**Experts in hull and
propeller performance
monitoring**



Propulsion Dynamics Inc. provides technical and commercial managers with the information they need to sustain highest propulsion efficiency in a changing technology environment for drydock treatment, planned maintenance and performance monitoring systems.



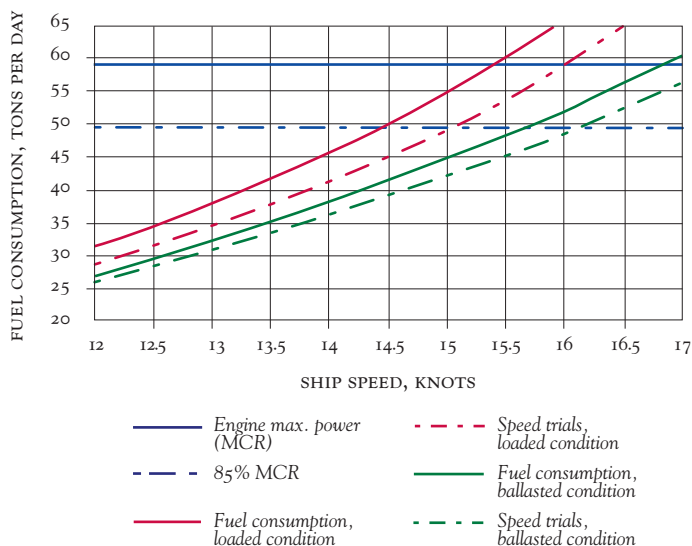
Hull/Propeller Performance Analysis and Benchmarking

Introduction to CASPER®

Since 2002, Propulsion Dynamics (PDI) has provided shipowners and shipmanagers a web-based performance analysis service. CASPER is a subscription service based on vessel performance data collected at regular intervals while making way. This data is compared to sea trials (clean, smooth hull) using state-of-the-art naval architectural analysis. The results are CASPER Reports that illustrate *Actual Obtainable Speed/Consumption, Development of Hull and Propeller Resistance, Hull Efficiency, CO₂ Indexing, Charter Party Analysis*, and other technical areas of propulsion efficiency.

The following graph is an extract from a CASPER Report, showing true vessel performance in comparison to sea trials, indicating precise speed and fuel losses due to hull and propeller condition.

Actual Obtainable Speed/Consumption Curve



The CASPER Service can be initiated on any ship at any time and does not require additional software or equipment. Instead, performance data is recorded in a highly accurate recording process at specific intervals and transmitted to our offices. The performance data is fully corrected for wind, waves, sea current, draft/trim, fuel oil quality and other key variables that affect speed and fuel oil consumption. CASPER is compatible with all engine monitoring and data recording systems.

Each vessel in our service receives individual attention from the naval architect on our staff to whom it has been specifically assigned. Backed by more than 1,000 ship-years of experience, our analysis methods go beyond mere data filtering or trend monitoring, to achieve the most precise analysis and benchmarking of vessel performance in the industry.

How the CASPER service works

Vessel registration

The CASPER method contains proprietary computerized mathematical models for ship resistance and propeller performance, so that the theoretical design power can be calculated for any ship for which length, breadth, draft, displacement, design speed and propeller design/RPM are known. The completion of our proprietary "Vessel Registration Form" provides PDI with these particulars, which are then entered into our computer as a baseline for the vessel(s) under analysis. Sea trial or model test data creates a correction function transforming the general mathematical model into a specific ship performance model.

Dealing with men is as fine an art as dealing with ships.

Joseph Conrad



Fuel Conservation and Emission Reduction

Transmittal of performance data while sailing

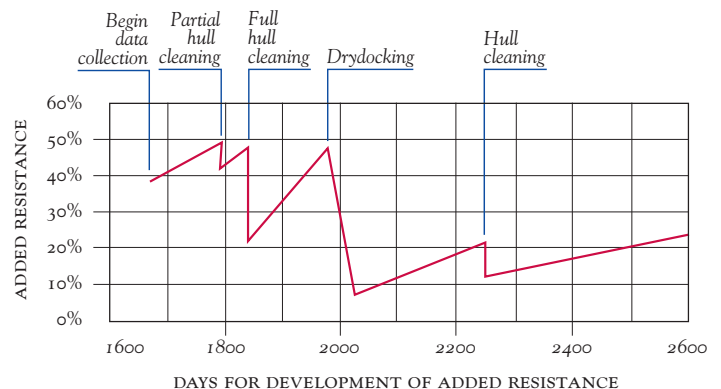
Based on the speed trials at the delivery of the ship, CASPER establishes a mathematical performance model, covering all speeds and drafts. The mathematical model contains modules for calculation of ship resistance as a function of ship type, main dimensions, draft, trim, and speed. It also contains modules for calculation of propeller power and thrust as a function of diameter, number of blades, area ratio, and pitch ratio. Further, it contains modules for calculation of wind and wave resistance as a function of wind speed and direction and wave height and direction.

Finally, and most important, are algorithms for calculation of the effects of marine corrosion and fouling (resistance) of the hull and propeller. Whatever the actual speed, draft and weather, CASPER compares the actual performance of the vessel enrolled to the performance under new-building sea trial conditions. The “added resistance” (as a percentage of the total resistance, design draft, and speed) defines the true condition of hull and propeller, and is utilized to reliably predict the speed/fuel consumption for any draft, speed, and weather condition, as well as a CO₂ Operational/Maintenance Index.

With CASPER, cost-benefit decisions for drydock treatment, coating selection, hull cleanings, and propeller polishing can be made without upfront capital.

The following is an evidence-based graph from a CASPER Report showing the isolation of hull and propeller resistance for a ship with several hull cleanings and drydocking. Changes in added resistance figures equate to speed and fuel penalties in relation to sea-trial conditions.

Long-Term Development of Hull and Propeller Resistance



Products

Based on analysis of our unique performance data format, we calculate a non-dimensional figure called the “added resistance”. The added resistance figure is independent of speed, weather and draft and represents the propulsion condition of the vessel in reference to sea trial performance.

Our products are CASPER Reports, providing shipowners and shipmanagers with unprecedented metrics for evaluating propulsion efficiency and benchmarking performance for similar ship-types. CASPER Reports also include recommendations to sustain highest hull and propeller performance, as well as meaningful graphs for our customers’ technical and chartering groups. Please contact us if you would like to see a sample Report.

PROPULSION DYNAMICS

CASPER® web-based reports contain quantitative and qualitative information, including:

For Vessel Owners

Evaluate Total Ownership Cost for pre-treatment of hull, final coating selection and optimal intervals for hull and/or propeller cleanings in service.

Establish a tangible fleet-wide CO₂ maintenance index for green initiatives.

For Chartered-Out Vessels

Actualize highest charter rate possible, based on true performance, as well as projected speed losses over time due to hull and propeller condition and defined weather allowances.

Furnish charter customers with documented actual propulsion efficiency and CO₂ maintenance index.

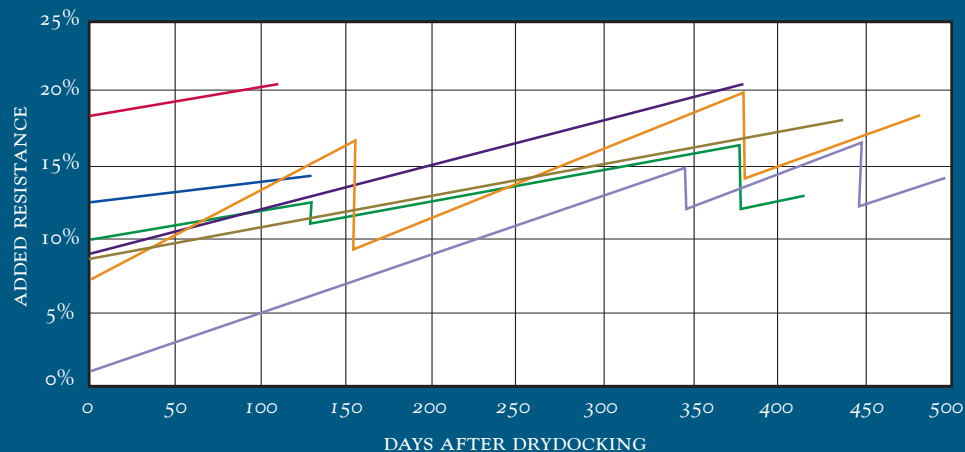
For Chartered-In Vessels

Measure hull and propeller performance of chartered-in vessels and document efficiency of various vessels under different ownership.

Determine hull and propeller performance losses (for long term chartered vessels) due to port stays, and losses due to weather versus hull condition.

The following graph is a compilation of CASPER Reports, illustrating changes in hull and propeller resistance for a fleet of ships from docking and hull and propeller cleaning intervals.

Fleet Monitoring of Hull and Propeller Performance



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