



Building a leading hydrodynamic consultancy base in Asia

创建亚洲领先的水动力学咨询基地



Full scale measurements

SEA TRIAL PERFORMANCE

The determination of the ship's performance through full scale measurements at sea is often the last step in the design cycle. Accurate performance of sea trials and measurement of all environmental conditions is of crucial importance to the analysis of the trials.

SSSRI-MARIN Co. Ltd. offers both scale model testing and on-board measurements. This, together with the use of present day sensors, measurement computers and analysis software, enables us to offer state-of-the-art sea trials and analyses.

A standard sea trial package includes speed and power trials (for EEDI verification), IMO manoeuvring trials, noise and vibration measurements and torsional vibration measurements. Additional services can be provided together and in cooperation with the MARIN Trials and Monitoring group.

Objectives

SSSRI-MARIN carries out trials with the following objectives:

- To assess the achieved speed for determination of the EEDI
- To provide the manoeuvring characteristics in compliance with IMO
- To establish contracted obligations between builders and owners
- To obtain performance data on full scale ships for use in future designs
- To update database and ship model correlation studies based on statistic analyses
- To validate SSSRI-MARIN's design models

The speed and power trial

In order to establish speed accurately ideal environmental conditions are necessary. Since ideal conditions often do not apply during a sea trial, SSSRI-MARIN offers a number of measurements that can be used to correct the sea trial during the post-processing phase.

As a member of the SEA TRIAL ANALYSIS Joint Industry Project, performed by leading ship owners and yards to increase the standard of speed trials, SSSRI-MARIN offers a high quality standard for Speed Trial Practice and Analysis.

SSSRI-MARIN offers a sea trial that consists of the following measurements:

- Measuring of ship's speed and position, with the use of a differential GPS system (accuracy 3 m)
- Wind speed and direction
- Wave height, period and direction
- The torque and rotation rate of propeller shaft(s)
- Rudder angle(s)
- Ship motions (roll, pitch, yaw, etc.)
- Water temperature and density



Analysis

For the analyses and correction of speed trials, use will be made of the STAIMO software, a flexible tool for the trial results on the basis of the latest ISO15016:2015 and ITTC Recommended Procedures and Guidelines (2014).

All of the above measurements have been incorporated in the analysis tool and the departure from a predefined draught can be determined and transformed to a different draught on the basis of speed/power/RPM relations from model tests.



IMO manoeuvring sea trials

Manoeuvrability of ships is essential for safe navigation and operation of all ships. Requirements and regulations as to the manoeuvring capacity have been issued by the International Maritime Organization (IMO) and adopted by the national regulatory authorities. Assessment of manoeuvring capacity has to be confirmed with full scale tests in order to comply with the IMO requirements.

Trials measurement system

Since final assessment of manoeuvring capacity has to be conducted with sea trials, SSSRI-MARIN operates an advanced IMO sea trial measurement system. This system combines accurate sensor techniques with modern data acquisition software which enables on-board processing and presentation of the full scale trial results.

Results

Results of the trials are normally used to provide the manoeuvring characteristics in compliance with IMO. Results can also be used for future designs and for validation of prediction methods.

Standard trial

The standard manoeuvring sea trial package includes: Turning circle, Crash stop and Zigzag tests. The measurements comprise:

- Position and heading (DPGS)
- Course over ground
- Ship speed
- The torque and rotation rate of propeller shaft(s)
- Rudder angle(s)
- Ship motions (roll, pitch, rate of turn)
- Wind speed and direction

All signals are synchronized and logged in one data acquisition computer. During the ship trial the data acquisition computer gives a practical graphical real time overview of all main parameters during the trial (sailed track, heading, rudder angle, course over ground, etc.). On completion of each manoeuvre the system produces a report with plots and initial results. Other deliverables are the Wheelhouse Poster in compliance with the IMO-regulations.

Noise and vibration services

Noise and vibration on board ships is of a growing concern to ship owners and yards, due to ships becoming faster, application of lightweight materials and higher comfort demands. To assist owners, shipyards, designers and propulsion suppliers in their quest to resolve potential problems, SSSRI-MARIN offers the following full scale measurements:

- Vibrations are measured by means of accelerometers deployed over the ship structure in order to determine local and global vibration modes and frequencies
- Dedicated instruments measure noise levels

Torsional vibration measurements

To determine the critical speed of the main engine the torsional vibrations of the propeller shaft have to be measured and analyzed. To confirm the barred engine speed provided by the engine maker, SSSRI-MARIN offers torsional vibration measurements. The measurements are carried out by using the power measurement system (PMS). An optical sensor records the RPM of the shaft, with a data acquisition frequency of 10000 Hz.



Additional services

Together and in cooperation with the MARIN Trials and Monitoring group, the following additional services can be provided:

- Wave height using a doppler level radar at the bow
- Site specific weather forecasting and hindcasting
- Pressure fluctuations
- Cavitation observation
- Seakeeping measurements
- Pre-contractual consulting for ship owners

Advanced full scale instrumentation

For a typical propeller-induced vibration measurement we install 6 to 10 pressure transducers in the hull plating above the propellers. Standardised penetrations, approved by major classification societies, can be used for most ship types. Hull pressure measurements can be combined with cavitation observations and underwater observations, so that interaction between aftship, propeller and rudder may be evaluated. For the evaluation of the full scale measurements detailed analyses in both time and frequency domain are conducted. Techniques such as harmonic and spectral analyses are standard. For vibration measurements the latest ISO standards are applied and special attention is given to the identification of resonance or forced vibration effects and corresponding excitation sources. In general, the excitations may involve propeller- and/or machinery-induced excitations.

To further comprehend observed phenomena or in order to investigate where measurements are impractical or expensive, detailed FEM analyses can be performed. These analyses are done to the required level of detail and taking into account the correct structural effects and damping ratios.

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