CENTRUM TECHNIKI OKRĘTOWEJ S.A.

Ship Design and Research Centre

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Yacht Research
general information

Motor yacht tested in Ship Hydromechanics Division, CTO S.A.

Infrastructure and software capabilities

www.yachtresearch.eu

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Ship Hydromechanics Division is a specialised research & development, design & manufacturing division of the CTO S.A. Research & Development Department. Its main objective is to solve all hydromechanics problems either at the yacht design stage or during her service time for Design Offices, Shipyards and Yachtowners. Moreover it undertakes different research and development problems within hydromechanics of naval crafts and other floating objects.

The division is capable of carrying out the following conventional model tests within the field of yacht hydromechanics:

- prediction of calm water yacht performance in deep and shallow waters including:
  - resistance and self propulsion model tests with stock or final propellers
  - wake measurements;
  - streamline tests;
  - open water propeller tests;
  - pressure distribution and/or fluctuation measurements on the hull surface;
- prediction of yacht sea-keeping qualities by means of towed and/or self propelled models tested in head or following waves for specified sea states, as well as models drifting in arbitrary headings;
- prediction of yacht manoeuvrability on the basis of free running models;
- cavitation model tests of propulsors carried out in cavitation tunnel in simulated velocity field, accompanied by measurements of pressure fluctuations due to propulsor operation.

Moreover the following experimental research can be carried out:

- measurements of forces and moments on rudder stock during yacht manoeuvres;
- captive model tests (by means of planar motion mechanism);
- model tests of side and end launchings;
- model tests of separate passive or controlled anti-rolling tanks and their efficiency on board;
- measurements of sea loads both global shearing forces and bending moments and local pressure pulses due to slamming.

The division works out yacht powering predictions taking into account yacht loading and environment conditions existing in areas accessible to the yacht. The analyses are made with the use of computer programs based on processed data-bases or taken from the most recent professional literature as well as by means of advanced theoretical and numerical methods.

Its specialists are always available consultants in the field of the yacht hydromechanics and they:

- design and modify arbitrary hull forms from the point of view of powering properties as well as yacht manoeuvrability and seaworthiness;
- design yacht hull forms on the basis of parent yacht, suggested or agreed with Customers, assuming fixed dimensions and hydrostatic parameters;
- design any sort of yacht propellers, making use of model test results and advanced computer aided procedures.

SHIP DESIGN AND RESEARCH CENTRE S.A.	SHIP HYDROMECHANICS DIVISION
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Research facilities of the division:

- **Towing Tank No.1** (deep water tank) of 265m×12m×6m (LxBxH), provided with a towing carriage moving with adjustable speed up to 12m/s and fitted with wave maker capable of generating both regular and irregular waves; the carriage can be equipped with a precise optical measuring system for determination of yacht movement in six degrees of freedom as well as a planar motion mechanism (PMM);
- **Towing Tank No. 2** (auxiliary shallow water tank) of 60m×7m×0m÷3.25m (LxBxH), with towing carriage speed up to 4m/s and a wave maker capable of generating regular and irregular waves; the carriage can be also equipped with a precise optical measuring system for determination of yacht movement in six degrees of freedom as well as a planar motion mechanism (PMM);
- **Cavitation Tunnel** with a 0.8m×0.8m×3.1m measurement chamber with a possibility of wake simulation and maximum flow velocity up to 20m/s, equipped with 2D LDA measuring system;
- **Wind Tunnel** – closed circuit and closed test section (having option to open side walls) measuring 1.3m x 1.0m x 4.0m and having available wind velocity up to 52m/s adjusted for testing marine and land based structures for wind loads, flow visualisation and local velocity determination.
- Basin and test stand for model tests of side launching;
- **Open air test station** on the lake equipped with high accuracy laser tachometer systems, predominantly to check manoeuvrability of free running, remotely controlled models;
- Bench for testing models of passive and controlled anti-rolling tanks.

Specialised computer programs, commercial and self-developed, being at the Ship Hydromechanics Division disposal, enable to perform:

- hull form design, modification and presentation by means of comprehensive CAD software (NAPA, MAXSURF);
- analysis of viscous flow around hull (incl. analyses of a superstructure) including prediction of wave system generated on the free surface, streamlines, pressure distribution, resistance coefficient and its components, propeller-hull interaction coefficients and propeller behaviour in behind conditions (commercial RANSE solver STAR CCM+ with self-developed module for dynamic trim and sinkage);
- analysis of propeller operation in non-uniform velocity field including prediction of unsteady cavitation, fluctuating bearing forces and moments as well as pressure pulses induced on a hull surface (UPCA2000);
- prediction of long-term as well as short term yacht behaviour in rough sea (WARES, RESTA).

Numerical analyses may form a part of a complex experimental/theoretical/numerical testing program or may be performed as a self-contained consultancy work.

The Ship Hydromechanics Division's workshop enables to manufacture with high accuracy:

- wooden and polyurethane foam hull models of any arbitrary shape up to 12m length;
- propeller models up to 350mm diameter;
- appendages, such as: rudders, fin-stabilasers, pod propulsors, bilge keels or any others;
- sophisticated test stands and measuring equipment as dynamometers, 3D wake survey devices, etc.

In order to keep close to the development of yacht hydromechanics the division carries out tasks within various domestic founded research projects, strictly connected with its area of activity. Moreover, it participates in EU research projects covering a wide range of experimental and numerical hydromechanics.

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