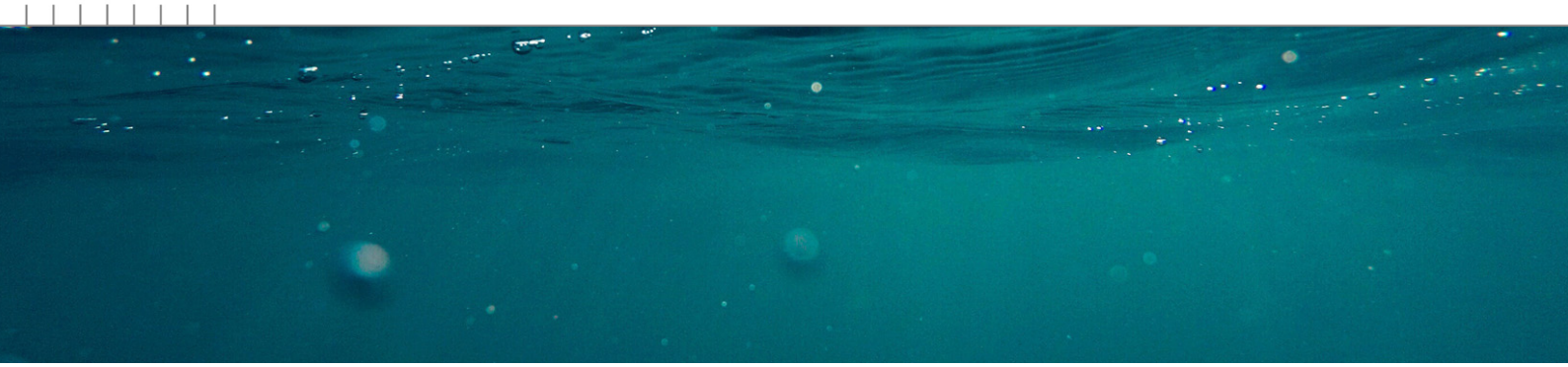


Propeller-induced hull pressure fluctuations and underwater radiated noise

Many ships have to fulfil requirements regarding inboard noise and vibrations. This is not only the case for cruise ships and yachts where the comfort of the passengers is paramount, but also for merchant vessels and work boats on which the health and safety of crew is essential. On naval and research vessels sensitive equipment requires low vibration levels.

Underwater-radiated noise

Traditionally, underwater radiated noise was mainly of interest to naval vessels and fishery research ships. Nowadays, however, there is growing concern that marine life is affected by the rise in background noise levels in the oceans, which is being caused by an increase in shipping, amongst other factors. Marine mammals and fish use sound to communicate and to sense their environment and this requires low background noise levels. These facts have led to a growing interest in evaluating underwater-radiated noise caused by shipping.

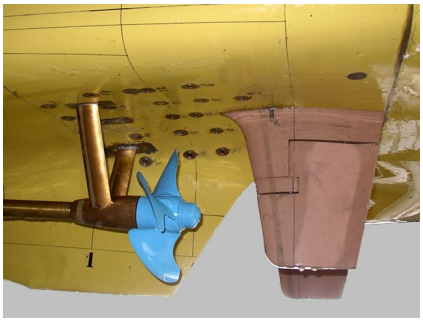
Silent Towing Carriage in the Depressurised Wave Basin

MARIN can assist in preventing noise and vibration issues

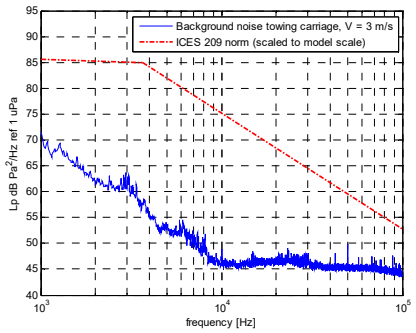
Often the prime source of inboard vibration and underwater-radiated noise is the cavitating ship's propeller. The propeller blade thickness, the unsteady propeller loading and, most importantly, the propeller cavitation induce a fluctuating pressure field on the ship's hull, which can lead to inboard noise and vibrations. The propeller-induced pressure fluctuations are also radiated into the water. It often proves difficult to remedy unacceptably high noise and vibration levels once a ship has been built. Therefore, it is good design practice to study the propeller's cavitation behaviour and to determine the resulting hull pressure fluctuations and underwater-radiated noise by means of model tests. On the basis of the results of such tests, the propeller and/or hull design may be modified before starting manufacturing.

MARIN's model testing facilities

The measurement of propeller-induced hull pressure fluctuations and underwater-radiated noise is performed in MARIN's Depressurised Wave Basin (DWB). Due to the basin's large size, the influence of reflections is limited. The basin's free surface satisfies the required pressure release boundary condition and automatically guarantees correct ship trim and sinkage. The DWB is equipped with a silent towing carriage to minimize background noise levels during measurements of underwater radiated noise. A special silent propeller drive train is installed in the model to minimize model vibration-induced pressure disturbances.



Ship model with flush-mounted pressure sensors



Background noise of towing carriage compared to ICES 209 norm (scaled to model scale)

Pressure fluctuations induced by the cavitating propeller on the hull are measured by means of sensors mounted flush with the hull above the propeller. The results of such measurements can be used as input for a Finite Element analysis of the expected inboard vibrations.

The underwater-radiated noise is measured by a pair of hydrophones fitted on a mast below the water surface. The ship model, with working cavitating propellers operating, sails over these hydrophones. Thus, a model scale version of a noise range is obtained.

In the DWB the noise of propellers that need to comply with strict noise requirements, such as the ICES 209 norm, can be measured. The background noise of the facility (including towing carriage and propeller drive train) is significantly lower than this norm.

With these facilities, MARIN offers unique features for the cost-effective reduction of propeller-induced noise and vibration in ship design.

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