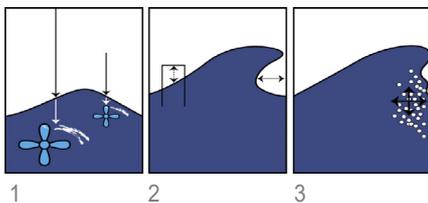


## Depressurised Wave Basin

The Depressurised Wave Basin is a unique research facility for testing ships and offshore structures in the most realistic operational conditions. The basin is fitted with wave generators and the air pressure in the basin can be decreased to as low as 2,5% of atmospheric pressure. This way many important research aspects concerning cavitation, wave forces, flooding and seakeeping can be studied using a properly-scaled condition for both water and air.

### Model size range

Due to the scaling issues at hand, the facility is designed to perform tests with free-running self-propelled large scale models in calm water as well as in waves. The models range from 2 - 12 m in length, up to 4 m in beam and a maximum draught of 1 m.



### Technical data

The basin dimensions are 240 x 18 x 8 m. The preparation harbour is 26 m long and 4.2 m wide. The basin can be depressurised to a minimum pressure of 2500 Pa.

### Research aspects

#### *Cavitation*

A self-propelled ship model up to 12 m in length can be tested for its cavitation and noise behaviour in still water, waves or even while manoeuvring. The propellers operate at the correctly scaled cavitation number everywhere in the flow and the free surface shows the correct wave pattern (see illustration 1).

#### *Wave forces and flooding*

The correct scaling of air cavities, e.g., air chambers and air cushions (see illustrations 2 and 3) enables the measurement of loads exerted on offshore structures, piles and on the insides of tanks. The forces on wave energy converters can also be measured, either as part of the energy recovery process or as an assessment of the extreme loads. The modelling of the flooding process as part of an installation or the assessment of a damaged ship is enabled through the correct scaling of the pressure for the enclosed air.

#### *Seakeeping*

With wave generators installed at the side and end of the wave basin, ships and offshore structures can be tested in a wide range of operational conditions. With the ambient air pressure being scaled, the behaviour of trapped air for slamming and wave impacts is correctly modelled.

#### *Resistance & propulsion*

The facility can also be used as a multi-purpose model basin for hydrodynamic research related to the resistance and propulsion of ships, current forces and dynamics relevant for offshore structures.



### Observation and measurement systems

Remote-controlled high-speed cameras and high-powered LEDs can be positioned anywhere within the model or in submerged housings fixed to the carriage, offering great flexibility in illumination and an excellent view of the cavitation behaviour at a typical frame rate of 4,000 frames per second. Up to 100 measurement channels can be acquired with a sample frequency of individual channels up to 100 kHz.



### Test capabilities

- Ventilation and cavitation inception and observation
- Hull pressure fluctuation measurements
- Radiated noise measurements
- Wakefield measurements
- Resistance and propulsion tests
- Motions and loads of fixed, moored, and dynamically positioned floating structures
- Seakeeping tests in waves from arbitrary directions
- Forced oscillation tests using a hexapod
- Flooding and damage stability tests (at scaled ambient pressure)
- Vortex-Induced Motion Tests

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## Waves

Dry-back multi-flap wave generators are positioned along the full width of the short side and along 120 m of the long side of the basin. They can be used to generate long and short crested waves from various directions. The force-feedback control compensates possible reflections from the model and the beaches, which are facing the wave generators. The long side wave generators can generate waves with heights of 0.4 m at a 3 s period; the short side generators can create waves with a height of 0.75 m at a 4 s period.

## Carriages

The basin is equipped with a towing carriage for hydrodynamic tests on ship models and a silent carriage for radiated noise measurements from ship models and propellers.



### Towing carriage

The models are fitted to a subframe of the main carriage and prepared in the harbour outside the DWB. The model enters through a pressure lock and is then connected to the main carriage for testing. The subframe can be fitted with four dedicated modules:

- A resistance and propulsion dynamometer test frame for towed models
- An observation module that carries all equipment required for cavitation observation and hull-pressure fluctuation tests
- A seakeeping test frame for free sailing models
- A test frame that is fitted with a six degree-of-freedom forced-oscillation Hexapod

The carriage can reach a speed of 6 m/s and is fitted with an optical 3D position measuring system used for measuring model motions.

### Silent carriage

The DWB is fitted with a silent carriage for noise measurements. The background noise of the silent towing carriage allows radiated noise measurements of ship propellers that need to comply with the ICES CR209 standard. Cavitation or flow noise can be measured by 2 hydrophones mounted in the DWB. Impulse response measurements have shown that the reflections of noise by the basin wall can be neglected at high frequencies allowing direct measurement of the far field radiated noise.

The silent carriage is fitted with a mooring ring so that fixed or moored test subjects can be rotated and exposed to any wave direction. High-speed cameras, LED illumination and optical tracking equipment can also be mounted.