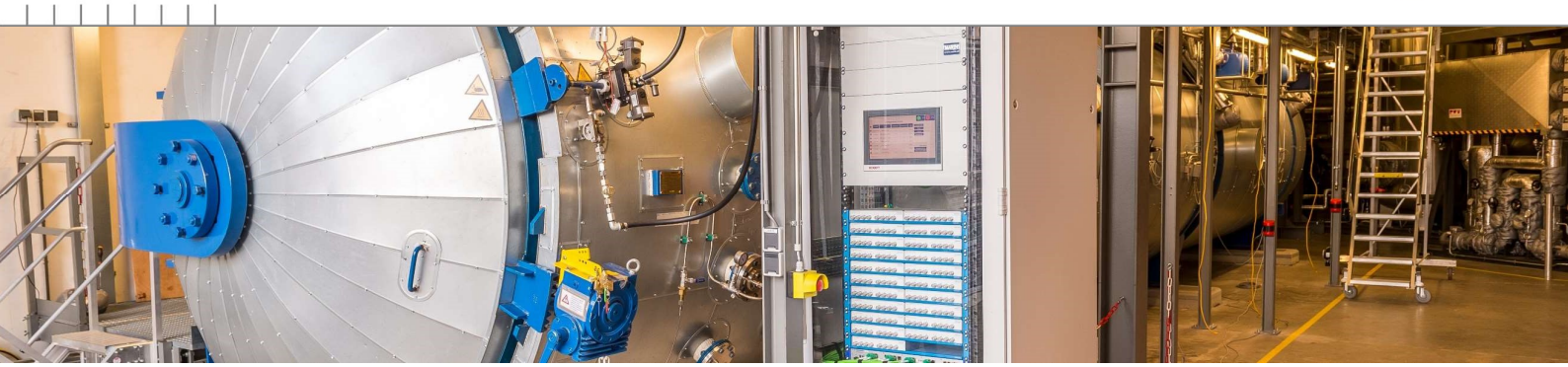
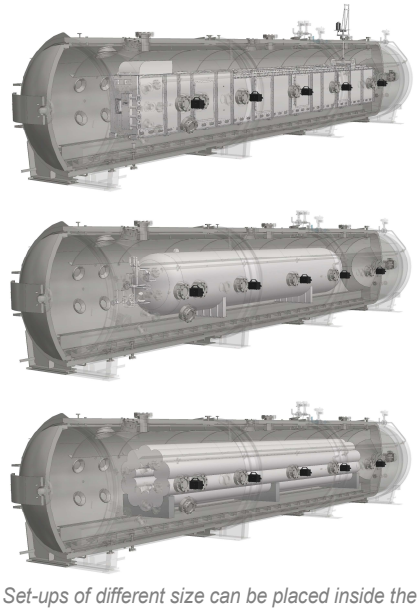


THE ATMOSPHERE

Control pressure, temperature, humidity, gas composition and flows of liquid and gas to create the ideal conditions for your research, product development and process optimization

The Atmosphere is a unique multi-purpose testing facility used for fundamental research, product development and process optimization. The Atmosphere consists of a precisely controlled environment wherein we can independently control the pressure, temperature and gas composition, to generate a diverse range of conditions. It can accommodate your models and dedicated testing setups within its controlled environment for extensive tests, accelerating technology readiness levels of your products and processes. Being partially funded by the Netherlands Organization for Scientific Research (NWO), this facility is open to a broad range of fields and available within NWO funded projects at operational costs only.



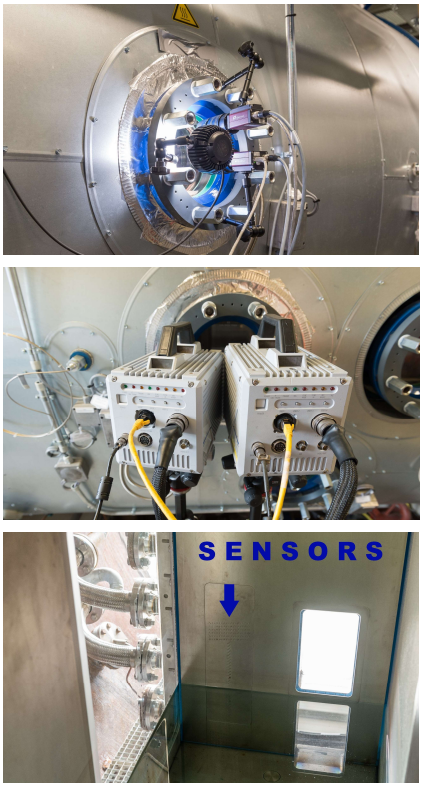
Set-ups of different size can be placed inside the autoclave

Technical specifications

The controlled environment is a cylindrical autoclave with a diameter of 2.5 m and a length of 15 m. Liquids and gases can be circulated through the autoclave, and their temperature can be independently controlled in a range from 15°C to 200 °C. The autoclave can be depressurized down to 5 mbar, and pressurized up to 10 bar absolute with a precision of ±2.5 mbar. Gas compositions of nitrogen, helium, sulphur hexafluoride or steam/water vapour can be created with an accuracy of ±1 volume percent. The 76.5 m^3 autoclave can accommodate set-ups of up to 8000 kg which can be connected to gas and liquid connections. Due to the high level of automation in the Atmosphere, these can later be exposed to any desired conditions in campaigns of durations up to multiple weeks. Using readily available solutions, we can introduce precise motion (rotational or linear) inside the autoclave in the entire range of available conditions. With the versatility of control and monitoring that the Atmosphere offers, your products and processes can be accelerated on their path to the market in a cost-efficient manner.

Observation and measurement systems

The autoclave is equipped with 17 inspection glasses with a viewing diameter of 200 mm, multiple flanges for instrumentation, and feedthroughs for shaft drives that can be connected to equipment inside the autoclave. 23 sensors measure the temperature in the liquid and gas. Additionally, the inside of the autoclave is observed with 2 high-speed cameras (up to 100 000 fps) and 4 low-speed cameras (up to 200 fps) The level of liquid inside the set-ups can be measured and controlled within a 0.1 mm accuracy. The facility is fully automated and can perform measurements 24/7.



Low-speed cameras (1), high-speed cameras (2) and impacting wall with pressure sensors (3)

Interested in doing tests?

Do you have an idea for a fundamental research project, need a proof of concept or require a better understanding of your processes? With the experience gained in the development of this unique facility which can be visualised as a highly-sophisticated process plant, we can help you develop your test set-up and testing programme. Using rapid modelling and advanced simulation tools, our experts can help you interpret the results and present them in accordance to any required standards. We are happy to welcome you, your technical experts and other interested parties. We offer virtual and live tours of the facility to further discuss your ideas.

For more information contact MARIN:
T + 31 317 47 36 23
E atmosphere@marin.nl

Examples of fundamental research in the field of physics of fluids

Wave impacts

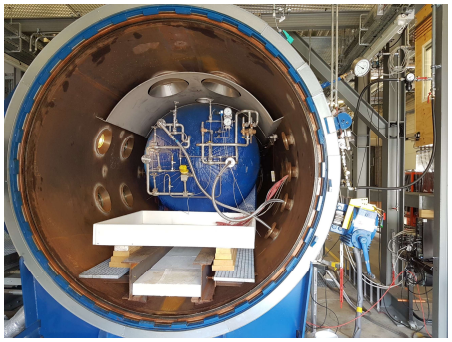
A custom built 12.5 m long, 0.6 m wide and 1.2 m tall flume tank with a heavy, instrumented impact wall is available at the facility to study wave impacts at different conditions. Using a precise piston-type wave generator, we can create diverse kinds of waves in the whole range of conditions and record dynamic pressures at up to a frequency of 100 kHz with a dense grid of 100 pressure sensors in the impact wall. An ongoing application for this set-up is through the SLING research programme by disentangling the physics of multiphase sloshing in liquefied natural gas.

Multiphase flow with phase change

By precisely manipulating, the pressure, temperature and gas composition of condensable and non-condensable gases, multiphase flows with or without phase change can be created in specified geometries. These flows are studied using a vast and wide range of techniques which are provided by MARIN's expertise. The knowledge obtained through this kind of fundamental research can be invaluable in industries such as (bio)chemical, food, process and energy.

Examples of product and process development and optimization

The LNG-PITCH4 project in 2019 is a demonstration of accelerated product development. Here, a new insulation system for small scale LNG tanks has been developed for the maritime industry. A prototype tank was placed in the autoclave and filled with liquefied nitrogen at approximately -196°C. With the tank inside, the temperature was controlled and varied within the operational range of such vessels to test the insulation effectiveness. Future tests in which the temperature, pressure, gas composition and humidity are varied, could be performed to further improve the thermal conductivity models along with durability tests, water vapour transmission, and the absorption of the insulation system.



LNG-PITCH4 tests: instrumented prototype tank outside (1) and inside (2) the autoclave