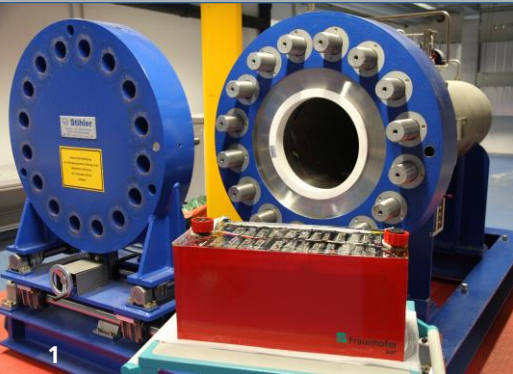




# Fraunhofer IBMT

FRAUNHOFER-INSTITUT FÜR BIOMEDIZINISCHE TECHNIK IBMT



- 1 600 bar pressure chamber and deep sea battery for AUV or ROV applications.
- 2 Submerging TIETEK-AUV during sea mission with research vessel ALKOR.
- 3 Obstacle avoidance system for AUV's.

## DEEP SEA TECHNOLOGY

### Exploration, Inspection and Monitoring

Systems and methods for exploring the seafloor, monitoring the marine environment, employment of offshore production facilities, process and quality control technology as well as the increase of navigation accuracy and performance are only a few of the keywords that can be found in the analysis of the requirements for a successful and sustainable industrialization of the deep sea. Autonomous control, inspection and intervention are necessary in depths where the use of manned platforms and vehicles are too risky, too expensive or simply impossible. Improvement and miniaturization of sensors, increase of energy efficiency, simple and robust programming and low request of maintenance are some of the requirements to facilitate the implementation of cost-effective systems for the maritime industry in the deep sea. IBMT uses its background in the development of complex mechanical and electrical systems for harsh environments to develop customized solutions that can be operated in the deep sea.

### Technology

IBMT focuses its competences on the application of pressure neutral technology for the development of complete pressure-resistant acoustic systems including sensors, electronics and data processing. Combining advanced simulation methods, material research and manufacturing technologies, complex systems can be realized, which can be operated under extreme environmental conditions.

Application-specific setups for sonar, imaging, monitoring or communication systems in a frequency range from a few kHz up to several MHz can be implemented by combining single or multi-element probes with appropriate electronic systems including single-channel modules or multi-channel array systems.

By the use of a special casting technology, the systems can be operated under pressures up to 600 bar which corresponds to a depth of 6000 m in the open sea.

### Fraunhofer Institute for Biomedical Engineering IBMT

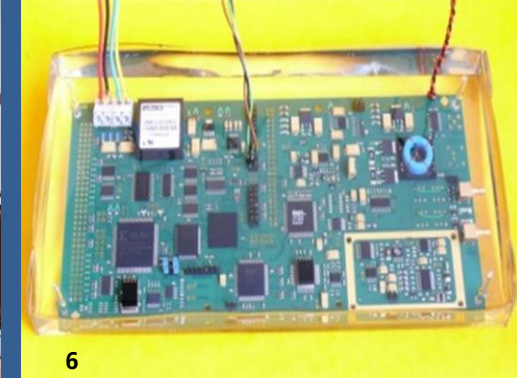
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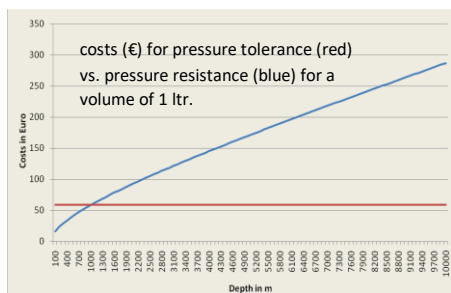
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## Pressure Tolerance vs. Resistance

Beyond a depth of 1000 m, the use of pressure-tolerant components is superior to other technologies concerning weight, energy efficiency and costs (see diagram).

A special casting technology in combination with customized components (electronics) and special materials (foams for void-filling or backing) ensures a save and robust usage of the pressure-tolerant systems down to a depth of 6000 m.



## Resources

In the Ultrasound Division at IBMT, a team of more than 40 engineers and scientists is working on research and development in the field of ultrasonic applications, material research, sensor technology, electronics, mechanical design as well as data processing and visualization.

Computer-aided design procedures throughout the whole development cycle from simulation to precision part machining allow the minimization of development steps and the minimization of development risks.

In-house testing and calibration facilities give confidence in performance and an ISO 9001 certified manufacturing system ensures reliability and quality. For the evaluation of underwater and high-pressure-resistant components and

systems, several indoor and outdoor test beds are available:

- 600 bar pressure chamber (diameter 0.43 m, length 2.2 m)
- measurement tanks (e. g. 6 × 8 × 6 m<sup>3</sup> with movable bridges).

## Ultrasonic Probes

Depending on distance and resolution requirements, single and multi-element ultrasonic probes in a broad frequency range are available.

For the operation under high pressures, special material and design concepts are used.

For instance, a multichannel imaging system for real-time cross-sectional (2D) or volumetric (3D) imaging with a miniaturized digital beamformer (128 channels, scalable) for direct integration into a compact device is one of IBMT's latest developments.

The FPGA-based design allows the direct high-level raw data processing and data transmission to a PC by Gigabit-Ethernet.

While the standard version of the system is designed for shallow water operations, a casted implementation of the system can be used in deep water applications.

## Electronic Platforms TRM and USS

Different platforms for the development of stand-alone or embedded systems are available at the IBMT. Next to pressure tolerance two of the most important aspects for a system operating for a long time in a deep sea environment are energy efficiency and size. The Ultra Sound System "USS" and the Transmit Receive Module "TRM" are prepared to work in low-power mode and can be switched to sleep-mode.

Both systems are prepared to be used for single channel application with up to 16 sensors (multiplexed) serving different applications (depth echo sounding, distance metering, obstacle detection/avoidance, flow profile, velocity, Doppler measurement, correlation, etc.).

Both have successfully been tested to operate under pressure up to 600 bar.

## Vehicle Technology (AUVs)

IBMT has mainly developed Fraunhofer's TIETEK AUV-platform. This AUV is a modular system for inspection and exploration purposes operating in shallow waters or in depths up to 6000 m. The pressure-tolerant realization of the vehicle makes it very lightweight and easy to handle on board of the service vessel. The modularity allows the assembly of a vehicle, which is exactly equipped with the tools that are required for a specific mission. Also a ROV-mode is possible – directly connected to the control center with camera-view and manipulators.

## Our Service Overview

Beyond acoustic technology, IBMT provides competences in the fields of:

- design of sensors and electronics
- signal processing and communication
- vehicle bus systems & control modules
- hydrodynamic simulation
- hull design and manufacturing
- design of mechanical components (manipulators, propulsion, rudder components and control),
- system assembly and testing.

4 Payload module of TIETEK-AUV with 6000 m 3-frequency side-scanner.

5 TIETEK-AUV boarding RV ALKOR.

6 Pressure tolerant electronic.