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- 1 4 kWh deep sea battery
- 2 600 bar pressure chamber and deep sea battery for AUV or ROV purposes.
- 3 TIETEK-AUV during sea mission with research vessel ALKOR

## DEEP SEA BATTERY TECHNOLOGY

### Compact Energy

Underwater and particularly Deep Sea Systems for mapping, monitoring the marine environment, control of pipelines or the search of wrecks have a strong need for compact and lightweight batteries with high energy content.

Applying a pressure hull (e.g. a titanium bottle) to standard cells mostly lead to a heavyweight energy storage system that also needs a lot of construction space in the carrier system. Pressure balanced systems are the lightweight alternative with high energy density.

IBMT has played a leading role in the project "TIETEK" with the aim of developing pressure balanced deep sea technology. Finally a full autonomous underwater vehicle was derived and tested. With this experience and the wide range of IBMT's technologies we have developed a pressure balanced, gel casted deep sea battery. Using our 600 bar pressure chamber for stressing the components and final assemblies we achieved a well-tested and reliable design that is now available!

### Battery profile

- Cell material: Lithium-Polymer
- Energy: 4,1 kWh
- Capacity: 159 Ah
- Voltage: 25,9 V (21 - 29,4)
- Discharge Current: 50 A (28 A in air)
- Charge Current: max. 28 A
- Dimension: 58 x 25 x 30 cm<sup>3</sup>
- Communication: CAN
- Connector: SubConn HP4
- Weight: 50 kg / 40 kg (\*)
- Max. depth: 6.000 m

- ➔ Up to 63 batteries in one vehicle.
- ➔ Loading of battery inside and outside of the vehicle is possible.

(\*) In the next development step

### Customization

IBMT offers the adaptation of the battery to customers' requirements and vehicle. For example we can adapt the voltage level, dimension, mechanical and electrical connections, energy content or communication protocol.

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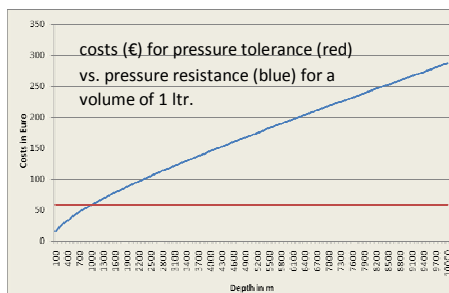
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## DEEP SEA TECHNOLOGY

### 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 the use of customized components (electronics) and special materials (foams for void-filling or backing) ensures a save and robust use of the pressure-tolerant systems down to a depth of 6000 m.



### IBMT – Deep Sea Activities

IBMT focuses its competence in the application of pressure neutral technology for the development of complete acoustic systems including sensors, electronics and data processing, batteries and carrier systems including mechanical and electrical components for drive, control and communication. Combining advanced simulation methods, material research and manufacturing technologies, complex systems which can be operated under extreme environment conditions, can be realized.

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 operate under pressures up to 600 bar which corresponds to a depth of 6000 m in the open sea.

### Ultrasonic Probes

Dependent on distance and resolution requirements single- and multi-element ultrasonic probes in a broad frequency range are available. For the operation under high-pressure special material and design concepts are used. For example a multichannel imaging system for real-time cross-sectional (2D) or volumetric (3D) imaging with a miniaturized digital beam-former frontend for direct integration into an array-probe (128 channels, scalable) is one of IBMT's latest developments. The FPGA-based design allows for direct high-level raw data processing and data transmission to a computer by Gigabit-Ethernet. The system is normally prepared to be used in shallow waters or, in a casted implementation, for deep water application.

### Electronic Platforms TRM and USS

Different platforms for the development of stand-alone or embedded systems are available. 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 water or in depths down to 6000 m. The pressure-tolerant realization of the vehicle makes it very lightweight and easy to handle on board. The modularity allows the assembling of a vehicle exactly equipped with the tools customers need for their missions. 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.

- 1 Payload module of TIETEK-AUV with 6000 m 3-frequency side-scanner.
- 2 TIETEK-AUV boarding RV ALKOR.
- 3 Pressure tolerant electronic.