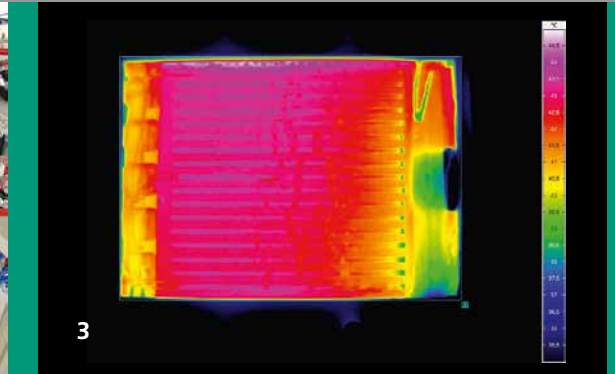




# Fraunhofer

## BATTERIEN

### FRAUNHOFER BATTERY ALLIANCE



1 Deformation test on a highly-charged (100 % SOC) Li-ion cell in a protective gas environment.

Photo: Fraunhofer EMI.

2 Connection of a measurement cell to a 96-channel battery tester.

Photograph: Fraunhofer ISC.

3 Thermographic image of a pouch cell with a cooling system.

Photo: Fraunhofer ICT.

## FRAUNHOFER BATTERY ALLIANCE TESTING AND EVALUATION

The Fraunhofer Battery Alliance, consisting of 19 Fraunhofer institutes, carries out research in the field of electrochemical energy storage devices (batteries and supercapacitors) in order to develop technical and conceptual solutions for commercial applications. Particular consideration is given to the social, economic and ecological implications of the technology.

Beside materials, cell production, simulation and systems, a further competence of the Alliance is in the field of testing.

### Competences and fields of work

The testing and evaluation of energy storage devices is an important stage in the development chain for automotive applications. Due to the range of challenges involved, a significant number of attributes must be investigated. Beside standard tests, the facilities available within the Fraunhofer Battery Alli-

ance enable specialized and highly scientific tests on specific topics, on a cell, module and system level.

### Testing on cell level

Cells are the basis of every battery system. The Fraunhofer Battery Alliance evaluates battery systems and their cell design. Abuse tests are carried out on a cell and module level, and damage and post-mortem analysis complete the service portfolio.

### Electrical testing on module and system level

The Fraunhofer Battery Alliance has long-standing experience in the field of battery system technology (construction of battery modules and systems, development of battery management systems) and battery tests (performance and aging tests), as well as the modeling and simulation of battery and energy systems.

### Fraunhofer Battery Alliance

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### Durability and system reliability during operation

Evaluation of operational stability and system reliability is an important step before new products are introduced onto the market. Activities of the Fraunhofer Battery Alliance include loading data analysis, testing methods and the accelerated testing of energy storage systems. Reliability tests (FMEA, ASIL, functional safety) are also used to evaluate energy storage systems.

### Behavior in accident scenarios

In accident scenarios it is important that batteries do not pose a hazard to humans or to the environment. The expertise and equipment available within the Fraunhofer Battery Alliance make it a leading institution in the field of impact and crash research.

### Facilities and equipment

#### Testing on cell level

- Chemical analysis of substances emitted in abuse scenarios
- Abuse tests in pressure containers
- Analysis of cell materials and components (e.g. REM, XRD, Raman, DSC, ICP-AES)
- Protective gas boxes to open and evaluate cells

#### Electrical testing on module and system level

- Over 140 test circuits for batteries ranging from small button cells to large battery systems for traction and stationary applications

- Performance test stand up to 1000 V, 600 A, 250 kW with CAN bus emulation
- Heated chambers and climatic chambers, and various water baths
- Testing unit for batteries and energy management systems

### Durability and system reliability during operation

- Various electrodynamic shakers up to 27 kN (RKV), including climatic chamber
- Possibility of customer-specific test setups with servo-hydraulic excitation
- Multi-axial vibration table for batteries up to 600 kg in mass, including climate chamber and energy source / sink (under planning)
- Scanning vibrometry (one- and three-dimensional)
- Comprehensive measurement technology for the measurement of operating loads

### Behavior in accident scenarios

- Battery testing stand for quasi-static and dynamic impact loads
- Component crash unit
- Tests in a protected environment
- Facilities for whole-vehicle crash testing
- Comprehensive measurement technology including a high-speed camera, gas analysis and CT

### Our offer

Our service portfolio covers all standardized tests, and also offers possibilities for customer-specific testing. Activities within the Fraunhofer Battery Alliance include

the definition or development of relevant testing and evaluation programs. The Alliance also offers consultancy and additional research and development competences in this field.

The following tests can be carried out:

- ISO 12405
- IEC 62660
- UN transport tests
- FreedomCAR tests
- Tests according to other common standards (SAE, UL, GB/SOC...)
- Safety tests on cells, modules and battery packs
- Analysis using different processes, e.g. CT
- Time-resolved gas analysis during abuse and safety tests
- Freely programmable testing cycles
- Material characterization
- Load and stress tests
- Aging tests
- Evaluation of operational stability and system reliability of battery systems, including set-up and connection methods
- Casing and storage
- Electronics
- Cooling systems and elements
- Consultancy, studies

4 Nail penetration test on Li-ion cells. Photo: Fraunhofer ICT.

5 Electrodynamic shaker including climatic chamber for environmental simulation. Photo: Fraunhofer LBF.