

Energy Storage Technologies

Southwest Research Institute® (SwRI®) has more than 25 years experience in hybrid electric vehicle modeling and simulation, control system development, fabrication, integration and testing. SwRI has conducted component and system development and testing of energy storage technologies including proof-of-performance for a variety of applications, from single cells to full battery packs, both mobile and stationary.

Energy storage technologies addressed at SwRI in transportation, medical and consumer electronics industries encompass most conventional and unconventional technologies such as flywheels, hydraulic accumulators, lead-acid, nickel-cadmium, lithium-ion, lithium-polymer, nickel-metal hydride, ultracapacitors and other experimental chemistries.

Research at SwRI has included energy storage technologies for small platforms such as scooters, two-, three- and four-wheeled vehicles, military and tracked vehicles, and large platforms such as electric locomotive and marine applications.

Testing

Types of testing include:

- Steady-state battery capacity characterization
- Transient battery response determination
- Heat generation and thermal calorimetry measurement
- Life determination testing
- Environmental impact on battery performance testing
- Battery abuse testing (environmental, mechanical and electrical)
- Testing for battery management system development
- Testing for component sizing and tradeoff/optimization studies
- Testing for modeling, simulation and hybrid control development

SwRI uses temperature-controlled units for testing batteries independent of the vehicle or in conjunction with the engine, transmission, or entire hybrid powertrain. Thermal battery testing is also available to test complete powertrains or vehicles.

Customized battery testing can be designed to meet specific client needs, with unconventional battery combination testing such as exposing the energy storage system to vibration, thermal and electric loads simultaneously to better emulate realistic operating scenarios.

Equipment

Examples of SwRI's state-of-the-art testing equipment include:

- AV 900V battery testing system
 - Power rating up to 250 kW
 - Voltage rating up to 900 Vdc
 - Current rating up to 1000 Adc
- ABC 150 battery testing system
 - Power rating up to 125 kW
 - Voltage rating up to 420 Vdc
 - Current rating up to 530 Adc
- Hydraulic press for battery abuse standards such as SAE, ISO, UN and others
- Specialty salt fog chamber
- Short-circuit test rig for high-energy batteries

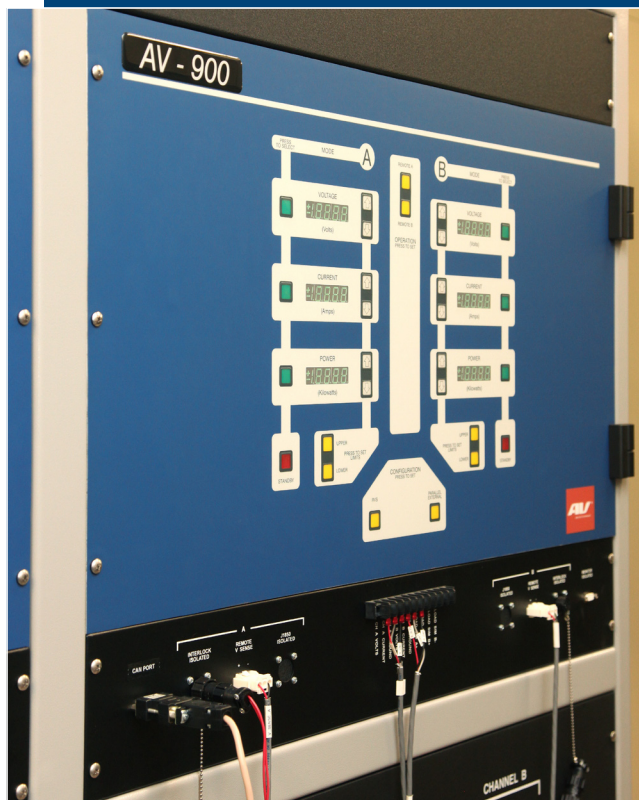
Testing Levels

Testing levels include:

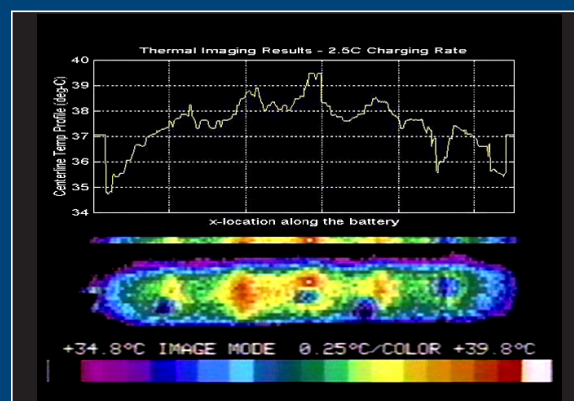
- Cell-level lab
- Battery pack
- Battery with electric motor and power electronics
- In-vehicle battery pack
- In-vehicle battery and powertrain
- Component-in-the-loop



High-temperature battery testing in SwRI's 7-ft³ capacity kiln may include temperatures higher than 2300°F.



The AV 900V battery testing system is used for cycling batteries under test and has a power rating up to 250 kW, voltage rating up to 900 Vdc, and current rating up to 1000 Adc.



Infrared thermal imaging of hybrid vehicle components identifies harmful temperature gradients resulting from fast charging and discharging, and provides essential data for proper thermal management design.

Quality Accomplishments

The Office of Automotive Engineering (OAE) at SwRI is certified to ISO 9001:2008, "Quality Management Systems – Requirements," accredited to ISO/IEC 17025:2005, "General Requirements for the Competence of Testing and Calibration Laboratories," and certified to ISO 14001:2004, "Environmental Management Systems." The OAE has also achieved Ford Tier 1 status for providing engineering services and the Engine, Emissions and Vehicle Research Division has received the Ford Q1 Quality Award. In addition, the Petroleum Products Research Department is a Nuclear Procurement Issues Committee (NUPIC)-approved laboratory and the Fuels and Lubricants Research Division has maintained its status as an American Chemistry Council (ACC)-approved laboratory.

Additional Capabilities

- Hydraulic accumulators
 - Model, design and cycle test
 - Pressure test to failure
 - Integrate to vehicular applications
 - Develop embedded systems for control
- Ultracapacitors
 - Model and test
 - Integrate to vehicular applications

With the characteristics of both a battery and a capacitor, ultracapacitors can provide hundreds of thousands of charge and discharge cycles compared to batteries that degrade significantly with rigorous use. With their ability to release and absorb charge, ultracapacitors are an ideal complement to electric drive vehicles with fuel cells or batteries.



Southwest Research Institute is an independent, nonprofit, applied engineering and physical sciences research and development organization using multidisciplinary approaches to problem solving. The Institute occupies 1,200 acres in San Antonio, Texas, and provides more than 2 million square feet of laboratories, test facilities, workshops and offices for more than 3,200 employees who perform contract work for industry and government clients.



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