h.e.l

Battery Performance and Safety Testing Solutions

Empower Your Research with Precision, Safety, and Performance

Battery Chemistry Screening, Advanced Abuse Testing, and Performance Characterization

Unleash Safe and High-Performance Batteries

As battery demands grow for higher energy densities, faster charging, and longer lifespans, safety and performance become increasing important. High-energy batteries contain reactive chemicals that pose hazards under mechanical, electrical, and thermal stresses.

H.E.L Group's advanced testing solutions help you understand thermal behavior, control cell self-heating, and mitigate thermal runaway risks—ensuring safety for normal use and extreme conditions.

40+	Global	Expert	2,500+
Years of Experience	Service Network	Technical Team	Systems Worldwide

Our expertise drives performance optimization, linking thermal behavior to electrical efficiency for superior cell development. Trust H.E.L to deliver precision and reliability for your battery research.

Safety Testing

Subject batteries to mechanical, electrical, and thermal stresses to define safe operating limits and prevent thermal runaway.

Performance Testing

Characterize heat generation and electrical performance under a range of operating conditions for cell development and quality control.

Thermal Mapping

Identify regions of higher thermal energy to implement targeted thermal management strategies in battery modules and packs.

Safety Testing vs. Performance Testing

Safety Testing

Assess how components and cells respond to mechanical, electrical, and thermal stresses. Our adiabatic calorimeters simulate real-world, worst-case scenarios, enabling you to define safe operating limits, explore thermal runaways, and mitigate risks like thermal propagation.

Key Benefits:

- → Define safe operating limits (temperature, voltage, current)
- → Explore thermal runaways and propagation mechanisms
- → Identify hazards in component materials

Recommended Products:

BTC-130:
Ideal for small cell and component hazard screening

BTC-500:
Engineered for high capacity cell testing

Performance Testing

Characterize thermal behavior and electrical performance under normal and extreme conditions. Our isothermal calorimeters drive cell development, ensures quality control, and informs thermal management strategies for optimal battery efficiency.

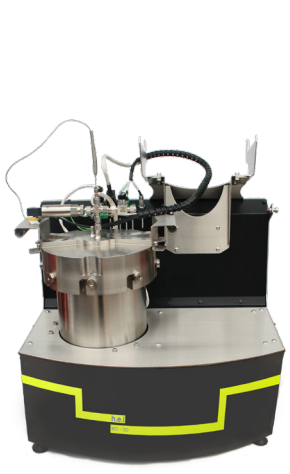
Key Benefits:

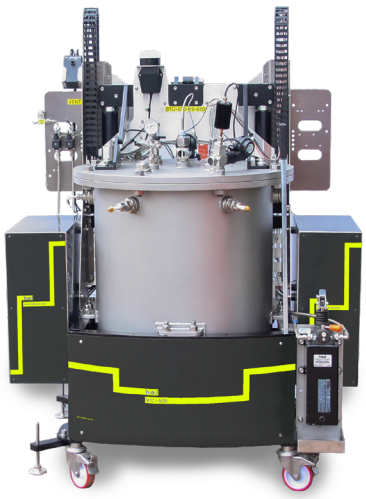
- → Optimize cell design and efficiency
- → Studying cell aging and capacity inefficiencies
- → Ensure quality control across production batches

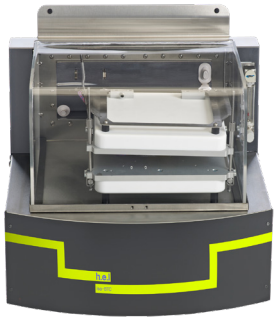
Recommended Products:

iso-BTC:
Performance testing for small to medium cells

iso-BTC+:
Performance testing for larger cells







Advanced Safety Testing with BTC-130 and BTC-500

Safety testing is critical to evaluate how cell components, cells, modules, and packs respond to mechanical, electrical, and thermal stresses. H.E.L's BTC-130 and BTC-500 Battery Testing Calorimeters deliver precise, reliable results under adiabatic conditions, simulating worst-case scenarios to ensure safety.

Mechanical Stress

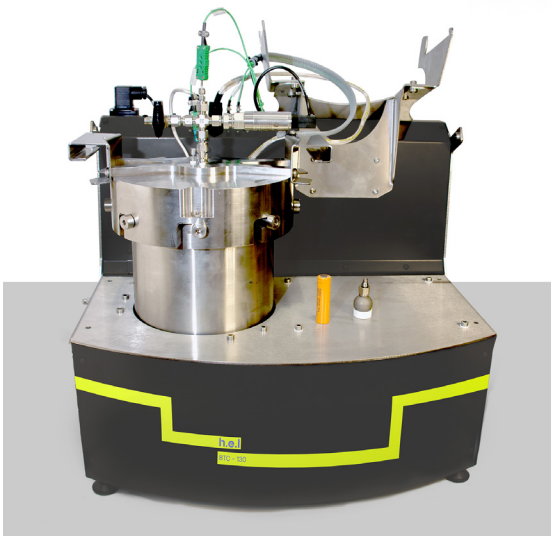
Supports nail penetration tests to assess structural integrity and response to mechanical damage.

Electrical Stress

Integrated with charge-discharge units offering external short circuit options.

Thermal Stress

Maintains adiabatic conditions to evaluate thermal stability, capturing heat retention and thermal events.



BTC-130

BTC-130: Component Hazard Screening

Perfect for small volume test cells and early-stage development

Key Features:

- Assesses individual component thermal stability under adiabatic conditions
- Detects low self-heating temperatures, pressure increases, and toxic gas production
- Enables informed decisions for safe cell development
- Constructed with robust 316 stainless steel to withstand explosions

Why Component Testing Matters

Batteries are used in diverse environmental conditions and undergo internal heating and cooling from normal use and stress conditions. Understanding how individual cell components behave under various temperatures is crucial in early development.

Critical Early Indicators:

- Low temperature of self-heating could indicate thermal runaway risk
- Rapid pressure increases might compromise cell integrity
- Toxic gas production may require component reassessment

Define Safe Operating Limits with BTC-500

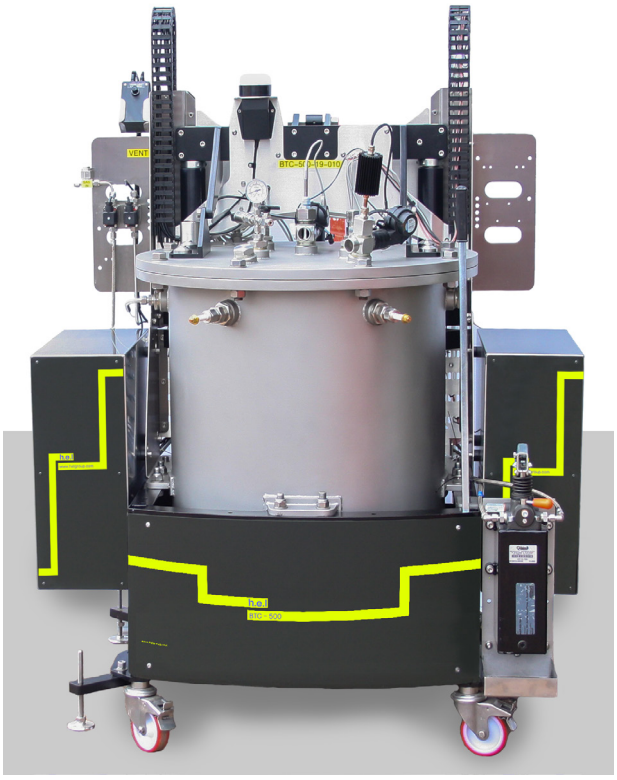
Identifying safe operating limits for cells, modules, and packs is crucial to prevent thermal runaways and its catastrophic consequences. The BTC-500 subjects batteries to mechanical, electrical, and thermal stresses, providing data to establish safe working parameters.

Critical Safety Parameters:

Safe Working Temperature
Determined through adiabatic temperature rise testing

Maximum Voltage & Current
Established via over-charging and discharging tests

Mechanical & Short Circuit Resilience
Evaluated under controlled conditions



BTC-500

Superior Construction

With a robust 316 stainless steel construction and aluminum heat spreader, the BTC-500 is precision engineered to withstand higher capacity cell explosions. Outperforming designs made with with copper or aluminum. Using H.E.L's proprietary calibration model (HLC), environmental fluctuations are accounted for in real time and adjusted for automatically, ensuring zero heat loss during testing.

316 **Stainless Steel Construction**
Maximum safety and durability

0% **Heat Loss**
Perfect adiabatic conditions

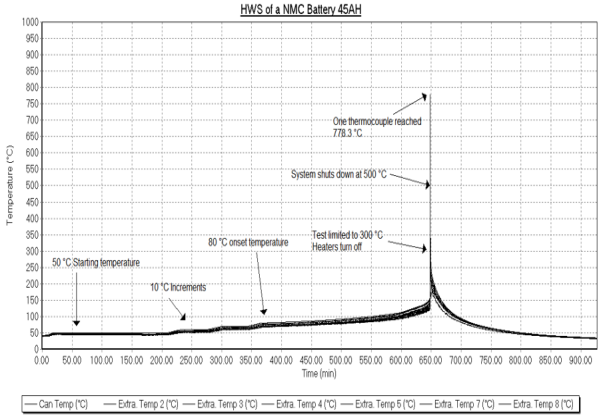
Explore Thermal Runaways and Propagation

Visualize Thermal Events

The BTC-500's integrated camera visually captures thermal runaways in cells, allowing design effective mitigation strategies and ensure heat dissipation outpaces generation—safeguarding your batteries.

Data-Driven Insights:

- Determine critical points for cell self heat rate (dT/dt) and crucial temperature (Tcr).
- Analyze evolved gas composition pre-, during, and post-thermal runaway.
- Model thermal behavior based on adiabatic temperature rise test data.



Adiabatic temperature rise test (Heat Wait Search)

Optimize Performance with iso-BTC and iso-BTC+

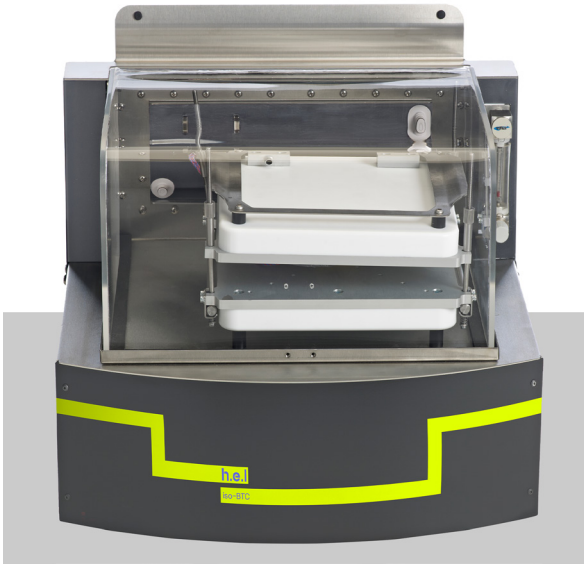
Performance testing and electrical efficiency under normal and stress conditions to unlock performance insights and ensure quality control. H.E.L's isothermal calorimetry solutions measure heat generation with integrate charge-discharge units for automated cycling, recording performance and heat evolution simultaneously.

iso-BTC: Isothermal Precision

Advanced isothermal calorimetry for real-world operating conditions

Key Features:

- Tests cells under normal and extreme conditions
- Adaptors for various battery sizes and shapes
- Investigate impact of chemistry, electrodes, cell type, and age
- Models performance for enhanced thermal management



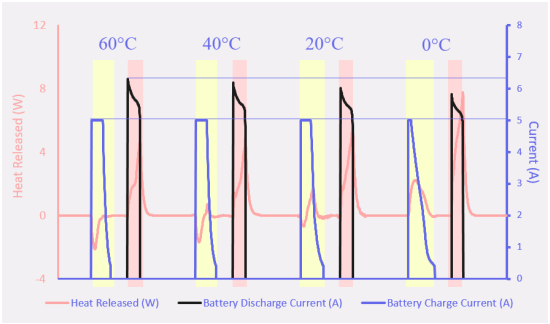
iso-BTC

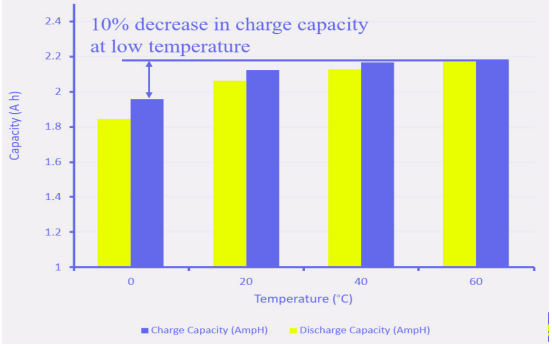
Characterize Performance Differences

Battery chemistry, electrode composition, cell type, and age all significantly influence performance. Investigate these variables during cell development and quality control processes.

Key Performance Metrics:

- Battery efficiency across temperature ranges
- Charging and discharging capacity variations
- Heat evolution at different C-rates





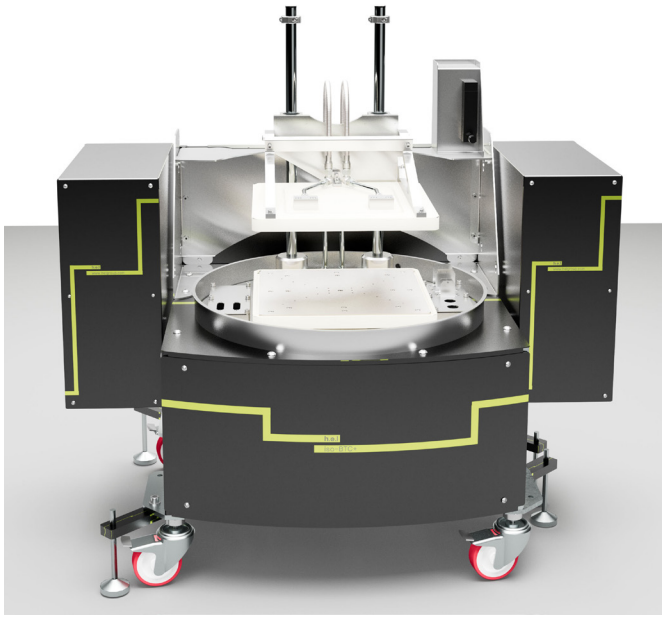
Data from the battery cycler to quantify the effect of temperature on capacity, Triple gel cell battery, 2.2 Amp hour capacity

iso-BTC+: Enhanced Performance Testing

Isothermal calorimetry for larger cell formats and higher capacities.

Key Features:

- Advanced thermal mapping capabilities
- Higher sensitivity for subtle thermal changes
- Extended temperature range for comprehensive testing
- Suitable for both research and quality control applications



iso-BTC+

Performance Metrics Checklist

- [x] Battery efficiency at specified temperatures
- [x] Heat evolution profiles at various C-rates
- [x] Charging capacity validation
- [x] Discharging capacity consistency
- [x] Thermal behavior under specified conditions
- [x] Cycle life performance

Quality Control Benefits:

1. **For Cell Manufacturers**
   Demonstrate and verify stated performance metrics consistently across production batches
2. **For Battery Integrators**
   Check cell performance downstream to ensure supplied cells meet specifications
3. **For Research Teams**
   Establish consistent testing protocols for comparable results across experiments

Advanced Thermal Mapping

The iso-BTC and iso-BTC+ support thermal mapping during testing to uncover cell regions of greater heat generation and hot spots, enabling targeted thermal management strategies.

- Heat Mapping
- Hot Spot Detection
- Balance Verification

Battery Safety Testing Solutions

Specification Point	BTC-130	BTC-500
Measurement Type	Adiabatic Calorimetry	Adiabatic Calorimetry
Type of Test	Safety Testing	Safety Testing
Selected Key Data	• Onset Temperature • Battery Thermal and Electrical Behavior Under Stress Conditions	• Onset Temperature • Battery Thermal and Electrical Behavior Under Stress Conditions
Internal Testing Chamber Dimensions	Cylindrical Diameter 130 mm x Height 200 mm	Cylindrical Diameter 500 mm x Height 500 mm
Battery/ Sample Size	Cell Components, Coin Cells, Small Pouch Cells, and Cylindrical Cells	Cylindrical Cells, Prismatic Cells, Pouch Cells, and Small Modules
Temperature Range	Ambient to 500 °C	-40 °C to 500 °C*
Control & Analysis Software	Y	Y Including Video Monitoring
Data Acquisition Rate	Up to 10 000 Hz*	Up to 10 000 Hz*
Operation and Safety Features	Automatic Shutdown	• Automatic Shutdown • Containment Vessel • N_2 Purge
Instrument Dimensions (w x d x h)	700 x 600 x 800 mm	1200 x 900 x 1980 mm
Additional Options	• Integrated Charge Cycler • Nail Penetration Test • Heat Capacity Evaluation • Compatible with Spherical Test Cells for Cell Component Testing	• Integrated Charge Cycler • Nail Penetration Test • Heat Capacity Evaluation • Thermal mapping* • External Shorting Test • Automated Gas Analysis

Supported Standards

SAE J2464_202108 | ECE R100 Rev3 | UN 38.3

GB/T 36276-2023 | SAND2017-6925 | AIS 048: 2009

Supported Test Types

- ✓ MCp
- ✓ Overload
- ✓ Overcharge
- ✓ Short Circuit
- ✓ Over-Current
- ✓ Over-Discharge
- ✓ Thermal Stability
- ✓ Forced Discharge
- ✓ Propagation Point
- ✓ Thermal Runaway
- ✓ Partial Short Circuit
- ✓ External Short Circuit
- ✓ Rapid Charge/Discharge
- ✓ Adiabatic Temperature Rise

Battery Performance Testing Solutions

Specification Point	iso-BTC	iso-BTC+
Measurement Type	Isothermal Calorimetry	Isothermal Calorimetry
Type of Test	Performance Testing	Performance Testing
Selected Key Data	Battery behavior as a function of (Dis) Charging rate and Temperature • Heat Release Profiles • Battery Efficiency Profiles • Battery (Dis)Charging Capacity Profiles	Battery behavior as a function of (Dis) Charging rate and Temperature • Heat Release Profiles • Battery Efficiency Profiles • Battery (Dis)Charging Capacity Profiles
Internal Testing Chamber Dimensions	255 x 275 (width x depth)	350 x 350 mm (width x depth)
Battery/ Sample Size	Coin cells, cylindrical cells, small prismatic cells, and small pouch cells	Cylindrical cells, prismatic cells, and pouch cells
Temperature Range	-20 °C to 90 °C*	-20 °C to 90 °C
Control & Analysis Software	Y	Y
Data Acquisition Rate	Up to 10 Hz	Up to 10 Hz
Operation and Safety Features	• Automatic Shutdown • N_2 Purge	• Automatic Shutdown • N_2 Purge
Instrument Dimensions (w x d x h)	600 x 550 x 750 mm	1200 x 900 x 1980 mm
Additional Options	• Integrated Charge Cycler • Heat Capacity Evaluation • Thermal mapping* • Custom Battery Adaptors	• Integrated Charge Cycler • Heat Capacity Evaluation • Thermal mapping* • Custom Battery Adaptors

"...heat determination under isothermal condition reveals that an efficient and smart battery thermal management system must comprehensively consider the effects of work temperature, state of charge, charge-discharge current rate, and charge-discharge protocol on heat generation. These findings will shed promising lights on thermal runaway prevention as well as development of high energy safe lithium-ion batteries."

Huang, Lang - Qingdao Institute of Bioenergy and Bioprocess Technology, Chinese Academy of Sciences

WinISO

Bringing effortless efficiency to your laboratory automation

With the power of WinISO, elevate your research with a software solution that adapts to your needs.

Flexibility and control

- Fully configurable workspace – improved efficiency by displaying the info you need.
- No swapping between windows required; configure the workspace to suit you.
- Powerful and flexible code base combined with an intuitive and user-friendly design.

Empowering proactive experimentation

Designed around the user experience, WinISO combines:

- advanced real-time data display.
- automated monitoring of experiment completion and failure states.
- rapid data capture modes.

across single or multiple parallel reaction systems.

Real-time interactivity

- Change and adapt on the fly as you navigate through your experiments.
- Interactive design empowering real-time adjustments.
- Ensure that your research evolves, aligning with your insights and discoveries.

Safety at the core

- Robust safety features protect both the operator and the experiment.
- Ensuring a secure environment for your experiments, allows you to focus on pushing boundaries.

For more information, and how to request an upgrade, visit
https://helgroup.com/products/laboratory-automation-software/
or speak to your local H.E.L representative

Upgrades, Support and Training

We understand that your needs can change over time and you may require:

- **A system upgrade**
- **Training for new team members**
- **Support on your processes**
- **To book some time with our service team**

Our dedicated service team and highly knowledgeable technical staff will work with you to find the right solution.

Customer Service Enquiries & Technical Support Requests

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About H.E.L Group

H.E.L Group's mission is to work together with chemistry, safety and biotechnology experts to engineer and unleash the full potential of the scientific community. To this end, H.E.L develops and manufactures innovative scientific instruments and software designed to optimize the efficiency, safety and productivity of key processes in chemistry and biology applications.

The H.E.L team includes highly skilled process and software engineers, based at their extensive research and manufacturing facilities in the UK, as well as sales and support offices around the world.

H.E.L has a long history of solving complex challenges for customers. For more than 30 years the company has worked with businesses and laboratories globally, providing proprietary automated solutions for the pharma, biotechnology, chemical, battery and petrochemical sectors.
H.E.L is accredited with ISO 9001 : 2015 and ISO 14001 : 2015.

- With a strong focus on the customer, our **service and support** enables our customers to keep working efficiently
- Our **wide range of customizable products** put the customer at the heart of what we do, with solutions designed around their needs

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