

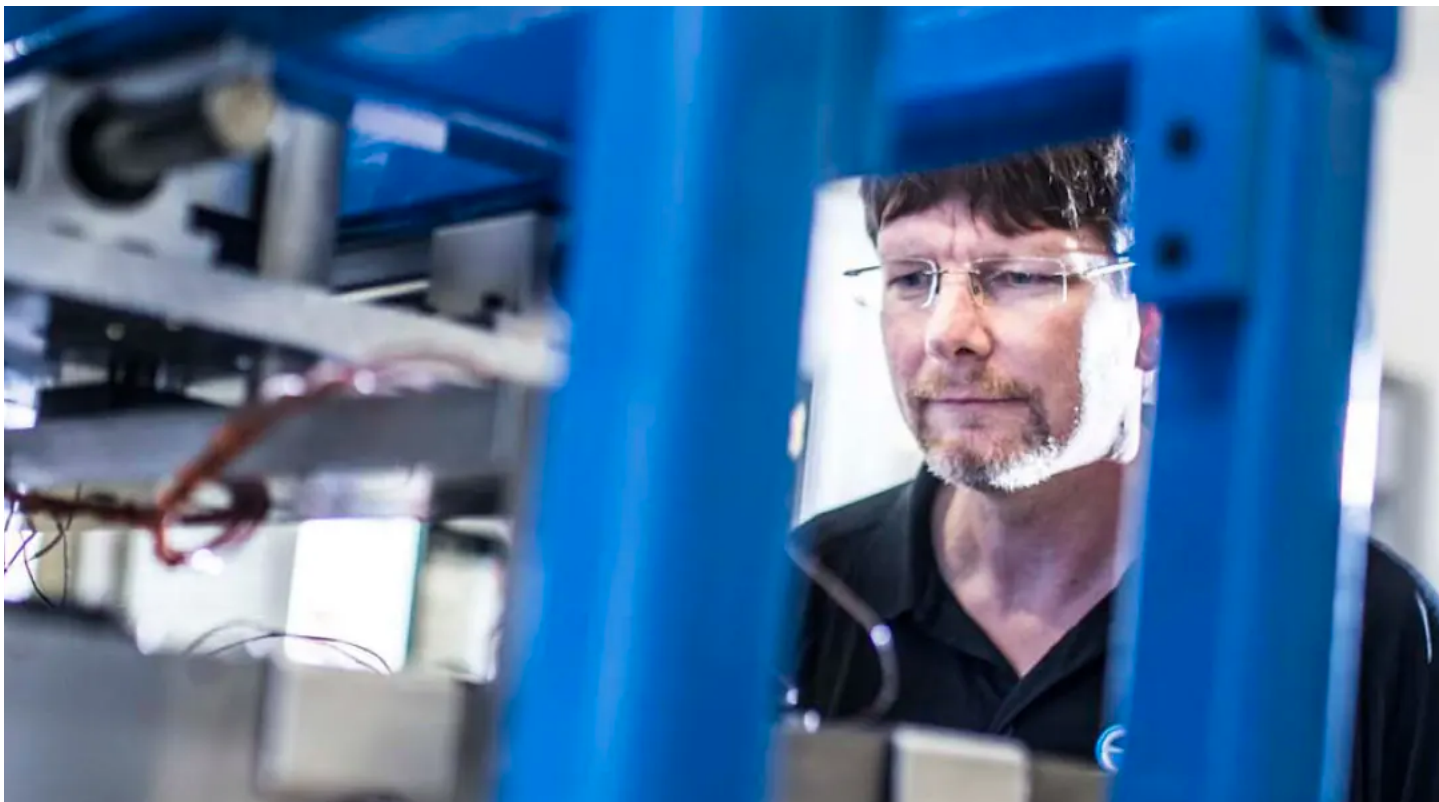


ELEMENT: YOUR SOURCE OF POWER

**THE BATTERY TESTING CAPABILITIES
OF AMERICA'S LEADING LAB**

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ACHIEVE COMPLIANCE. GAUGE PERFORMANCE.

Battery testing is complex. Development cycles are long. But they don't have to be. The sky is the limit when you have the leading accredited cell and battery testing lab in North America in your corner.

As your battery testing partner, Element accelerates your timeline with customizable regulatory and performance-based evaluations. Our mission is to deliver the comprehensive, affordable, and responsive testing you need to verify performance and achieve compliance.

And we're more than just a battery testing lab. Our holistic, forward-looking approach sets Element apart. From day one, we work to build a close rapport with your team and an upfront understanding of the standards and requirements your product will face. The earlier we can dive into your development process, the easier it is to mitigate risks and get a high quality product to market on schedule.

Let our knowledge and flexibility become your competitive edge. When you need regulatory or performance battery testing and certification, there's no need to stress internal capacity or stretch your resources. Element gives you the insights you need to make better business decisions — and the capabilities to test all chemistries and sizes.

OUR BATTERY EXPERTS ARE YOUR SOURCE OF POWER



SERVICES FOR YOUR NEEDS

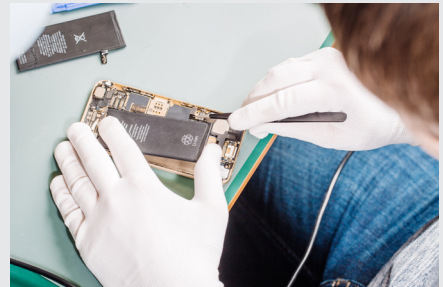
Element's testing labs place 100% of their focus on executing robust battery testing procedures and engineering services, day-in and day-out. With over a hundred years of combined experience in the battery-powered products industry, our team is prepared to assemble a package of expert services that suits your specific needs.



PERFORMANCE TESTING



TRANSPORTATION TESTING



FAILURE ANALYSIS



ENGINEERING ANALYSIS



SAFETY TESTING



COMPETITIVE BENCHMARKING

PERFORMANCE TESTING

Our performance testing capabilities will reveal how your battery or battery-powered product performs under pressure. Element can test performance in a multitude of contexts, including environmental, longevity, and peak output related procedures. We always provide a detailed results report and access to real-time data (with software by Voltaiq) so that you have the timely insights you need to stay ahead.

Our performance testing capabilities include:

- Discharge capacity verification (low, room, & high temp)
- High-rate discharge at operating temperature
- Charge retention (residual capacity)
- Charge recovery (recoverable capacity)
- Cycle life/endurance cycling at specific discharge rates
- AC and DC impedance
- Electrostatic discharge (ESD)
- Dimensional variation
- Storage at various temperatures
- Rate capability (available capacity at different discharge rates)
- Incoming inspection (variation of samples)
- Open circuit voltage (OCV) variation
- Thickness and swelling over various exposure and use cases

TRANSPORTATION TESTING

Lithium-related battery chemistries are classified as dangerous goods during transport and must be tested and packaged accordingly. Element can perform battery transportation testing to ensure your batteries are compliant with international transport regulations laid out in UN 38.3 and IEC 62281.

UN 38.3: Recommendations on the transport of dangerous goods – UN Manual of Tests and Criteria, 7th revised edition.



FAILURE ANALYSIS

Battery failure analysis is an essential service for reacting to (or anticipating) consumer or field issues for energy systems, batteries, and cells. Failures can range from benign issues (e.g. dead lithium-ion battery) to battery overheating resulting in damage or injury.



With robust failure analysis and other engineering services, we're able to provide insights that help you:

- Determine the root cause for quality and safety-related failures
- Benchmark your products against the competition (design, safety, and/or cost)
- Evaluate and/or qualify new suppliers
- Identify patent infringement or counterfeit products
- Drive lessons-learned for next-generation products
- Electrostatic discharge (ESD)

ENGINEERING ANALYSIS

Element is proud to offer battery engineering evaluations of energy systems, batteries (such as lithium-ion), and component cells. We're always excited to take a proactive (pre-launch) approach and work with our customers from early in the design process.

Utilize our engineering services for procedures such as:

- **Product Teardowns and Product Benchmarking** - Protecting your brand by revealing what's inside your batteries. Use battery teardowns and cell construction analyses to identify potential design, performance, or safety issues and help understand cost structure — or even to benchmark your competition or determine whether a product is counterfeit.
- **Battery and Cell Evaluation** - We can help define and execute a test protocol and set the minimum criteria for cells, batteries, and battery-powered devices to meet your customer needs. The scope can include safety, performance, and reliability attributes, as needed, through x-ray imaging, CT scanning, microscopy, product dissection, circuit analysis, and replication testing.

SAFETY TESTING

Ensure the integrity of your product and brand with safety, quality, and reliability testing for cells, modules, and packs. We proudly provide these services for a variety of industries including industrial, medical and consumer goods across a wide range of applications. Our commitment to safety gives you confidence in your products and peace of mind in your regulatory compliance.

We test and certify in accordance with local and international battery testing standards including:

IEC 62133-1/2

UL 2054

UL1642

IEC 60086-4

IEC 62368-1
Annex M

Take advantage of our full menu of abuse testing services to ensure the safety and reliability of your battery cells and packs before they impact the end consumer.

We conduct safety tests for:

- Humidity
- Thermal shock, hot and cold
- Vibration
- Mechanical shock
- Impact
- Crush
- Drop
- Nail penetration
- Short circuit
- Forced discharge
- Overcharge
- Alt/cycling

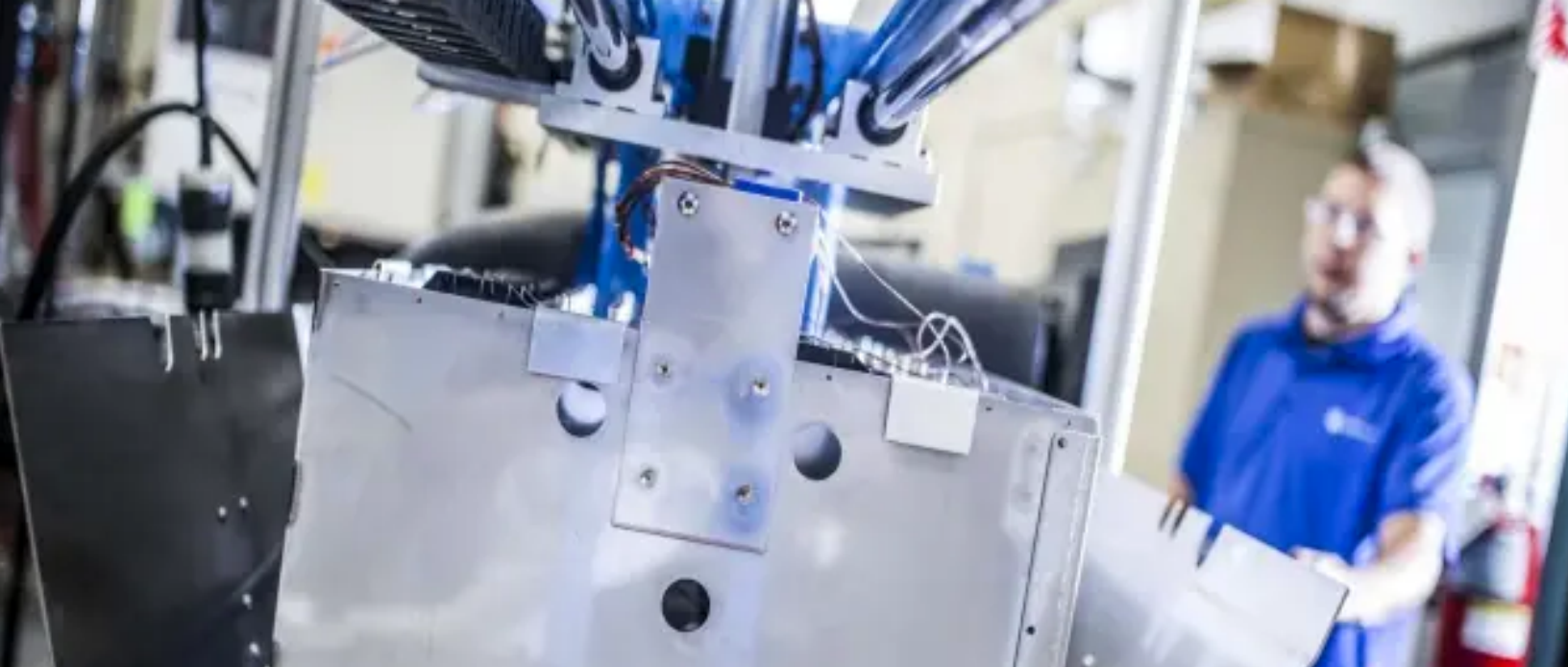
COMPETITIVE BENCHMARKING

Benchmark testing is the perfect way to discover how your product stacks up against competitors in performance. If you're evaluating multiple suppliers, our competitive benchmarking protocol and evaluation will help you make the best choice.

Through our battery comparison evaluation, we will provide you with a unique scoring output and report detailing performance and overall quality to make your battery selection as easy as possible.

Our customizable benchmarking capabilities include:

- Cell and battery cycle life testing
- Cell and battery capacity checks
- High rate discharge performance
- Capacity at temperature
- Temperature cycling
- Storage at temperature
- Oven exposure, heating
- Short circuit at room/elevated temperature
- Overcharge and overvoltage testing
- Forced discharge
- Low pressure/altitude
- Vibration
- Mechanical shock
- Crush/impact
- Free fall to various surfaces
- Nail penetration



LEADING LAB CAPACITY

As the largest cell and battery testing lab in North America, Element has unrivaled capacity for the full range of performance, safety, regulatory, and engineering analysis procedures. Our state-of-the-art labs in Detroit, MI; Gainesville, GA; and Hopkinton, MA; provide complementary capabilities spanning all battery formats and applications.

GAINESVILLE LAB CAPABILITIES

Our lab in Gainesville, GA, just a short drive from Atlanta, provides industry-leading capabilities for small and medium formats, including:

Cycling Capabilities

- ~2000 channels
- Voltage range (10V-150V)
- Amp range (up to 400A)
- Current accuracy (150 μ A)
- Pulse capable (5ms)

Environmental Chambers

- 60 chambers
- 25°C & 45°C storage room (10ft x 15ft each)
- Temp. ranges (-70°C to 300°C)
- Humidity capable
- High ramp rate (>10°C/min)
- Air-air thermal shock

Additional Capabilities

- Vibration
- X-ray and CT
- Mechanical shock
- SEM
- Accelerated rate calorimetry
- EIS

HOPKINTON LAB CAPABILITIES

Our Boston-area lab in Hopkinton, MA, significantly expands Element's capabilities with medium-to-large formats for EV, ESS, and other industries. Leverage our sophisticated test equipment and high-current capacity for your most complex testing projects and super-sized energy storage applications.

Cycling Capabilities

- ~1200 channels
- Voltage (5V)
- Amp range (up to 1200A)
- Current accuracy (150 μ A)
- Pulse capable (5ms)

Environmental Chambers

- 150 chambers
- 25°C storage room (15ft x 8ft)
- Temp. ranges (-70°C to 300°C)
- Humidity capable
- High ramp rate (>10°C/min)
- Air-air thermal shock

Additional Capabilities

- Full site capability
- Automotive cell validation (per USABC standards)
- Testing for grid-storage/ESS profiles
- Cycle life, calendar life, charge rate, cold crank, HPPC
- Custom procedures supported

DETROIT BATTERY CAPABILITIES

Element’s battery testing roots started in the Detroit, MI, area, focused on supporting batteries used in traditional ICE vehicles. With the expansion of CASE and new technologies due to the increased electrification of vehicles, Element continues to invest in new and better technologies to support all of your cell, module, and pack testing needs.

Module, Pack, and Cell Cycling Capabilities

- ~300 channels of various types
- Voltage range (5V to 750V)
- Amp range (up to 1000A)
- Up to 500kW of power in parallel

Abuse and Environmental Battery Testing

- Vibration/Mechanical Shock
- Altitude/Low Pressure/Dust
- Temperature and Humidity
- Thermal Shock
- Large Pack Vibration; MAST 1 to 100hz with six degrees of freedom

Additional Capabilities

- Test standards include UN38.3, UL 2580, IEC 60095, ECE R100, and more
- Ability to support many R&D test profiles
- Specification development and consulting
- Ability to develop customized test programs



SIZE AND CHEMISTRY

Our laboratories offer you the ability to test nearly all battery sizes and chemistries, ranging from small formats (up to 36 volts) all the way to large formats (up to 150 volts and 200 amps).

Batteries and Products We Test

- AA, AAA, C & D Batteries
- Battery packs
- Chargers
- Coin & Button Cell Batteries
- MP3, Cell Phone & Laptop Batteries
- Pack controllers 9V & 12V Batteries
- Primary Battery Systems (Alkaline, Lithium)
- Secondary Battery Systems (Rechargeable, Lithium-Ion)
- Super Capacitors
- Small format (cells & packs)
- Medium format modules
- Large format cells

Battery Chemistries

- Alkaline
- Lead-acid
- Lithium cobalt oxide
- Lithium iron phosphate
- Lithium manganese oxide
- Lithium nickel cobalt aluminum oxides
- Lithium nickel manganese cobalt oxide
- Lithium-carbon monofluoride
- Lithium-iron disulfide
- Lithium-manganese dioxide
- Lithium sulfuryl Chloride
- Lithium sulfur Dioxide
- Lithium thionyl Chloride
- Lithium-titanate
- Low self-discharge nickel-metal hydride
- Mercury oxide-zinc
- Nickel-cadmium
- Nickel-hydrogen
- Nickel-iron
- Nickel-metal hydride
- Nickel-zinc
- Rechargeable alkaline
- Silver-oxide
- Zinc-air
- Zinc-carbon



INDUSTRIES WE SERVE

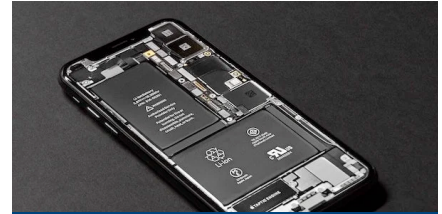
Element builds enduring relationships with customers across diverse industries. We have the experience and knowledge to offer industry-specific advice and testing that will enable you to deliver products into the global market on time and performing properly.



AEROSPACE



AGRICULTURE



CONSUMER GOODS



CRITICAL POWER



DATA CAPTURE (IOT)



ELECTRIC VEHICLES



ENERGY STORAGE



INDUSTRIAL



INDUSTRIAL VEHICLES



MEDICAL



MILITARY

INDUSTRY SPOTLIGHT: AEROSPACE

Get your aircraft accessory products to market faster with our accredited aerospace battery testing solutions.

Element maintains a customized containment facility to safely manage the hazards associated with intentional thermal runaway testing. Minimize schedule delays with our team of onsite failure analysis experts on standby to offer rapid evaluation of battery pack and cell failures.

Our state-of-the-art facility provides:

- Multipoint video coverage
- Datalogging of thermal, electrical, and communications parameters
- Multiple options to initiate thermal runaway
- Onsite Failure Analysis with X-ray, CT, and cell teardowns
- Multiple material evaluation techniques



INDUSTRY SPOTLIGHT: ELECTRIC VEHICLES

Our comprehensive testing solutions for Electric and Hybrid Vehicles are supported by a specialized EV & grid-storage (ESS) cell testing lab in Hopkinton, MA — the premier battery life and performance testing facility for large formats in the U.S. Leverage our high-current cycling capacity to test batteries for cutting-edge automotive applications.

Our EV testing procedures and capabilities include:

- Cycle Life
- Calendar Life Storage Testing
- Charge Rate Mapping
- Cold Crank
- HPPC
- Custom Procedures
- 150+ Environmental Chambers
- Maccor battery cyclers
- Multiple industry-standard formats (large capacity prismatic, opposed & same-side tab)
- Temperature Control from -70°C to 150°C
- 100% Temperature recording during testing (individual cell and chamber-level)



INDUSTRY SPOTLIGHT: ENERGY AND GRID STORAGE

We're proud to offer real time data access (provided by Voltaiq) and the ability to execute robust, customized grid-storage/ESS life cycle profiles. The Element team brings many decades of combined industry-relevant battery test experience to the table.

Our energy & grid-storage cell testing lab is the largest performance testing facility of its kind in North America, with capabilities including:

- Cell, module, & unit level ESS testing to UL9540A
- 1,180 Maccor cell test channels, 100A-1,200A
- Multiple industry-standard cell formats (large capacity prismatic, pouch, cylindrical)
- Ability to conduct cell failure analysis
- Cell radiographic imaging (2D x-ray; 3D CT scanning)
- Mechanical cell teardown to identify failure mechanisms associated with the electrodes, active materials, and separator





YOUR SOURCE OF POWER

At Element, we're firm believers in authenticity, expertise and dependability. Our holistic approach to battery engineering, testing, and analysis has helped us to establish lasting partnerships since we were founded in 2009. We're not just your battery testing lab — we're your source of power.

Our customers benefit from focused and expansive services at a lab that purely operates to test batteries. On top of that, we're committed to complete transparency so that you always feel knowledgeable and in control. Count on us for the dependable support and full dedication you need on every unique project you bring our way.

“They are thought leaders in the lithium ion battery testing space and I know they will always provide the highest level of customer support, while solving complex battery related testing issues, for our PRBA members.”

George Kerchner — Executive Director at PRBA,
The Rechargeable Battery Association

**YOU CAN REST ASSURED
WITH ELEMENT.**

**CALL US TODAY TO DISCUSS
YOUR NEXT PROJECT.**

REFERENCES

1. <https://www.voltaiq.com/>

2. <http://www.maccor.com/>



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