ENVIRONMENTAL CHAMBERS FOR BATTERY TESTING
Cincinnati Sub-Zero (CSZ) is a leading provider of environmental test chambers with over 76 years of industry experience in designing and manufacturing temperature-humidity controlled products. We supply a variety of test chambers for testing batteries of any size with extensive experience in chambers designed for testing NIMH, lead acid and lithium ion batteries from small battery cells to large battery packs.

Battery testing chambers are supplied to a variety of industries including, automotive, computer, telecommunications, defense, and alternative energy markets. With the goal of reducing automobile emissions and the push toward electric hybrid vehicles, the need for lithium ion battery testing is even more critical. Our proven experience provides the most cost-effective solutions.

Each test chamber is built according to specific test requirements and may be interfaced with battery cyclers, control & monitoring data acquisitions systems and other test equipment for a complete integrated test solution.
Environmental chambers are available from small benchtop chambers for testing small battery cells to large walk-in chambers for testing large battery packs.

Temperatures range from -70°C to +190°C (-94°F to +375°F) with an optional humidity range as low as 10% to 95%. Sizes are available from small benchtop units to large walk-in rooms.

**Products**
- High/Low Temperature Cycling Chambers
- Humidity Chambers
- Thermal Shock Chambers
- AGREE Temperature/Vibration Chambers
- Altitude Chambers
- Explosion Proof Chambers

**Temperature Ranges**

**Single Stage:** -34°C to +190°C (-30°F to +375°F)
**Tundra®:** -45°C to +190°C (-49°F to +375°F)
**Tundra II:** -50°C to +190°C (-58°F to +375°F)
**Cascade:** -70°C to +190°C (-94°F to +375°F)

**Exclusive Tundra® Refrigeration System**

The utilities involved with battery testing facilities and electric consumption add to the operating cost of each piece of equipment, a consideration to the bottom line and an important aspect in selecting test equipment. The compressors on an environmental chamber are often a large portion of the electrical load. CSZ offers the patented Tundra system, which utilizes a single compressor to get to -45°C (-49°F), and the Tundra II system which also uses a single compressor and provides the ability to test as low as -50°C (-58°F).

By using only one compressor for cold temperature testing at these low temperatures, significant savings can be realized in both operating and maintenance costs.
Safety Features and Options
We provide safety features for reliability and abuse testing of batteries. Each environmental chamber is designed with safety in mind. Safety features may be incorporated into CSZ test chambers and tailored to the various hazard levels (0 - 6) to help mitigate potential risks.

Battery Testing Risks
- Chemical reactions
- Thermal charges & thermal runaways
- Reactions to overcharge
- Reactions to fast charge
- Reactions to damage
- Rupture
- Fire & flame from ignition of flammable gas/liquid
- Explosion

Failure Modes
- Cracks in membrane separating anode and cathode
- Overheating
- Over charging
- Under charging

<table>
<thead>
<tr>
<th>Hazard Severity Level</th>
<th>Description</th>
<th>Classification Criteria and Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>No Effect</td>
<td>No effect. No loss of functionality</td>
</tr>
<tr>
<td>1</td>
<td>Passive Protection Activated</td>
<td>No defect; no leakage; no venting, fire, or flame; no rupture; no explosion; no exothermic reaction or thermal runaway. Cell reversibly damaged. Repair of protection device needed.</td>
</tr>
<tr>
<td>2</td>
<td>Defect/Damage</td>
<td>No leakage; no venting, fire, or flame; no rupture; no explosion; no exothermic reaction or thermal runaway. Cell irreversibly damaged. Repair needed.</td>
</tr>
<tr>
<td>3</td>
<td>Minor Leakage</td>
<td>No venting, fire, or flame*; no rupture; no explosion. Weight loss &lt;50% of electrolyte weight (electrolyte = solvent + salt).</td>
</tr>
<tr>
<td>4</td>
<td>Major Leakage/Venting</td>
<td>No fire or flame; no rupture; no explosion. Weight loss ≥50% of electrolyte weight (electrolyte = solvent + salt).</td>
</tr>
<tr>
<td>5</td>
<td>Fire or Flame</td>
<td>No rupture; no explosion (i.e., no flying parts).</td>
</tr>
<tr>
<td>6</td>
<td>Rupture</td>
<td>No explosion, but flying parts of the active mass.</td>
</tr>
<tr>
<td>7</td>
<td>Explosion</td>
<td>Explosion (i.e., disintegration of the cell).</td>
</tr>
</tbody>
</table>

* The presence of flame requires the presence of an ignition source in combination with fuel and oxidizer in concentrations that will support combustion. A fire or flame will not be observed if any of these elements are absent. For this reason, we recommend that a spark source be used during tests that are likely to result in venting of cell(s). We believe that “credible abuse environments” would likely include a spark source. Thus, if a spark source were added to the test configuration and the gas or liquid expelled from the cell was flammable, the test article would likely progress from level 3 or level 4 to level 5.
Safety Features and Options

- External Lights - externally mounted lights eliminates potential spark source
- Temperature Limited Sheath Heaters - Standard ni-chrome wire heaters can reach temperatures of +540°C (+1000°F). Temperature is set below ignition temp. of gases. Includes Intrinsically Safe Barriers (to prevent T/C sparking)
- Intrinsically Safe Barriers - Prevents the potential of high voltage pulses
- Protective Enclosure/Structure - External structure that would contain any fire or explosion
- Non Sparking Fan Blades or Blower Wheels - Prevents sparking/explosion
- Reinforced Chamber Floor - To support weight of heavy product and extreme temperature
- LN2 Test Article Surface Cooling - Used to cool cells or packs if they overheat - may help prevent thermal runaway

Fresh Air Exchange System
- Aids in removing all gases from inside the chamber prior to opening the door

Safety Door Interlock
- Prevents entry either during tests or after an event

Gas Monitors - O2, H2, CO, etc - Can be interlocked to controller to shut down chambers

Custom Pressure Relief Vent - Protects chamber from a sudden release of high pressure gas
Fire Suppression Systems
Inert Atmosphere Uses N2 or CO2 to eliminate Oxygen - does not prevent thermal runaway but can help contain

Pressure Relief Port
A 12” X 12” square port in the ceiling of the chamber with a plug on slide rails.

GN2 Purge
Helps flush out outgassing from product under test.
Features and Options

Battery Cell Testing

Ambient Air Blower to Provide Air Exchanges after Detection of Gases or CO₂ Deployment

Non-Sparking Fan Blades

Gas Monitor (Other Options Available)

Temperature Limited Sheath Heaters with Intrinsically Safe Barriers

GN₂ Tank (Supplied by Customer)

Pressure Relief Exhaust Duct

Customer Air Exhaust Duct

CO₂ Fire Suppression System Activates when Chamber Temperature Exceeds 90 °C of Flame Contacts Tube

Door Interlock Switch

CO₂ Tank (Mounted on Chamber)

Alarm

Battery Cell Testing
Battery Test Specifications for Environmental Testing

Below are common battery testing standards that require the environmental testing such as temperature cycling, humidity, altitude and vibration.

<table>
<thead>
<tr>
<th>Test Specification</th>
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<tr>
<td>IEC 62660-2</td>
<td>Reliability &amp; Abuse Testing for Lithium Ion Cells in Electric Vehicles</td>
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<tr>
<td>SAE J2464</td>
<td>EV &amp; HEV Rechargeable Energy Storage System Safety &amp; Abuse Testing</td>
</tr>
<tr>
<td>SAE J2929</td>
<td>Safety Standard for Electric and Hybrid Vehicle Propulsion Battery Systems Utilizing Lithium-based Rechargeable Cells</td>
</tr>
<tr>
<td>IEC 60086-4</td>
<td>Primary Batteries, Part 4: Safety of Lithium Batteries</td>
</tr>
<tr>
<td>UL 1642</td>
<td>Standard for Lithium Batteries</td>
</tr>
<tr>
<td>UL 2580</td>
<td>Batteries for use in Electric Vehicles</td>
</tr>
<tr>
<td>UN/DOT 38.3</td>
<td>UN Lithium Battery Testing Requirements</td>
</tr>
<tr>
<td>IEC 61960</td>
<td>Secondary Lithium Cells and Batteries for portable applications</td>
</tr>
<tr>
<td>IEC 62133</td>
<td>Secondary Cells and Batteries Containing Alkaline or Other Non-acid Electrolytes - Safety Requirements for Portable Sealed Secondary Cells, and for Batteries Made from them, for Use in Portable Applications</td>
</tr>
<tr>
<td>IEC 62281</td>
<td>Safety of Primary and Secondary Lithium Cells and Batteries during Transport</td>
</tr>
<tr>
<td>RTCA DO-311</td>
<td>Minimum Operational Performance Standards for Rechargeable Lithium Battery Systems</td>
</tr>
<tr>
<td>UL 2054</td>
<td>Household and Commercial Batteries</td>
</tr>
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</table>
The Next Generation Controller with Smartphone Technology

Save valuable time with the ease of use of the EZT-570S featuring fewer steps to accomplish your daily testing needs while incorporating simplified operation and programming to test faster.

All features are built into the controller interface so no additional software or internet is required for access to all the features the controller has to offer.

Manually control, run or stop a profile directly from the home screen and view a snap shot of current activity like actual/setpoint values, alarm, datalogging, profile, security, IP address information and more.

Communications & Connectivity

- Monitor and/or Control the chamber remotely for anytime, anywhere access from any device (PC, smartphone or tablet) using LAN/VNC.
- Alarm notification system sends email and/or text phone messages in the event of a test chamber alarm, saving valuable tests while reducing downtime.
- Email built-in to send data, alarm, audit trail files directly from controller. Also create and send new emails.

Profiling

- Profiling includes up to 99 steps and 1000 cycles.
- Program ramp steps entering time or °C/min.
- Programs may be written using product control function.
- Easily review profile using trend chart or review list of steps before running profile.
- Profile status view displays current step, estimated start/stop date and time and more.
- Profiles may be transferred to different chambers via USB or optional EZ-View software.
- Automated delay profile start.

Data Logging

- Configurable log interval, data file length, filename, operator entered batch & lot information as well as an unlimited number of operator notes saved to the data file.
- Access data files directly from controller or PC.
- Easily download profiles, alarm files, audit trail files and data files using LAN (FTP, email) and/or USB in a compatible .csv file format for ease of use. Files may also be automatically backed up daily for hassle-free file management.
User Convenience & Flexibility

- Controller may be configured in any of one of 28 languages - one setting up dates icons, menus and help screen.
- Selectable power failure/recovery options.
- Full system security allows up to 30 different users with four different levels of security.
- Audit trail files track changes in settings by each user.
- Import/export configuration settings to other controllers saving time. (Personalized to your use)
- Configure alarm setting and maintenance alerts.

Graphing Technology

- Real-time trend display graph with adjustable time and min/max values.
- Up to eight configurable trend graphs with left & right axis
- Graph historical data files
- Zoom in/out graphs

Enhanced Communications & Control Options

- Digital input option provides 8 inputs that can be configured for various control functions including starting, stopping and pausing a profile. “Wait for” function allows the user to pause a profile during a particular step of the profile until a specific digital input is turned on or off.
- Digital output “customer event” feature provides 15 programmable outputs. Each output can be configured to perform other operations including alarm or profile status indicators for more control over your testing.
- Optional refrigeration monitor package displays and data logs temperatures and refrigeration system compressor suction/discharge pressures.
- Condensation control option helps prevent condensation from collecting on the part by automatically managing the air dewpoint.
- Bar code option allows user to scan barcode to start profile and to add notes to current data file when datalogging.
CSZ Testing Services is an A2LA Accredited Test Laboratory utilizing the latest test technology. We are your one stop source for all of your environmental simulation testing needs. Our testing laboratory is here to help with your product qualification testing, overflow testing and/or third party product validation. Testing capabilities include Temperature, Humidity, and/or Vibration, Thermal Shock, Burn-in, Radiator Testing, Altitude, Vibration, HALT/HASS, Shock, Salt Spray, Cyclic Corrosion test, and Drop Testing. Serving you from two locations in Cincinnati, OH and Sterling Heights, MI.

FOR MORE INFORMATION please call CSZ Testing headquarters at 513-793-7774 or visit www.csztesting.com.

CSZ is committed to your satisfaction every step of the way. With the initial point of contact, through the process of fully understanding your unique needs and partnering to develop the right solution, through implementation and delivering outstanding post-sale support.

CSZ has two manufacturing facilities in Cincinnati, OH with world-wide sales and service.

CSZ is your one stop solution for Environmental Chambers
- Temperature Cycling
- Humidity
- Stability Cabinets & Rooms
- Thermal Shock
- Stress-Screening
- Altitude
- AGREE Vibration
- HALT/HASS
- Freezers
- Liquid Chillers
- Wind & Rain
- Sand & Dust
- Other Temperature Management Solutions

 Sizes range from benchtop to full walk-in/drive-in chambers.

Services
- Refrigeration Retrofits
- Controller Upgrades
- Preventative Maintenance
- Calibration Services

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