NRC·CNRC

THERMAL RUNAWAY INITIATION METHODOLOGY (TRIM)

A leading-edge technology solution to improve the safety of battery systems

The use of batteries as a source of large scale rechargeable energy storage is now considered as a viable solution for many industries around the world. In this context, integrators and battery manufacturers are searching for ways to effectively assess battery safety. In an environment where regulators are raising safety requirements and asking for reliable tests for evaluating compliance of energy storage technologies, the National Research Council of Canada (NRC) has taken a leading role[1] in developing a tool and methodology to validate the safety of battery systems against potential abusive thermal events. As a realistic, reproducible and minimally invasive approach, the NRC's Thermal Runaway Initiation Methodology (TRIM) has been adopted by various business and R&D environments and will be a part of the testing toolbox for global battery safety testing standards.

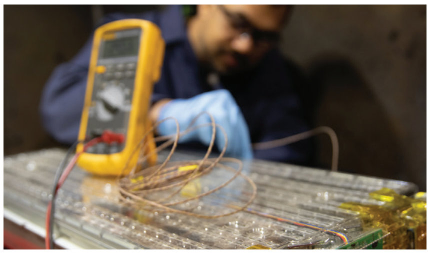
With several evaluation licenses issued, the TRIM technology is available for various commercial or R&D purposes. In this regard, the NRC is currently seeking partners interested in discussing opportunities to:

- Further develop the technology through research collaboration
- License for manufacturing purposes
- License for distribution purposes

ABOUT THE TRIM TECHNOLOGY

Recent safety incidents involving lithium-ion batteries (LiB) in electric vehicles (EVs), aircraft and consumer electronics, highlight the need for an improved understanding of lithium-ion battery safety.

The NRC's patented TRIM device and testing methodology can be used to study how a single cell thermal runaway failure can propagate through battery modules and packs. The TRIM method consists of locally heating the external surface of one lithium-ion cell with a pulse of heat, which rapidly (in a few seconds) increases the cell's active material above some critical temperature to initiate thermal runaway without preheating neighboring cells. It represents significant progress towards a reliable compliance validation test for LiB pack thermal runaway. The testing methodology designed around the TRIM is currently being drafted into an upcoming ISO standard as well as potentially into a United Nations Global Technical Regulation[2].



Our staff is highly trained to conduct TRIM-initiated thermal runaway propagation tests.

BENEFITS

TRIM has several advantages over conventional battery testing methodology for thermal runaway activation:

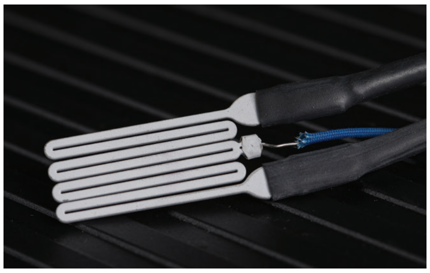
- Realistic: It applies heat locally and rapidly in the same manner as a single-cell internal short circuit; a failure scenario that may lead to thermal runaway and propagation.
- Minimally invasive: TRIM has been successfully deployed on fully operational battery systems, including vehicles, in which the TRIM was invisible to the thermal and battery management system.
- Reliable: An embedded temperature feedback sensor prevents premature element failures or unwanted cell sidewall ruptures.
- Repeatable: A high-speed temperature controller ensures the desired temperature profile is maintained.
- Adaptable to a wide variety of cell types, sizes and geometries; at the cell, component or system scales. Its small size and minimum thickness allows placement almost anywhere.

POTENTIAL APPLICATIONS

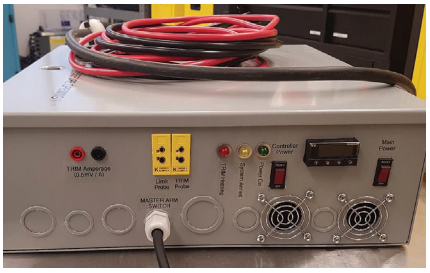
- Understanding thermal failure modes of batteries to improve detection and mitigation strategies. Investigating and validating how packaging materials, cell spacing and thermal management strategies can mitigate the propagation of single cell thermal failures.
- Suitable for applications that utilize lithium-ion batteries including: automotive, military, aeronautical, marine, energy storage, medical and more.
- Adaptable to safety performance testing at any technology readiness level, from initial prototype to end-use compliance.

POTENTIAL OUTPUTS:

- Evaluation of the thermal response of your battery design in realistic conditions
- Explore how your battery reacts in hazardous situations and failure scenarios
- Identify improvement opportunities for your chosen battery design
- Establish safeguards within your chosen battery cell choices and pack designs



Heating element V4.



Controller unit.

TECHNICAL SPECIFICATIONS

Heating element V4

Specification	Value
Active Surface Area (cm^2)	5.4
Thickness (mm)	1.2
Mass (g)	6
Peak Applied Power (W)	2000
Typ. Heat Flux (W/m^2)	> 1×10^6
Typ. Ratio of applied electrical energy divided by target cell's rated discharge capacity	< 10%

Controller Unit

Specification	Value
Input Voltage	180 to 260 VAC @ 50/60Hz
AC Current	15.5A/180VAC
TRIM Output Voltage	24VDC

Features:

- Programmable operational modes such as multiple ramp and soak
- High frequency response – 100ms
- Temperature feedback ensures heating power is stopped once self-sustaining exothermic reactions begin
- Thermostatic control prevents unwanted elements burnout or sidewall ruptures
- Optional software control

For the last two years, the NRC's TRIM technology has been used to perform safety evaluations with clients based in North America, Europe and Asia. Coupled with multiple presentations delivered by our researchers during industry forums related to battery safety and global standard development working groups, NRC's TRIM technology continues to receive extremely positive reviews.

With the objective of concentrating its efforts on its core competencies of advancing research in this field, the NRC wishes to create and welcome partnering opportunities for production and/or distribution. Since batteries of various chemistries, formats and energy densities will continue to appear in the market for some time to come, the NRC is also interested in opportunities to collaborate in areas that will contribute to further developments of battery safety and related technologies.

If you are interested by any of these opportunities please contact us.

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[1] With the financial partnering support of Transport Canada
[2] "*Apparatus and Method for initiating Thermal Runaway in a Battery*" with application date of January 18, 2018 numbered PCT/CA2018/050055.