



Li-ion Battery Safety NHTSA Research Update GTR (Sept 2017)

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Li-ion Battery Safety Research FY 2018 & 2019

1) NHTSA will conduct safety research focused on documenting "Best Practices" in the area of Li-ion battery pack Thermal Runaway Propagation (TRP) which:

- Research the influence to which an ignition mechanism selection has on the performance of a cell-to-cell TRP test (NHTSA 2014 *SCTRI test* and 2017 Sandia NL *Laboratory Abuse Test Manual*)
- Develop an "*Engineering Methodology and Decision Matrix Document*" for optimally and correctly selecting, sizing, and locating a thermal initiation mechanism for TRP testing and describe the adverse effects of alternate choices. This will be supplemented with limited empirical data and modeling simulation (where possible).
- Document the TRP safety optimization procedures which will allow battery designers to quantify the safety performance of thermal mitigation strategies (cell selection, spacing, peripheral pack materials). The empirical work for this will be performed at automotive pack scale.

2) NHTSA will continue research embeddable technology to determine the safety related health and stability of a Li-ion based RESS, particularly in one which has lost communication or has been isolated as in the case of a vehicle crash, or post crash circumstance.

This research is limited to documenting and providing "Best Practices" of measurement methodology available to industry, a test basis and pass/fail criteria will not be developed in the course of this work.



Battery Management System Safety during Operation:

Over-discharge

Over temperature test

Over-current

External short circuit

Soft short circuit

Under temperature charge

Over-voltage overcharge

Under temperature overcharge

Internal Isolation

Green = Complete and Validated

Yellow = Research Continues



Battery Management System Safety during Charging:

Level III – DC Fast Charge

- Ground Fault Test
- Chassis Ground Offset Test
- DC Bus Short Test
- DC Bus Held High Test
- System Overvoltage Test (12V Board)
- 12V System Under voltage Test
- 12V System Disturbance Test
- 12V System EMI/EMC Test ***
- Vehicle Movement Test
- Vehicle Crash or Bump Test ***
- Charge Operation Disturbance Test
- Charge Connector Control Signal Disturbance Test
- Charge Connector Field Ground Connection Disturbance
- Charge Connector HV Connection Disturbance
- Visual Inspection of Charge Port
- Cooling Heating System
- BMS Internal Fault Detection ***
- Overcharge Test

Green = Test Developed and Validated

Yellow *** = Test Developed but Validation Not in Scope of Research



Battery Management System Safety during Charging:

Level I & II A/C Charge

- Ground Fault Test
- Chassis Ground Offset Test
- DC Bus Short Test
- DC Bus Held High Test
- System Overvoltage Test (12V Board)
- 12V System Under voltage Test
- 12V System Disturbance Test
- 12V System EMI/EMC Test ***
- Vehicle Movement Test
- Vehicle Crash or Bump Test ***
- Charge Operation Disturbance Test
- Charge Connector Control Signal Disturbance Test
- Charge Connector Field Ground Connection Disturbance
- Charge Connector HV Connection Disturbance
- Visual Inspection of Charge Port
- Cooling Heating System
- BMS Internal Fault Detection ***
- Overcharge Test

Orange = Test Developed and Not Yet Validated (FY 2018)

Yellow *** = Test Developed but Validation Not in Scope of Research



Battery Management System Safety during Charging:

Level IV D/C “High Power” Charge (Up to 350kW)

This topic was included in a FY 2017 project with Argonne N.L.
Project completion is scheduled on Sept 30, 2019

NHTSA

