

Long-term fire resistance test

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Long-Term Fire Resistance Test

- Fire Resistance (Long Duration)
 - “Purpose of the long duration test should be clarified.” –EVS1315-008/xlsx
- Existing Engineering Standards with Long Duration Fire Tests
 - SAE J2929 - Safety Standard for Electric and Hybrid Vehicle Propulsion Battery Systems Utilizing Lithium-based Rechargeable Cells
 - Published February 2013
 - 4.7 Exposure to Simulated Vehicle Fire
 - Rationale: “This condition simulates exposure to a vehicle fire condition to verify that the battery system does not pose additional risk due to explosion.”
 - Condition: “...subjected to a high temperature heat and flame environment until the battery system is fully involved in the fire.”
 - UL2580 – Batteries for Use In Electric Vehicles
 - Published December 2013; ANSI Approved June 2016
 - 42 External Fire Exposure Test
 - 42.1 The purpose of this test is to determine an electrical energy storage assembly’s ability to prevent an explosion as a result of exposure to a simulated fuel or vehicle fire external to the electrical energy storage assembly.
 - 42.4 ...The test is concluded when this minimum temperature indication of 590°C (1094°F) has been maintained for 20 min.

Recommendation

- The purpose of the long duration fire resistance test should be to demonstrate that no additional hazard (e.g., explosion) occurs.
- Based on significant prior research work, a long-duration fire test would not provide any additional safety benefit and should not be included in Phase 2 GTR content.

NFPA Research¹

- Research conducted to develop data-based best practices for emergency response to incidents involving electric vehicle batteries
 - Six full-scale tests conducted
 - Propane burners used to ignite battery; allowed to burn 1 minute after visible signs of battery involvement occurred (approx. 8-20 minute duration) prior to suppression activity
 - Two battery types
 - 4.4 kWh lithium ion for HEV application
 - 16 kWh lithium ion for PHEV application
- “However, no projectiles, explosions, or bursts were observed during the test while the battery was exposed to the burners, while it was in a free burn state, while it was being suppressed, or after suppression efforts ceased.”
- “In addition, water and gas samples collected during testing did not include any compounds or gases that differed significantly from what is typically found in a conventional ICE vehicle fire.”

¹ Long, R. T. Jr., Blum, A., Bress, T., & Cotts, B. (2013). Best Practices for Emergency Response to Incidents Involving Electric Vehicles Battery Hazards: A Report on Full-Scale Testing Results. Quincy, MA: The Fire Protection Research Foundation.

Real-scale Vehicle Fire Research²

- Conducted full vehicle fire tests of battery-powered vehicle and a gasoline-powered vehicle
 - Evaluated flame propagation, rate of heat release, and radiation heat flux
- “...there was no explosive burn of the LiB pack.”
- “The fire risk posed by the battery-powered vehicle ... was at a level similar to that posed by a gasoline-powered luxury sedan.”

² Watanabe, N., Sugawa, O., Suwa, T., Ogawa, Y., Hiramatsu, M., Tomonori, H., ... Honma, M. (2012, September). Comparison of fire behaviors of an electric-battery-powered vehicle and gasoline-powered vehicle in a real-scale fire test. In *Proceedings from Second International Conference on Fires in Vehicles-FIVE* (pp. 195-205).. Chicago.

General Motors Experience

- Conducted gasoline pool fire tests on several pack designs
 - Duration up to 10 minutes
 - Varying sizes – 0.4, 1.4, 21 kWhr
 - No evidence of battery explosion
- Have conducted full-vehicle fire tests
 - No evidence of battery explosion
 - No evidence that battery contributes to increase in severity of fire

Conclusions

- Based on the construction and content of a vehicle battery, it provides fuel if involved in a fire.
 - This is inherent to battery technology (e.g., electrolyte, packaging & structural materials)
- Testing has shown no added vehicle fire hazard caused by a burning battery
 - No explosion
 - No added gases