Update Progress and Suggestion

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TF5 task force – thermal propagation

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Next step work proposal

(8th meeting in Washington DC)

- USA will go on research of the method of initiating the battery thermal runaway and propagation from all the levels (i.e. cell/module/system?) (before 2015-08-01);
- Japan will propose the definition of thermal runaway and propagation and the criteria of thermal propagation (before 2015-08-01);
- OICA will provide more evidence explaining that the safety design of vehicle level can avoid the thermal propagation, and can give occupants enough time to escape when the thermal propagation occurs, as well as the safety condition description between the single cell thermal runaway and the battery pack thermal propagation happening (before 2015-08-01);
- China will organize one or two telecom TF meetings to conduct more efficient discussion on the thermal runaway and propagation (before 2015-08-15).

Definition of thermal runaway and propagation

(Japan proposal)

- “Thermal runaway of the battery cell” means the phenomena of uncontrollable heat generation with continuous temperature rise caused by exothermal chain reaction in the cell.
- “Thermal propagation” means the sequential occurrence of thermal runaway within a battery system triggered by thermal runaway of a cell in that battery system.

OICA viewpoint on the thermal propagation

1**) The safety design of vehicle level can avoid the thermal propagation?**

As OICA previously commented (see OICA comment dated 10 March 2014 and 7 November 2014), OICA understands that the purpose of EVS-GTR is to ensure the safety of the vehicle in the market and therefore the vehicle-based tests and requirements should be considered at first.

In general, manufacturers are taking several measures from material level to vehicle level. OICA considers that the certification tests for vehicles should not disregard any of the relevant measures implemented in the final product (i.e. vehicles).

The evaluations at cell level (or module level in certain case) are important to define the design parameters for the higher levels during the development phase, but not appropriate for vehicle certification requirement since the safety measures implemented at the higher level are not evaluated.

OICA viewpoint on the thermal propagation

2) the safety design of vehicle level can give occupants enough time to escape when the thermal propagation occurs?

The measures to prevent or mitigate the risk from thermal runaway and thermal propagation varies depending on several aspects such as cell chemistry, cell material, cell design, battery pack design, battery management, battery installation, powertrain configuration, etc.

Therefore, it will not be feasible to provide the evidence that can generally be applicable for all possible vehicle configurations.

Nevertheless, industries' experiences indicate that the phenomenon of thermal propagation is not instantaneous and there are several indications to the driver with sufficient time before whole vehicle goes into the critical incidents (such as fire of vehicle cabin). In the most cases, visible venting gas from the cell (which goes to thermal runaway) will be an obvious indication of the abnormality of the REESS.

OICA viewpoint on the thermal propagation

3) the safety condition description between the single cell thermal runaway and the battery pack thermal propagation happening

For protection of occupants in the event of thermal runaway in a battery system, the following conditions are considered:

a) The occupants are not directly and instantly exposed to the toxic gases nor the heat from the flames from the event of single cell thermal runaway.

b) The driver will recognize the abnormal situation of the REESS at a reasonable timing and by reasonable means.

c) If necessary, the vehicle and its HV system shall be switched to the specific mode of operation (e.g. fail-safe/limp-home mode, shut-down), according to the manufacturer’s safety strategy relevant to the configuration of vehicle/powertrain.

OICA viewpoint on the thermal propagation

3) the safety condition description between the single cell thermal runaway and the battery pack thermal propagation happening

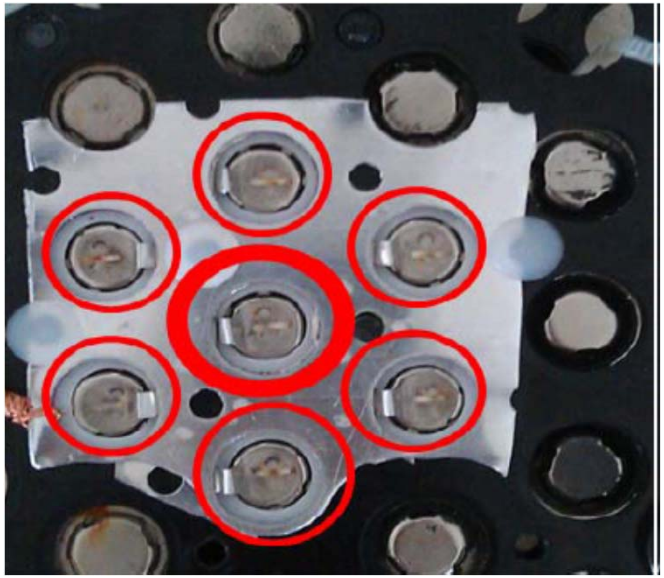
d) The fire will not extend to vehicle cabin for sufficient time.

•It is recommended not to argue what is the sufficient time for evacuation from the indication of the warning because many factors (e.g. detection timing, vehicle operation mode after the event, warning message, number of occupants, number of doors, road conditions, etc.) are variable and cannot be generalized.

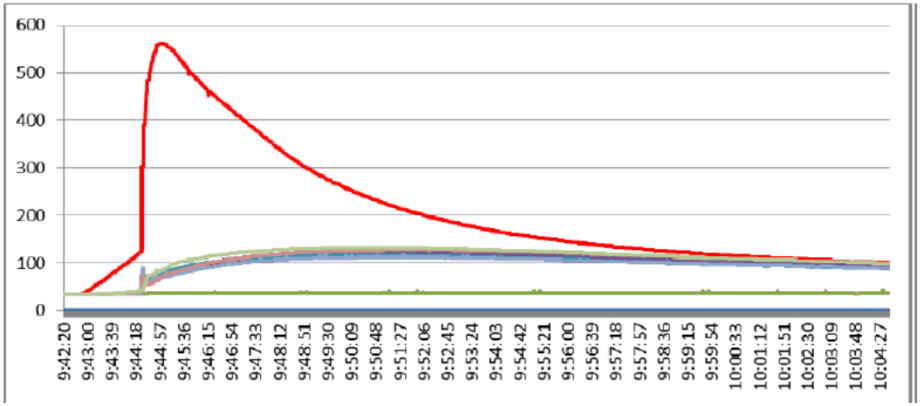
•“No fire or explosion within certain period of time after the initial thermal event” will ensure the time required for evacuation in general. (c.f. “1 hour observation period” is applied for other tests in current GTR draft.)

Thermal propagation test done-module level

(China side)



Heat the cell with resistive wire.



Thermal runaway of the cell happened 2 minutes later with the max. temp. of 565 ^{o}C.

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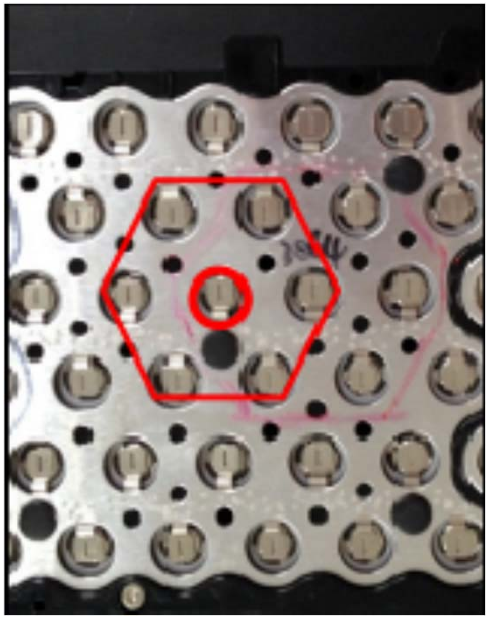
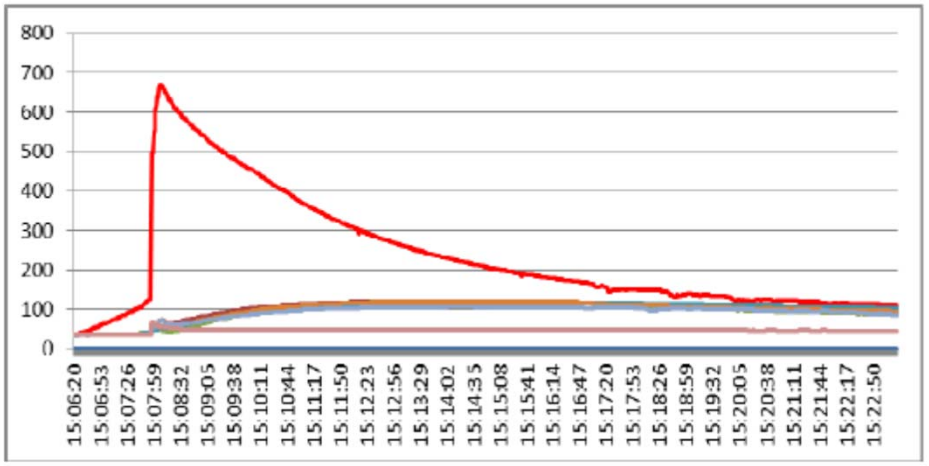
Thermal propagation test done-pack level

(China side)





Thermal runaway of the cell happened 1.5 minutes later with the max. temp. of 668 ^{o}C.

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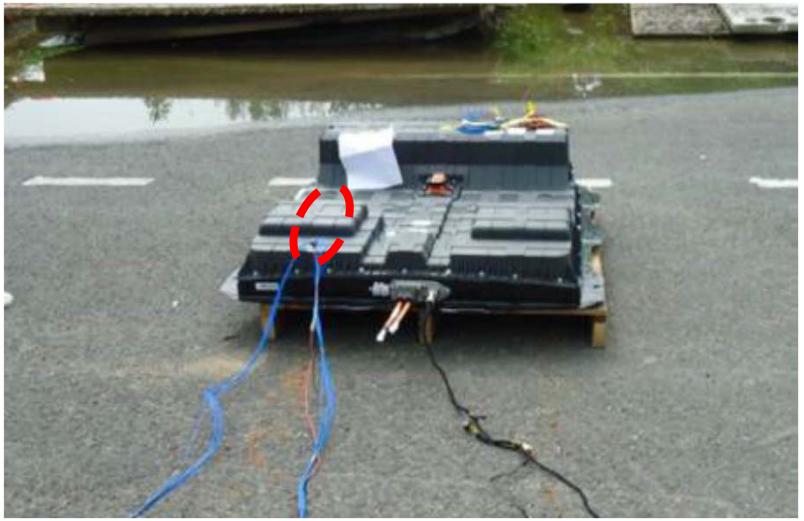
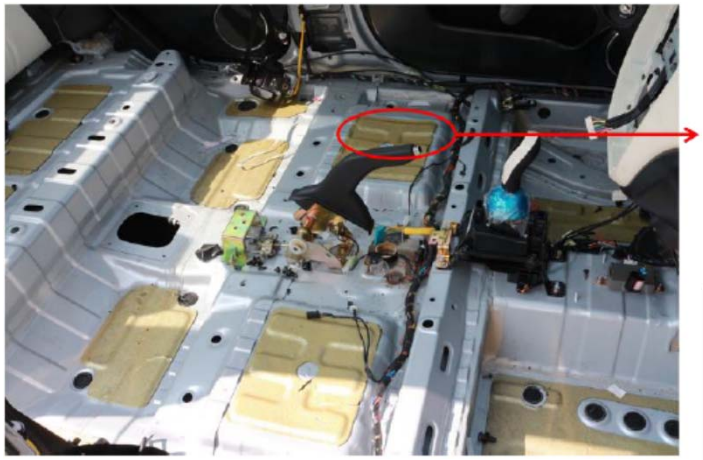
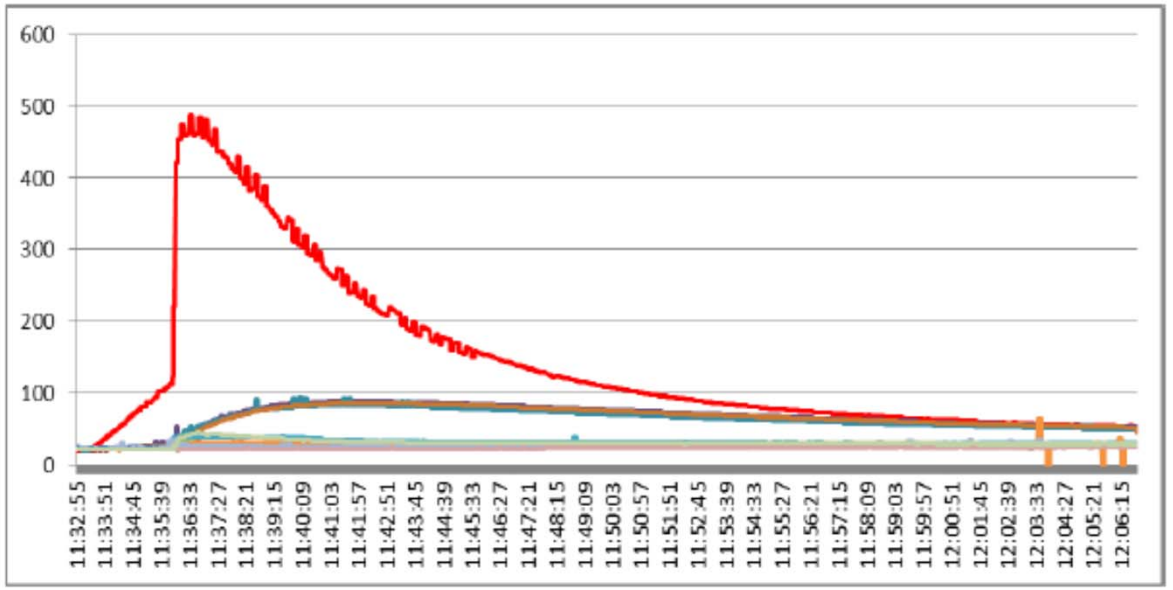


Thermal propagation test done-vehicle level

(China side)



Position of thermal runaway cell



Thermal runaway of the cell happened 3 minutes later with the max. temp. of 487 ^{o}C.

Proposed method on thermal propagation test

- Let one cell thermal runaway to see if the battery pack can keep the normal function for certain time before thermal propagation happens.
- To find an acceptable test method by parties to initiate the thermal runaway and propagation.
- Proposed test methods by relevant parties:

  Heat (a few methods), overcharge and nail penetration (partial and full)

Test Procedure and criteria of thermal propagation

Test procedure:

- Battery pack is fully charged;
- Heat a cell (surrounded by other cells) with resistive wire or heating plate until thermal runaway happening;
- Monitor for at least an hour.

Criteria:

- No fire, no explosion;
- Keep normal function for at least 5 minutes? (to be discussed)

Thanks !