NRC comments and questions in advance EVS19-E1TP-0600 JASIC

Dec 3-5, 2019 **19 EVS - GTR** **Berlin, Germany**

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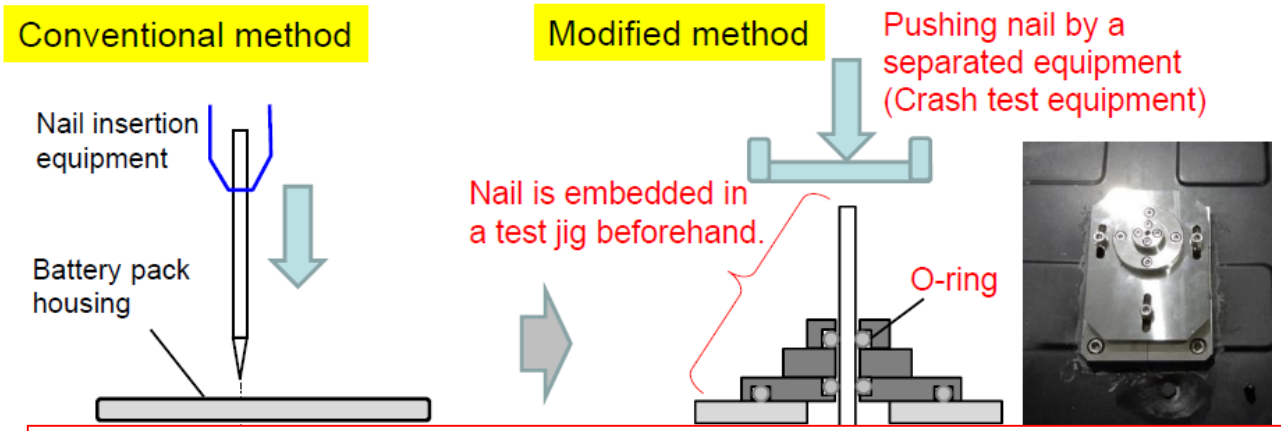
Comment:

1. On the previous slide, it states no modifications as an advantage. This seems like a significant modification which would involve engineering support from the battery supplier. Modules may also need to be predrilled, depending on their design and the target location/direction.



A vehicle manufacture may purchase battery modules from a module supplier and assemble a battery pack according to its own design. In this case, the battery pack can be modified by the vehicle manufacture easily without getting help from the module supplier. It is a great benefit for vehicle manufactures to conduct tests.

In many cases, nails can penetrate resin parts. However, in some cases, predrilling of modules may be necessary. It may be possible without getting help from the module supplier.

Questions:

2. Nail penetration direction appears to be downward from the top of the pack. How could this approach be applied at the vehicle level? What if a pack design has cells which are oriented such that up/down is parallel to the electrodes?

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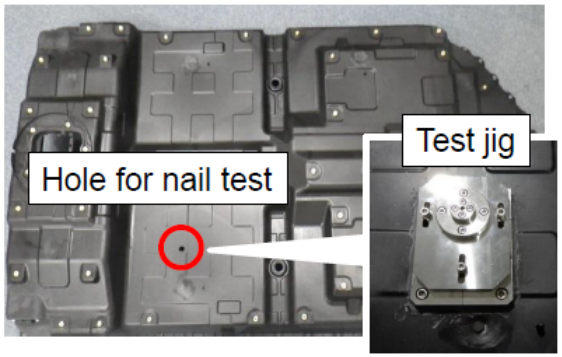
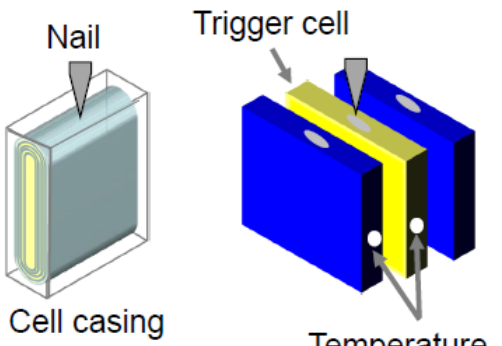
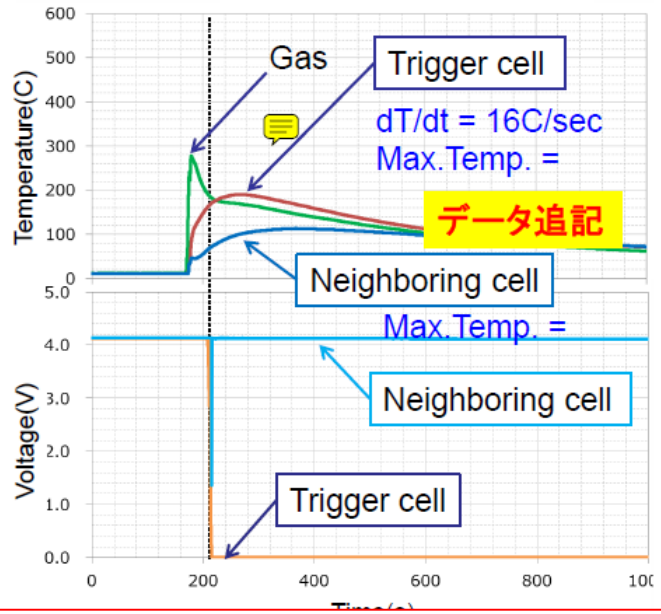
■ Test setting and results





Test condition

- Nail material : Steel
- Diameter : 3 mm
- Tip angle : 30 degree
- Neil speed : 5 mm/sec



Nail penetration direction needs to be vertical to the electrodes. Nail penetration in a horizontal direction is necessary depending on situations.
Depending on the pack or vehicle design, the nail method may not be feasible.

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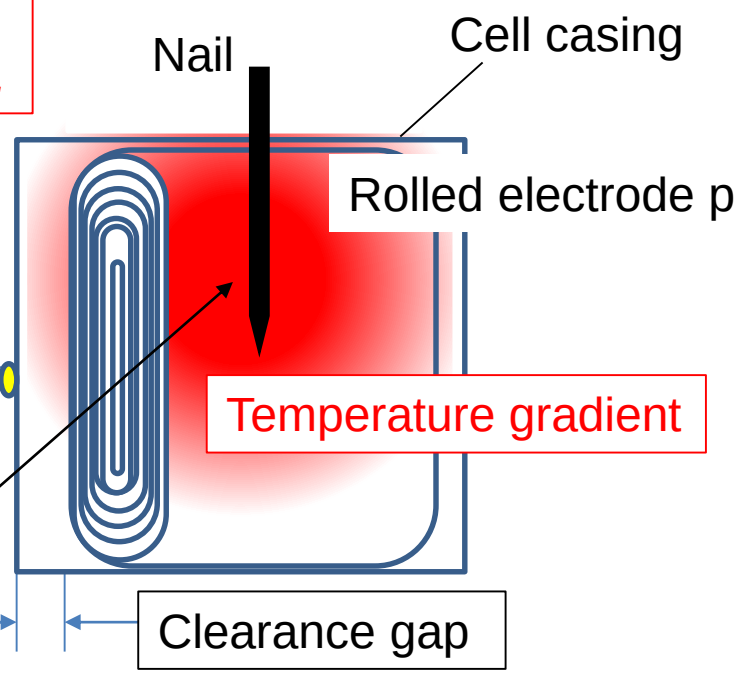
3. From the graph, the peak temperature of the trigger cell appears to be 200C. Can you please explain why this value is so low?

Probable cause of the low peak temperature
→ A clearance gap and a temperature gradient.



Temperature measurement point

Max.Temp. = 190 C
dT/dt = 16 C/sec

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Cell thermal runaway occurs.

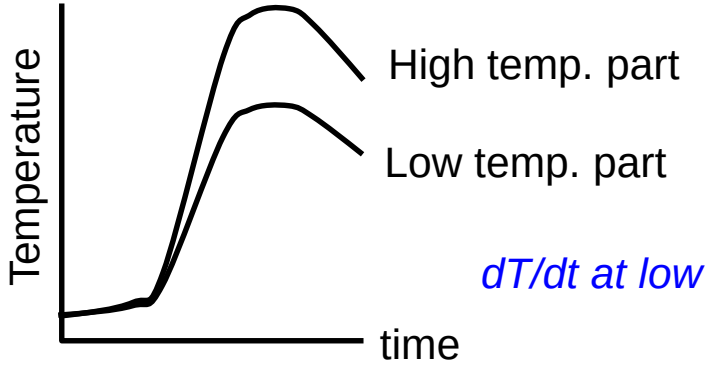
⇩

<Presumption>
Temp. inside electrodes > around 250 C

⇧

Onset temperature for thermal decomposition of positive electrode

<Additional comment>



dT/dt at high temp. part > dT/dt at low temp. part

⇩

dT/dt at low temp. part is also valid for pass/fail judgement of initiation.

Comment:

- It is best practice to remove a small volume of resin parts in the immediate area around the heating element to avoid this issue.

Question:

4. Can you please share experience of performing nail tests on thin prismatic cells in a pack assembly? Based on the previous slide, the nail direction options will be limited to predrilling or puncturing these resin parts and only end cells are suitable targets. From our experience during nail tests, cells will vent hot ejecta in the direction of the puncture (side wall rupture), which influences thermal propagation performance.

Modification to remove resin parts from a module is practical approach. However, a help from a module supplier is indispensable.

We have an experience of nail tests for thin prismatic cells with 12.5mm in width. There was no need to aim at the end cells.

We do not have any information about the impact on thermal propagation performance by hot ejection from sidewall rupture. Could you show us your test data?
From our experience, the hot injection is mainly released from a cell vent even if a nail is pricked at different places.
Nail prick to a vent of a cell may be a good approach, if the hot ejection from a nail hole has an impact on test results.