

TP test experience and proposals

China

March 2022

1、 The implementation experience of TP test in China

The implementation experience in China

- **China's mandatory traction battery standard (GB 38031-2020) includes thermal propagation test requirements in coordination with GTR 20 Phase 1, which has been enforced for more than a year. According to the verification test in the drafting process and the feedback after implementation, the current thermal propagation test method is basically enforceable and repeatable for various types of RESS.**
- **The standard allows manufacturers to choose the vehicle level or component level test, and we have the test experience both at the vehicle level and component level tests. However, according to the feedback of several test agencies, all mandatory tests are carried out at the component level so far.**

2、 Comparison of component level with vehicle level in TP test

Comparison of component level with vehicle level in TP test

Consensus in the previous discussion

- Compared with vehicle level test, component-level test is easier to implement for test agencies, and the difficulty of sample preparation and overall cost are lower.
- There have been relatively mature method for component level test which has been discussed for a long time (EVS-GTR and ISO 6469-1 AMD)
- Even with further research, the complete equivalence of the two methods couldn't be achieved due to the different objects of the component test and the vehicle test.
- If the set judgment criteria are consistent with the vehicle level, the component-level test is more stringent than the vehicle level

3、 Test procedure and important conditions

3.1 General conditions

EVS-GTR phase1 [rationale]:

- ❑ 23B.3.1.General test conditions
- ❑ The following condition shall apply to the test:
- ❑ (a) The test shall be conducted at temperature: $25 \pm 2^{\circ}\text{C}$;

■ Note

- The test may be carried out in an outdoor or semi-outdoor environment.
- Suggestions on monitored temperature points: all temperature points monitored by the battery pack BMS (except those arranged on the battery pack shell) shall meet the requirements.
- For the selection of the ambient and battery temperatures, we are pleased to listen to other suggestions.

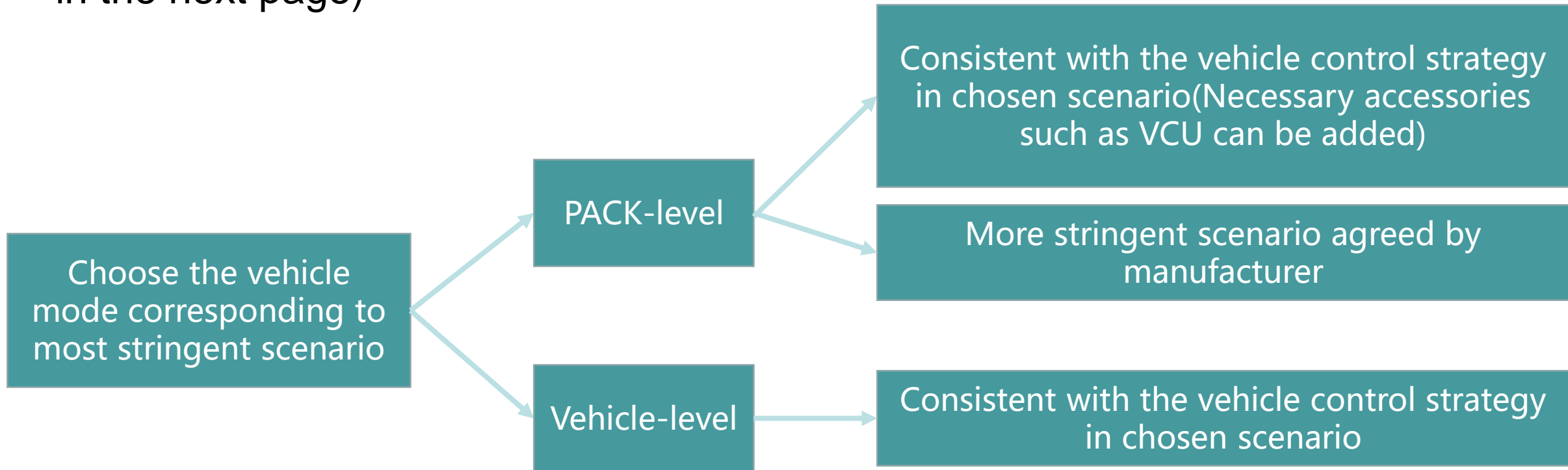
Proposal:

- ❑ Ambient temperature: The test shall be conducted at temperature 0 to 40°C.
- ❑ Battery temperature: Maintain the RESS temperature between 18 °C to maximum permissible operating temperature

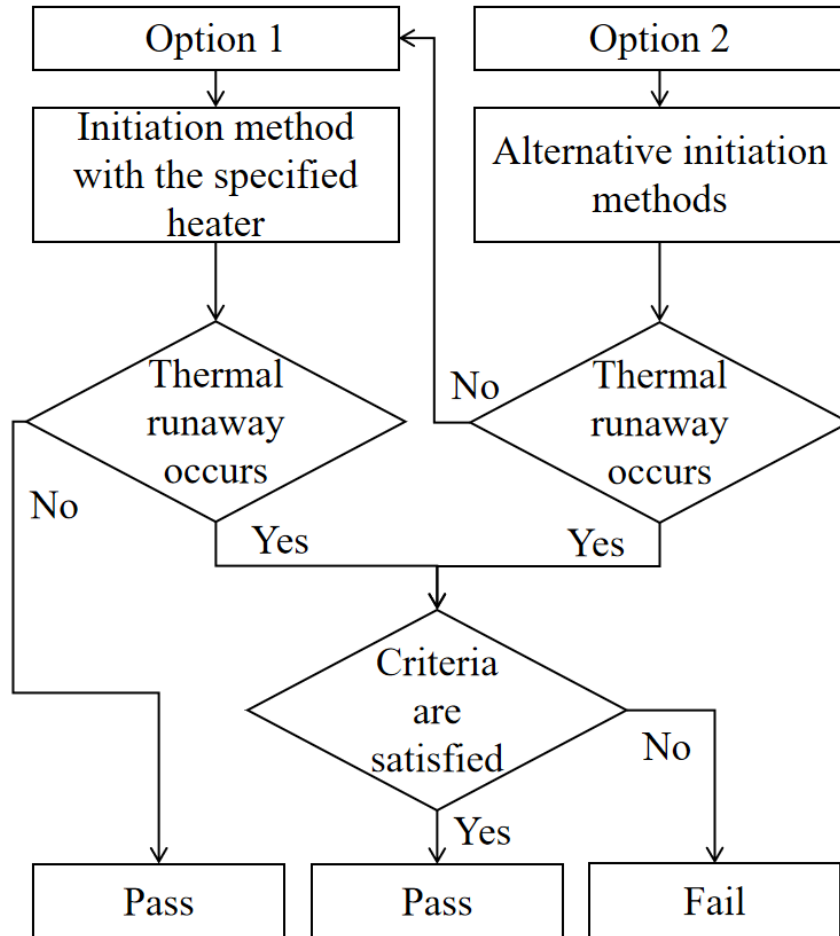
3.2 Test modes

Proposal :

- need to investigate all possible modes but select most stringent mode(example in the next page)

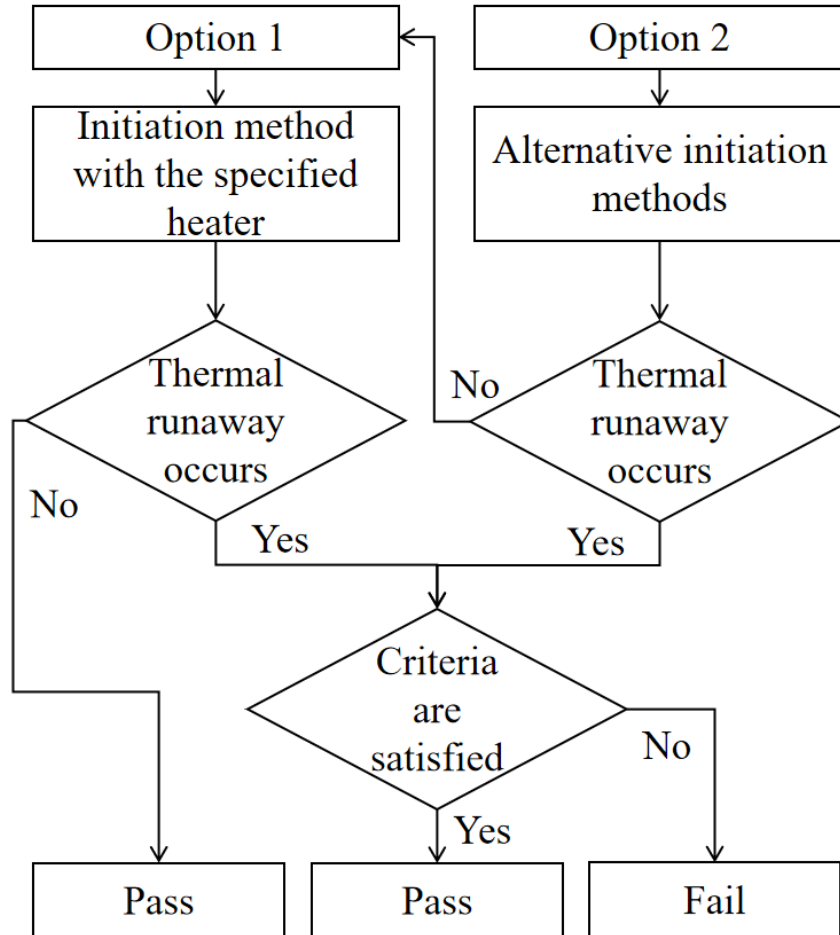


3.3 Initiation methods



- When it is ensured that the thermal runaway of the cell can be triggered, other initiation methods other than that specified in the standard can be used as alternative initiation methods.
- If the alternative initiation method cannot trigger TR, the external heating specified in the standard must be used as the initiation method.
- When the external heating specified in the standard is used to trigger TR, If the measured temperature is over 300°C and lasts more than **10 minutes**, there is still no thermal runaway. It can be determined that the cell does not have thermal runaway.

3.3 Initiation methods



- ❑ Power-off condition is very important and our proposal is based on China's experience. We also open to other options.
- ❑ Should certain restrictions be given for alternative initiation method? Such as referring to existing standards, such as ISO 6469-1 AMD or IEC 62660?

3.4 Detection of TR

23B.3.3. Detection of thermal runaway. Thermal runaway can be detected by the following conditions:

- (i) The measured voltage of the initiation cell drops **to below 75% of initial value**
- (ii) The measured temperature exceeds [the maximum operating temperature defined by the manufacturer];
- (iii) $dT/dt \geq [1 \text{ } ^\circ\text{C/s}]$ of the measured temperature.

Thermal runaway can be judged when:

Both (i) and (iii) are detected;

Or Both (ii) and (iii) are detected **and - Voltage drop or Fire or Venting gas or smoke or Occurrence of ejected solid material.**

If the sample is small or the monitored temperature is close to the heating plate, dT/dt caused by excessive heating power may exceed $1 \text{ } ^\circ\text{C} / \text{s}$ and the temperature exceed the maximum operating temperature (Such as 90°C), but the cell does not really thermal runaway.

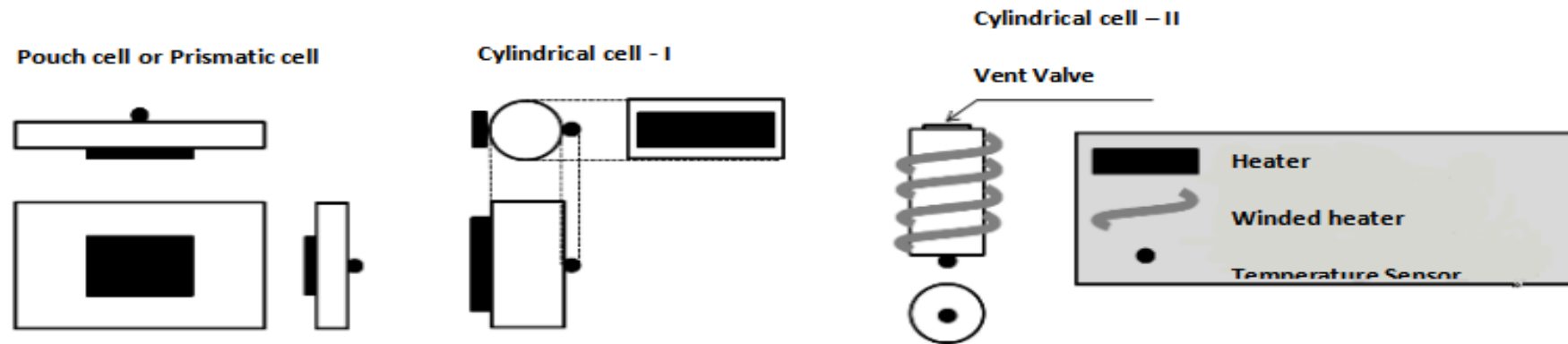
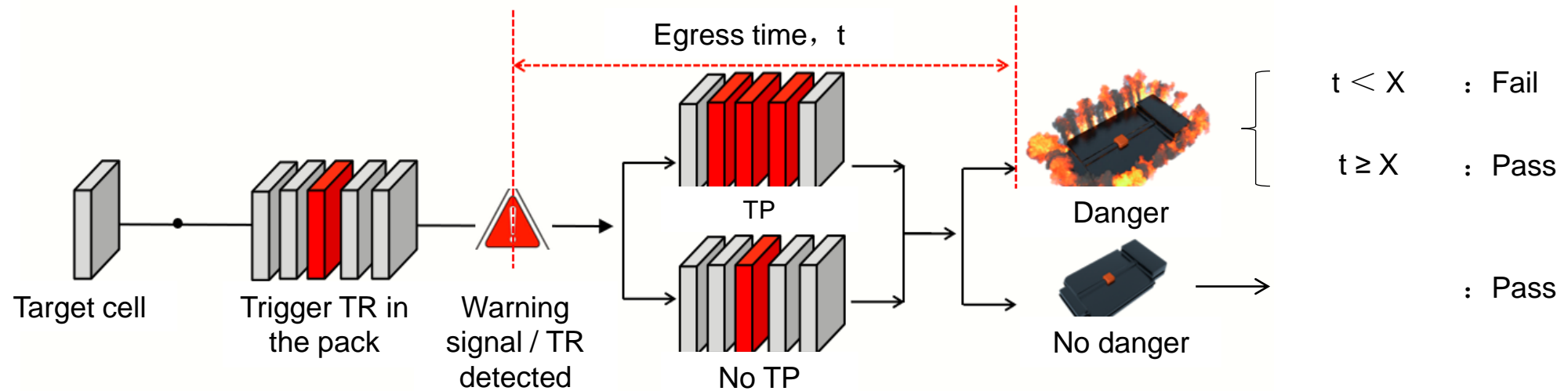


Fig. XX Example of set positions of heater and temperature sensor in external heating

3.5 Pass/fail criteria



Note:

- Choose the shorter one of the two situation (Warning signal \rightarrow Danger, TR detected \rightarrow Danger) as the egress time. This is to avoid the possible cheating caused by the failure of TR triggering or the continuous heating after the REESS sends out the warning signal.
- X is the necessary egress time.

Criteria of TP test

- The most important problem is the definition of hazards.
- Fire, explosion, smoke.....?
- As the current research and data on smoke are insufficient and can not support the formulation of standards, **it is suggested to only keep the external fire and explosion as the definition of hazards. It can be adjusted and supplemented when the relevant research is mature.**

Thank You