Thermal propagation round robin test

Technical aspects

Report to GTR EVS IWG from CA, CN, EU, KR

26th GTR EVS IWG meeting
April 18-20, 2023

Car model

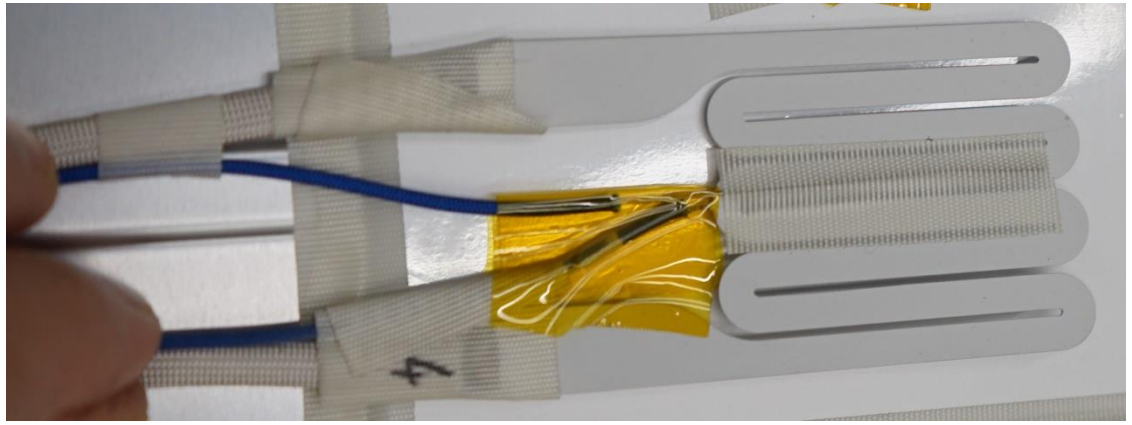
Vehicle X

	Model	Single factory?	Battery capacity [kWh]	Type of cells	Cathode chemistry
	Vehicle X	YES (China)	78	Pouch (LG Chem) Metal can prismatic (CATL)	NMC

CA: LG Chem cells (to be confirmed), long range, single motor, MY2022
EU: LG Chem or CATL cells (to be confirmed), long range, single or dual motor, MY 2023
KR: LG Chem cells, long range, single motor, MY 2022
CN: LG Chem cells, long range, single motor, MY to be confirmed (2021?)

Vehicle X is not available in Japan

Initiation method



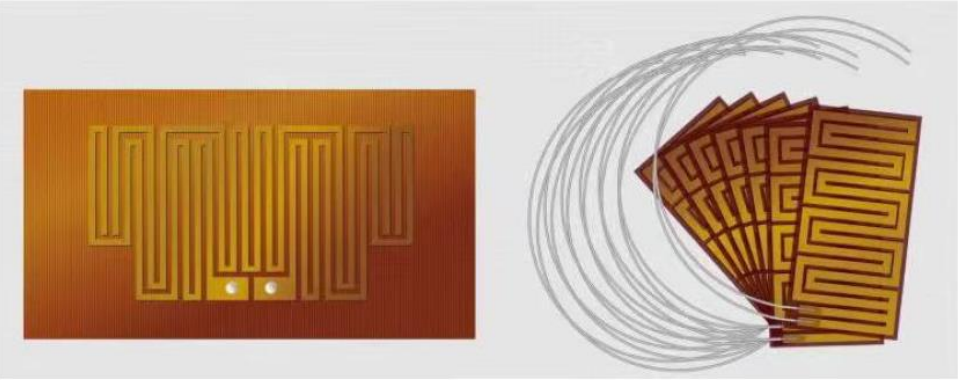
"Apparatus and Method for initiating Thermal Runaway in a Battery" with application date of January 18, 2018. PCT/CA2018/050055

The approach proposed:

- Localised rapid external heating
- V5 elements developed by NRC Canada
  - Active heating area: 39 mm x 55 mm (21.5 cm^2)
  - Thickness of the element: 0.7 mm
  - Thickness of connections: 0.7 mm
- Temperature controller to track the temperature/time profile via closed loop control
- CA can provide equipment to KR

Initiation method

- CN: plans to use a different heater

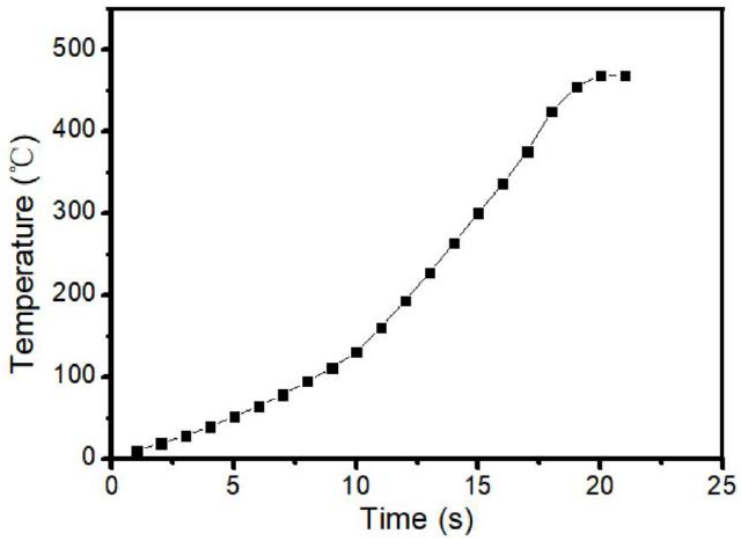


Thickness:~0.2mm

Weight: ~0.04 g/cm^2

Resistance:~50 Ω/cm^2

Power density:Determined by use conditions



Surface area: ca. 70 cm^2, adjustable
Heating power: 500W constant power heating program (7.1 W/cm^2)

Initiation parameters

- Initiation cell (option: a back-up cell)
  - CA, CN, EU and KR – agree to use the same initiation cell; no need for back-up
- "How to" install the heater – advice on conductive paste, thermal barriers, etc.
  - To coordinate with CA and EU, once heaters to be used are agreed
- Heating programme – 20°C/s up to 500°C, soak time 4 min, then move to 900°C
  - Allows not to exceed 20% of the cell's energy
  - CA, EU, KR agree on the heating programme
    CN plans to use 500 W constant power heating

Instrumentation

Minimum requirements - Pack

- Temperature:
  - heater (control + independent measurement on the heater surface),
  - front face and back face of the initiation cell (x2 for redundancy),
  - adjacent cells on the heater side
- Voltage
  - Initiation cell
  - Adjacent cells in the initiation module
  - All modules in the pack
- Pressure
  - sensor in the pack with pressure range 0-1 bar(g), specs can be shared by CA and EU

** instruction on thermocouple installation – CA, EU*

Agreed by CA, CN, EU and KR

European Commission

Instrumentation

Minimum requirements - Car

- Temperature:
  - In the cabin – driver head rest, ceiling midpoint, service disconnect of the pack
  - Pack exterior (upper side close to initiation cell, close to the vent)

- Video footage:
  - External to the car
  - In the cabin for visual observation
  - In the cabin for warning signals on the dashboard and gas meters

- Gas and smoke monitoring equipment
  - In the cabin – multi gas meters (CO, LEL/CH_4, O_2) at the driver's seat
  - Suggestion CN - PM2.5 sensor

Agreed by CA, CN, EU and KR

Instrumentation

Optional requirements - Pack

- Temperature:
  - Additional cells/modules in the pack
- Video footage:
  - In the pack, with e.g. boroscope camera
- “Thermal runaway” sensors
- Pressure sensor
  - Different range 0-5 bar(g) at a different location

Additional elements can be installed AS LONG AS they do not interfere with the test

Agreed by CA, CN, EU and KR

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Instrumentation

Optional requirements - Car

- Temperature:
  - At other locations
- IR video footage
- Gas emissions analysis
  - FTIR, GC, other methods

Additional elements can be installed AS LONG AS they do not interfere with the test

Agreed by CA, CN, EU and KR

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Vehicle conditions

- Factory new vehicle to be tested by CA, EU and CN
  KR crash-tested vehicle without errors, properly functioning systems, cabin intact (gas tightness unaffected)
- Battery pack fully charged
- Vehicle to be placed in park, drive-ready, mode
- Accessories to be “on”
- OBD data collection is possible (CA to advice)
- Windows closed
- Duct (gas tight) to feedthrough wires
- Wheels/tires removed (recommended)

Agreed by CA, CN, EU and KR

Environmental conditions

- Battery pack temperature shall be maintained between 18 °C to maximum permissible operating temperature, defined by the manufacturer.
- The test shall be conducted either indoors or outdoors. In case of outdoor testing there shall be no precipitation for the duration of the test. Immediately prior to the test commencing, wind speed shall be measured at a location which is no more than 5 m from the DUT and the average wind speed over 10 min shall be less than 28 km/h. Gusts shall not exceed 36 km/h when measured over a period of 20 s.
- Relative humidity of 10% to 90%
- Atmospheric pressure of 86 kPa to 106 kPa.

Agreed by CA, CN, EU and KR

Test conditions

- No fire suppression for at least 5 minutes after the warning to the driver

Agreed by CA, CN, EU and KR

Test outcomes to compare among participants

- TR initiation – Y/N
  - T profile of initiation cell (if the same heaters are used by all participants)
  - Power profile of Heater (if the same heaters are used by all participants)
  - Initiation cell voltage (if possible)
- Propagation Y/N
- Cabin tenable at 5 min after warning Y/N
- Car warnings to the driver Y/N
  - Timing

Agreed by CA, CN, EU and KR

Time frame

- It is aimed at completing the tests by September/October 2023

Agreed by CA, CN, EU and KR

Thank you

European Commission