



JRC questions to SIGTP-02-18

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Stockholm, Sweden

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Typical Specification of Battery Pack and Cell for xEV

shared at the last meeting

	BEV/PHEV	HEV	
Cell capacity (Ah)	50- 200	3-5	Cell capacity and specific energy is much less than one of BEV/PHEV.
Cell specific energy (Wh/kg)	> 200	<100	
Battery pack energy (kWh)	10 ~ 120	0.5~1.5	Battery pack energy of HEV is extremely low compared to one of BEV/PHEV.
Weight (kg)	100~600	20~50	
External charging	Applied	Not Applied	

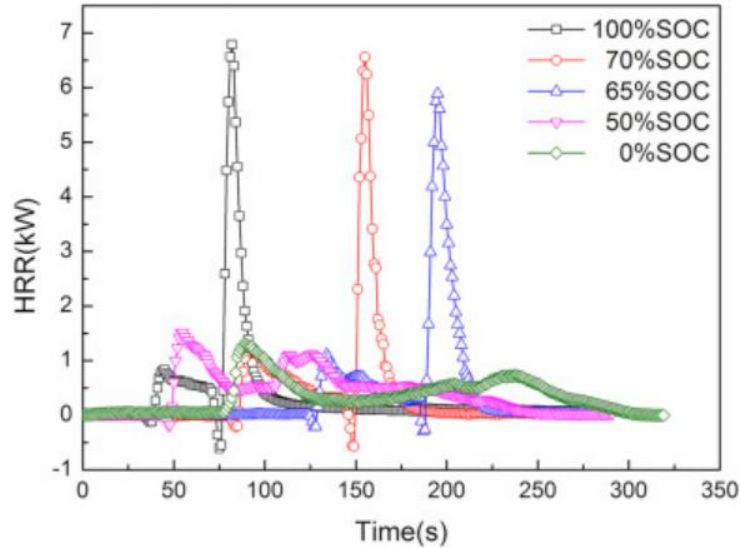
Literature data, collected by JRC, shows that:

- Ranges for cell capacity and cell specific energy for HEV and BEV/PHEV vehicles are similar
- Battery pack energy and weight for BEV/PHEV and HEV differ (less than) a factor of two
- Battery packs in both cases are high voltage systems

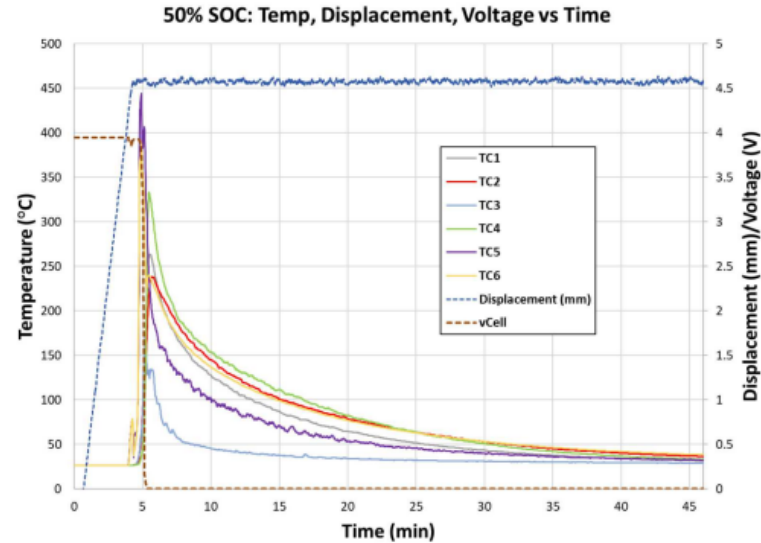
	BEV/PHEV	HEV	Reference
Cell capacity (Ah)	> 3	3 to 40	https://www.sciencedirect.com/science/article/pii/S0378775316300015#bib3 https://cleantechnica.com/2019/01/28/tesla-model-3-battery-pack-cell-teardown-highlights-performance-improvements/ https://www.batterydesign.net/lucid-motors/ https://www.nomura.com/europe/resources/upload/So_near_and_yet_so_far.pdf
Cell specific energy (Wh/kg)	110 to 250	60 to 90	https://www.nomura.com/europe/resources/upload/So_near_and_yet_so_far.pdf https://nap.nationalacademies.org/read/26092/chapter/7#85
Battery pack energy (kWh)	> 5	< 2	Y.S.Wong et al, <i>Vehicle Energy Storage : Batteries</i> , Encyclopedia of Sustainability Science and Technology pp 11502–11522, 2012
Weight (kg)	> 100	< 70	https://www.fiches-auto.fr/articles-auto/voiture-hybride/s-2397-hybride-hev-phev-differences-et-fonctionnement.php
Battery pack voltage (V)	> 200	> 200	Y.S.Wong et al, <i>Vehicle Energy Storage : Batteries</i> , Encyclopedia of Sustainability Science and Technology pp 11502–11522, 2012 https://www.fiches-auto.fr/articles-auto/voiture-hybride/s-2397-hybride-hev-phev-differences-et-fonctionnement.php

Thermal runaway can occur in cells with intermediate SOC with low energy input (nail)

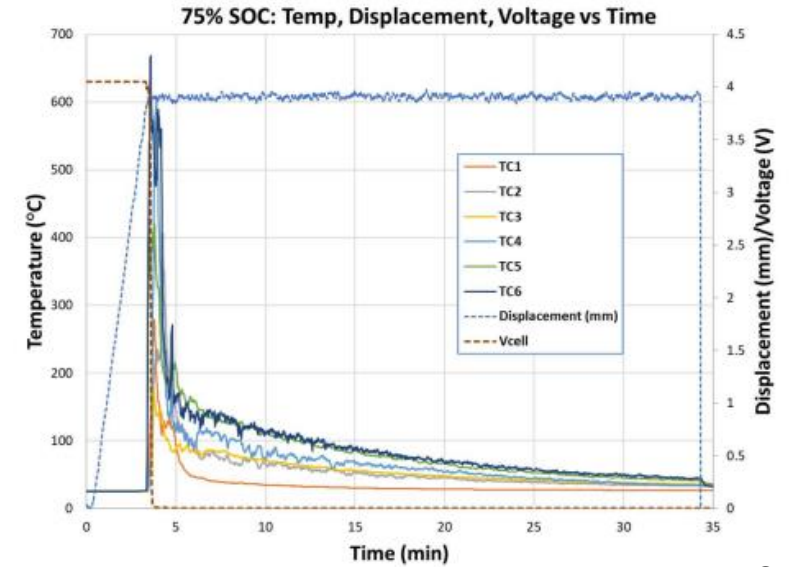
Effect of the SOC on heat release rate and cell temperature



Heping Zhang et al, An experimental study on burning behaviors of 18650 lithium ion batteries using a cone calorimeter, Journal of Power Sources, 2015



Thermal runaway event, max temp = 444.6°C



Thermal runaway event, max temp = 668.3°C

<https://www.osti.gov/servlets/purl/1770276>

The probability of TR propagation is the highest at SOC values in the range of 40% to 60%.

Yun Yang et al, Characteristics of and factors influencing thermal runaway propagation in lithium-ion battery packs, Journal of Energy Storage, 2021

Small cells can reach high temperature during thermal runaway

Wh	Peak runaway temperature (°C)	Material
3,5	271	LFP
8,3	348	LFP
8,3	331	LFP
7,1	651	NCA
10,7	765	NCA
14,3	682	NCA
12,8	238	LMO

Yuliya Preger et al, Investigating the Role of Energy Density in Thermal Runaway of Lithium-Ion Batteries with Accelerating Rate Calorimetry, Journal of The Electrochemical Society, 2021

Fire accidents with HEVs

Toyota Camry hybrid car fire in New Philadelphia ended in a series of explosions, 2022

“The driver, Debby Bair, of New Philadelphia, said she heard a loud pop as she was driving so she pulled her car into the parking lot...to investigate. New Philadelphia Auxiliary Police Officer Wendy Jones said there were flames already coming from the bottom of the Toyota Camry by the time Bair was able to stop and get out of the car.

New Philadelphia Fire Capt. Robert Snyder said firefighters and the department's brand new Engine No. 2101 narrowly escaped shrapnel from the series of explosions that followed. Snyder said putting out the fire was complicated by the fact the vehicle was a hybrid and its batteries exploded as flames consumed the vehicle.”

<https://eu.timesreporter.com/story/news/2022/08/27/new-philadelphia-firefighters-battle-explosive-hybrid-car-fire-friday-night-toyota-camry-hybrid/65459737007/>

A driving Kia Optima Hybrid spontaneously caught fire, USA 2018

“...after a careful review Kia said it was ‘unable to determine exact cause of the fire.’ ”

<https://www.nbcdfw.com/news/local/denton-woman-says-kia-wont-reimburse-her-after-car-catches-fire/268571/>

Une voiture hybride prend feu sur la route

DS 5, a Citroën hybrid, suddenly gives off a burning smell in the cabin, France 2023

“Pour l’heure, l’origine du feu sur cette voiture hybride n’est pas connue. ”

<https://www.ledauphine.com/faits-divers-justice/2023/09/11/une-voiture-hybride-prend-feu-sur-la-route>

Thank you



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