

热箱试验 oven test

- 热箱试验理由 Foundations of oven test
- 现有标准-Existing standards
- 一些试验验证 some test and analysis
- 试验规程 procedure of oven test

热箱130°C Heating test 130°C

QC/T 413-2002 《汽车电气设备基本技术条件》

QC/T 413-2002 *The Basic Technical Conditions of Electrical Equipment for Cars*

产品安装部位 Installation Site	下限工作温度 Lowest Working Temp.	下限贮存温度 Lowest Storage Temp.	上限工作温度 Highest Working Temp.	上限贮存温度 Highest Storage Temp.
装在发动机上的产品 Mounted on the engine			120; 115; 100	130; 115; 100
装在发动机罩下或受日光照射的产品 Under the engine cover / Exposure to the sun	-40 -30 -20	-40 ^a -30 ^b	85; 70	95; 80
装在其他部位的产品 Other site			65; 55	75; 65

a 对应于-40及-30下限工作温度时的下限贮存温度。

a corresponding to Lowest Working Temp. at -40/-30°C

b 对应于-20下限工作温度时的下限贮存温度。

b corresponding to Lowest Working Temp. at -20°C



当部分电池发生安全事故时，该电池周围的电池受到高温烘烤

When some battery safety issues happen, others besides them will endure high temperature

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☀ 热箱试验属于热稳定性的安全滥用试验而非一般可靠性试验，所以并不仅仅从应用环境温度角度考虑，还应该从电池本身热稳定性可能存在问题的关键因素出发考虑。

Oven test is not the normal reliability test, but also the safety/abuse test. Besides considering the environment temperature, more attention should be paid to the key factors for battery thermal stability.

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130°C左右，一方面负极SEI开始分解，放热反应开始，这是电池热失控的初始反应，热量开始累积，达到一定程度时会引起一系列反应，从而导致热失控。另一方面，该温度附近，隔膜开始熔断，电池发生内短路等风险增加。

At about 130°C, SEI start to decompose and exothermic reaction begin. Thermo runaway will probably happen with the heat accumulation. On the other hand, the separator start to melt at about 130°C, which lead to higher short circuit risk.

Energy of main reactions for lithium-ion accumulator measured by DSC

	Temperature range (°C)	Reaction	Energy (J/g)	Comment
1	110-150	$\text{Li}_x\text{C}_6 + \text{electrolyte}$	350	Rupture of passivation layer
2	130-180	Fusion separator P.E.	-190	Endothermic

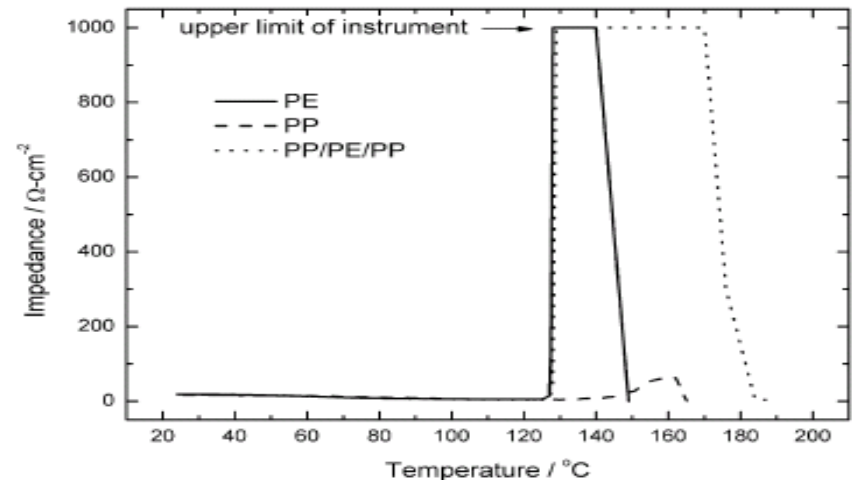
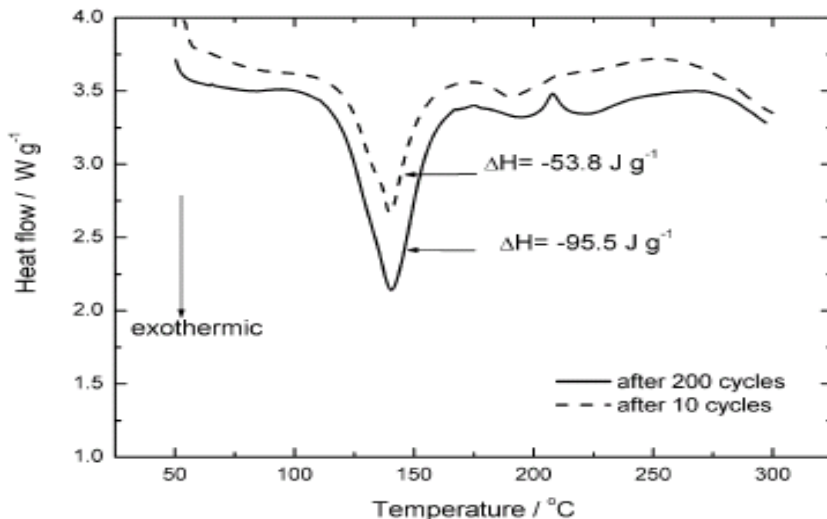


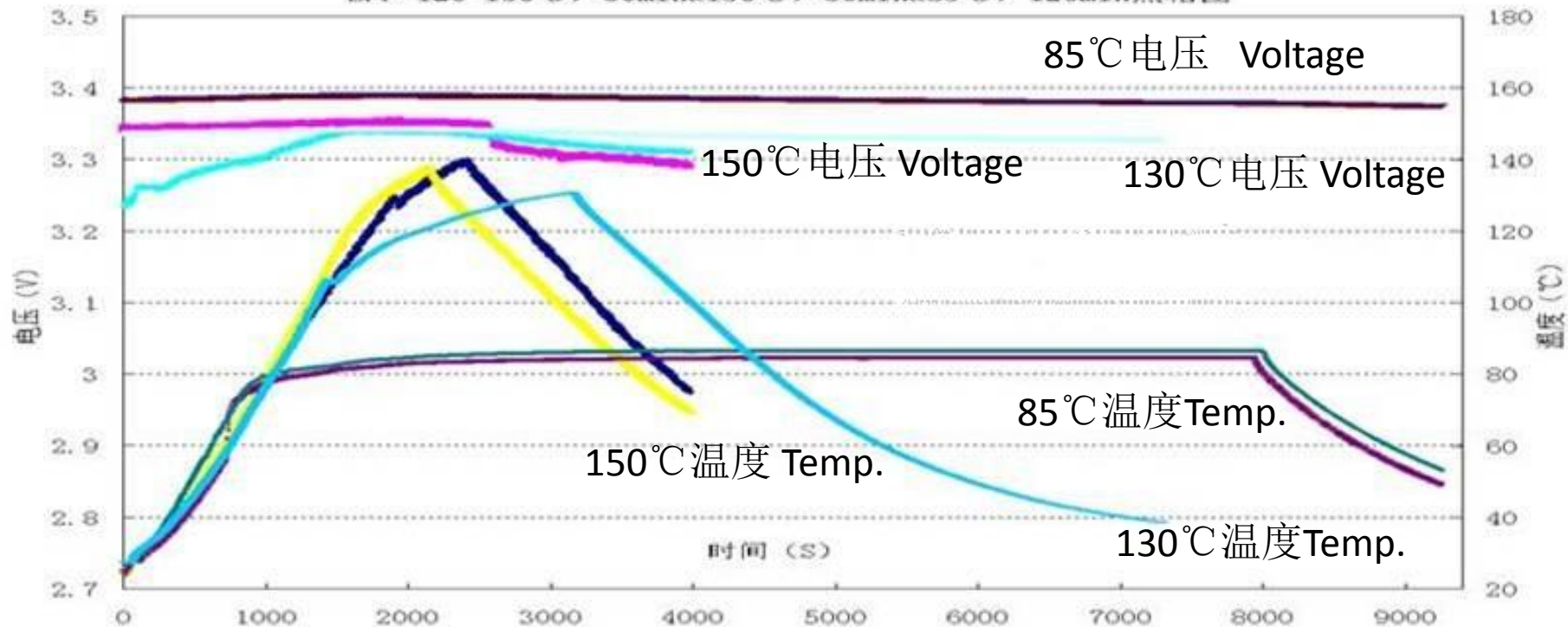
Fig. 4. Impedance of different separators vs. temperature.

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（目前三个标准中有类似测试：UL1642 Environmental Test - Heating Test、IEC62660 Reliability and abuse tests - High temperature endurance、SAE J2464 Thermal Abuse Test – Thermal Stability Test）

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LFP-120-130°C, 30min&150°C, 30min&85°C, 120min热箱图



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Test procedure:

- a) battery is full charged
- b) Put the battery into the temperature chamber, rise the temperature to $130^{\circ}\text{C} \pm 2^{\circ}\text{C}$, and keep for 30min. The rate of temperature rising is $5^{\circ}\text{C}/\text{min}$
- c) 1h Observation

Requirement: No explosion, no fire.