

塔菲尔初心——  
做更专业的中国“芯”

# Introduction of Tafel 150Ah Cell

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2018-8



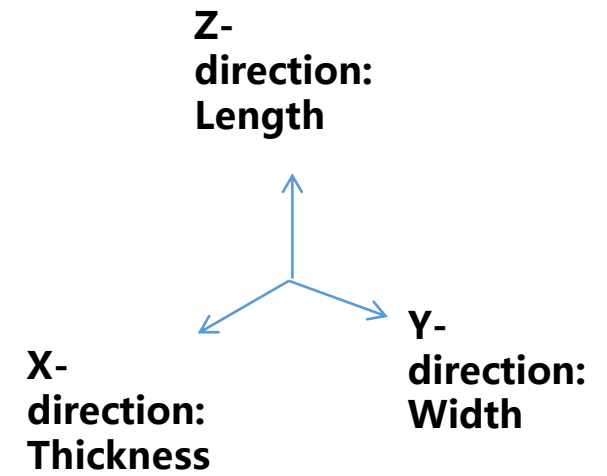
**TAFEL**  
TAFEL New Energy Technology

衡即动力 衡有动力  
BALANCE IS ENERGY POWER FROM ETERNITY

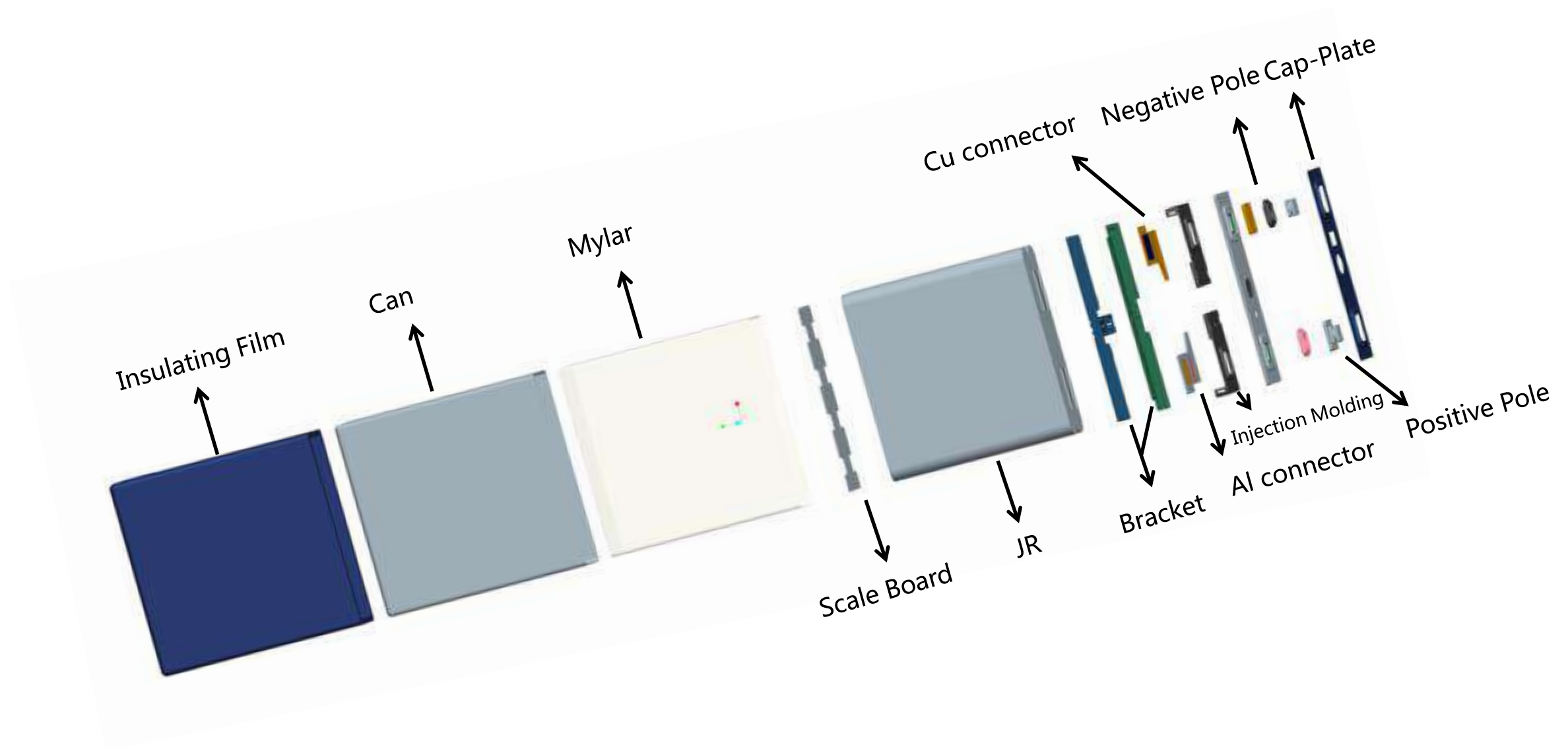
内部文件，请注意保密

- ❑ Cell Appearance
- ❑ Basic information
- ❑ Mechanical Design
- ❑ Electrochemistry Design
- ❑ Safety Design
- ❑ Cell Performance

# Cell Appearance



# Mechanical Design



# Electrochemistry Design

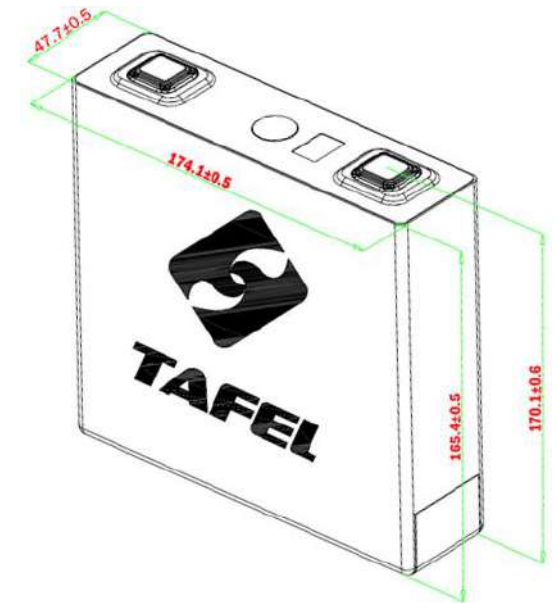
| Design Items |                  | 150Ah                         |
|--------------|------------------|-------------------------------|
| Cathode      | Active Material  | LiFePO <sub>4</sub>           |
|              | Conducting Agent | Super-P                       |
|              | Binder           | PVDF                          |
|              | Substrate        | Al                            |
| Anode        | Active Material  | AG                            |
|              | Conducting Agent | Super-P                       |
|              | Binder           | SBR                           |
|              | Substrate        | Cu                            |
| Electrolyte  | Solvent, Salt    | EC/EMC/DEC, LiPF <sub>6</sub> |
|              | Additive         | Additive 1,2                  |
| Separator    | Type             | PE + Ceramic Layer,           |
| JR Design    | Number of JR     | 2                             |

# Safety Design

| Item                        |                                                             | Function Description                                                                                                                                       |
|-----------------------------|-------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Active Material             | LiFePO <sub>4</sub>                                         | Adoption of thermally stable LFP                                                                                                                           |
| Separator                   | Ceramic coating on PE layer                                 | High thermal resistance by ceramic layer (Al <sub>2</sub> O <sub>3</sub> )<br>Shut-down of PE blocks overcharge current (PE)<br>Good Mechanical Properties |
| Positive Polarity of Can    | Al housing is electronically connected to positive terminal | Prevent Al housing corrosion → No electrolyte leakage in long-term usage                                                                                   |
| Reliable Vent               | Al plate is laser welded on Cap-plate                       | Releasing inner gas outside of the cell housing                                                                                                            |
| Electrode Insulating Layer  | Ceramic coating on electrode edge                           | Prevent burr contacting with electrode film                                                                                                                |
| Insulating Ring and SC Ring | High temperature point                                      | Prevent electrolyte vapor escape from pole                                                                                                                 |
| Scale Board                 | At the bottom of JR                                         | Insulation and prevent JR deformation                                                                                                                      |

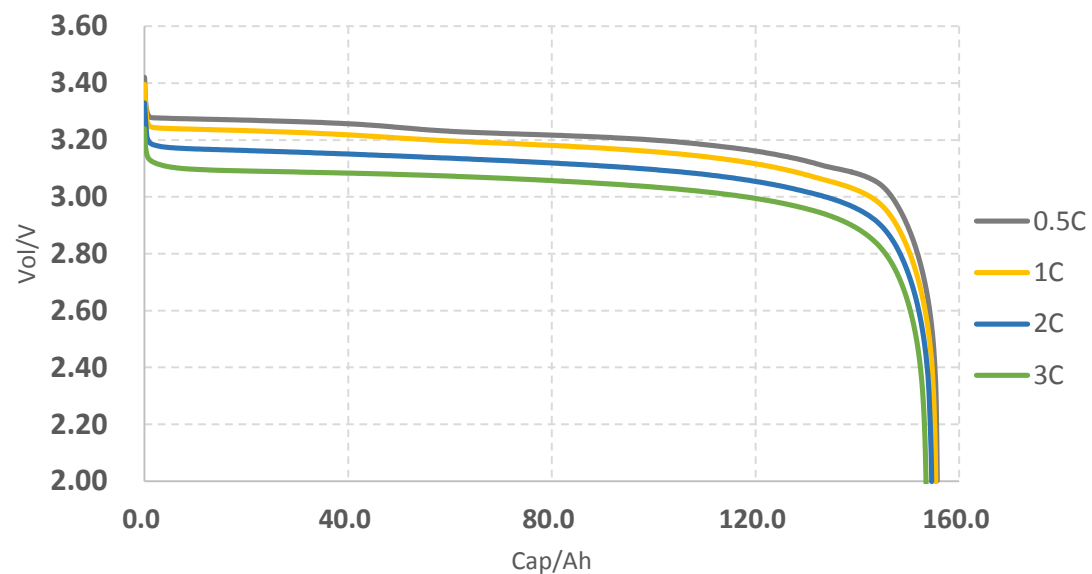
# Cell Performance

| Item              | Cell ID                                                   | F14                                           |
|-------------------|-----------------------------------------------------------|-----------------------------------------------|
| Energy Density    | Gravimetric (Wh/kg)                                       | 160                                           |
| Voltage (V)       | Nominal                                                   | 3.2                                           |
|                   | Max, Min                                                  | 3.65, 2.5                                     |
| Operation Current | Charge (C-rate/A, $\geq 25^{\circ}\text{C}$ ), Continuous | 1C/150A                                       |
|                   | Charge (C-rate/A, $\geq 25^{\circ}\text{C}$ ), Peak       | 3C/450A                                       |
|                   | Discharge (C-rate/A), Continuous                          | 1C/150A                                       |
|                   | Discharge (C-rate/A), Peak                                | 3C/450A                                       |
| Life              | Calendar Life (Year)                                      | 10                                            |
|                   | Storage Condition                                         | 100%SOC, $25^{\circ}\text{C}$                 |
|                   | Cycle Life (Cycle)                                        | 3500                                          |
|                   | Cycle Condition                                           | 100%DOD, 0.5C/1C                              |
| Temperature Range | Operation                                                 | $-30^{\circ}\text{C} \sim 60^{\circ}\text{C}$ |
|                   | Storage                                                   | $-40^{\circ}\text{C} \sim 60^{\circ}\text{C}$ |
| MP Date           |                                                           | 2018.Q3                                       |

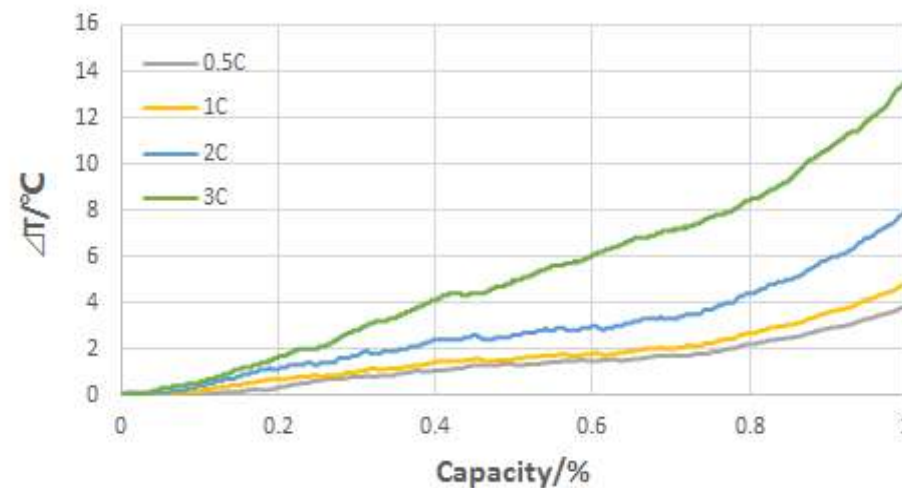


# Rate performance

Discharge Capacity at Different C-rate, 25oC

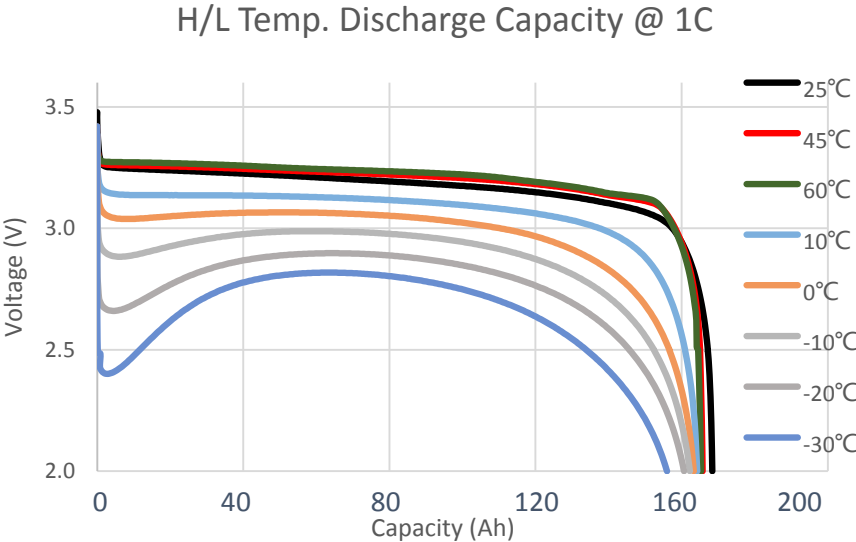
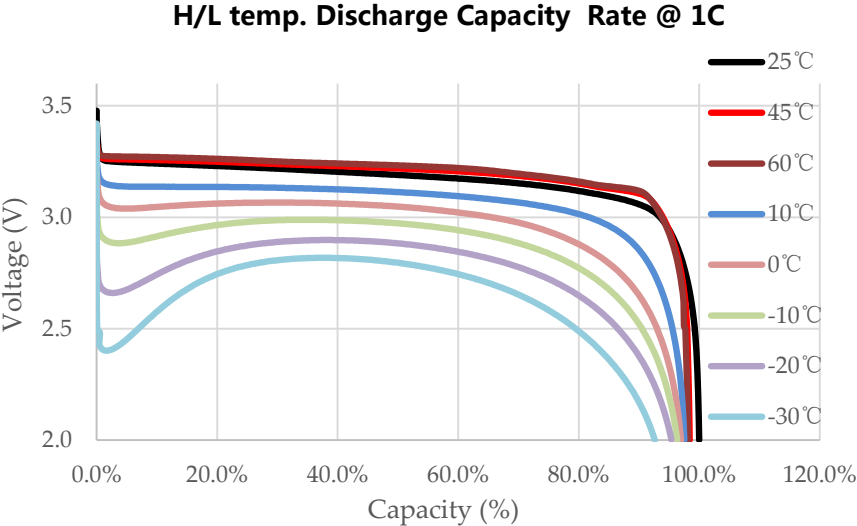


Surface temperature rise



| C-rate        | 0.5C   | 1C    | 2C    | 3C    |
|---------------|--------|-------|-------|-------|
| Capacity (Ah) | 155.7  | 155.4 | 154.9 | 154.6 |
| % (vs. 0.5C)  | 100.0% | 99.8% | 99.5% | 99.3% |

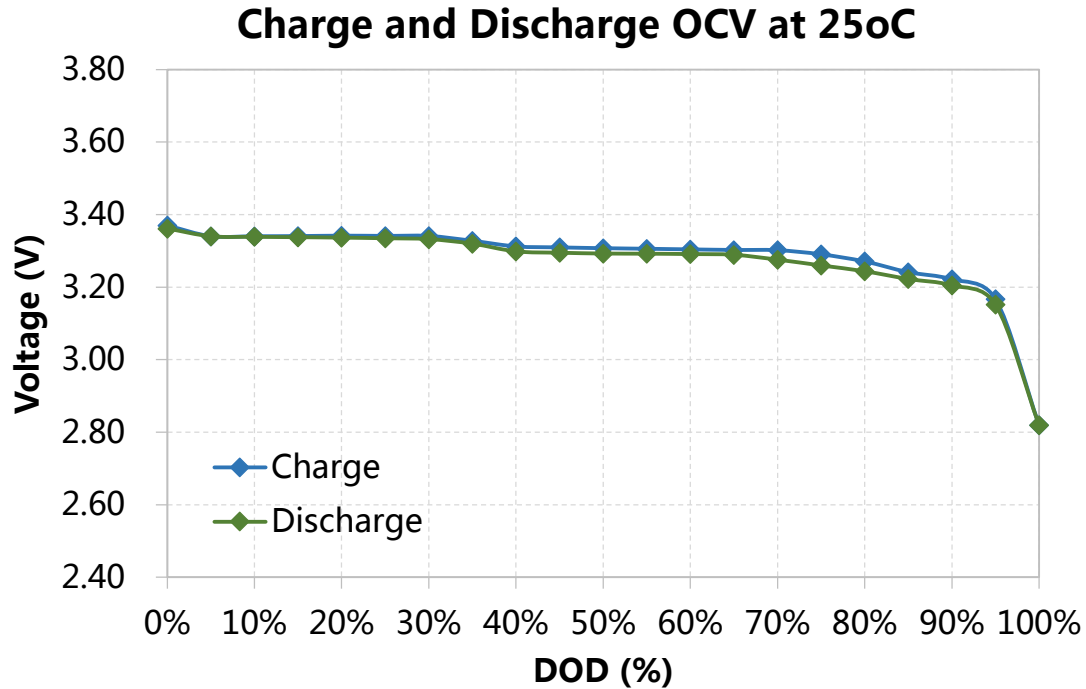
# H/L Temperature Capacity



| Temp.         | 25°C   | 45°C   | 60°C   | 10°C  | 0°C   | -10°C | -20°C | -30°C |
|---------------|--------|--------|--------|-------|-------|-------|-------|-------|
| Capacity (Ah) | 161.3  | 161.9  | 161.8  | 161.1 | 158.9 | 156.0 | 151.3 | 148.2 |
| % (vs. 25°C)  | 100.0% | 100.4% | 100.3% | 99.9% | 98.5% | 96.7% | 93.8% | 91.8% |

Testing Current: 1C  
Voltage Range: 2.0V~3.65V

# Charge and Discharge OCV

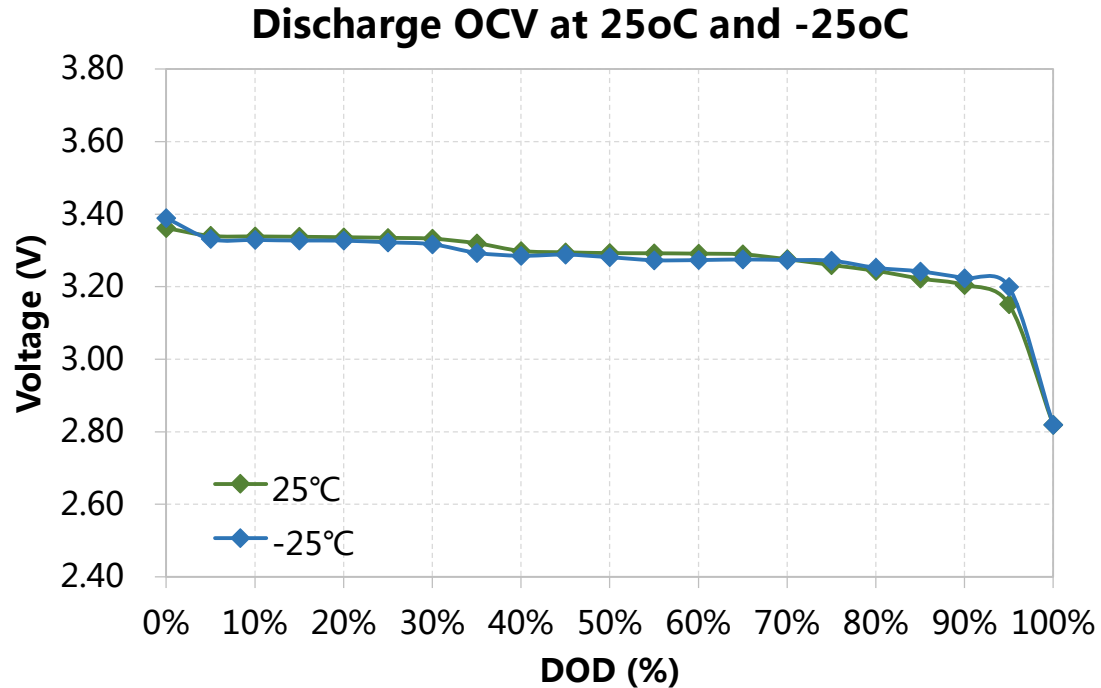


## Test Method

Cells shall be charged fully at 1/3C, and discharged 5 % of the capacity measured at constant current of 0.1C Ah. The discharge repeats 20 times. Cells take a pause for 360 minutes after every charge and discharge. OCV shall be recorded after every pause.

| SOC  | Discharge | Charge  |
|------|-----------|---------|
|      | OCV (V)   | OCV (V) |
| 100% | 3.362     | 3.370   |
| 90%  | 3.339     | 3.340   |
| 80%  | 3.337     | 3.342   |
| 70%  | 3.332     | 3.341   |
| 60%  | 3.299     | 3.312   |
| 50%  | 3.293     | 3.307   |
| 40%  | 3.291     | 3.304   |
| 30%  | 3.276     | 3.302   |
| 20%  | 3.244     | 3.271   |
| 10%  | 3.205     | 3.222   |
| 0%   | 2.819     | 2.819   |

# Discharge OCV at 25oC and -25oC



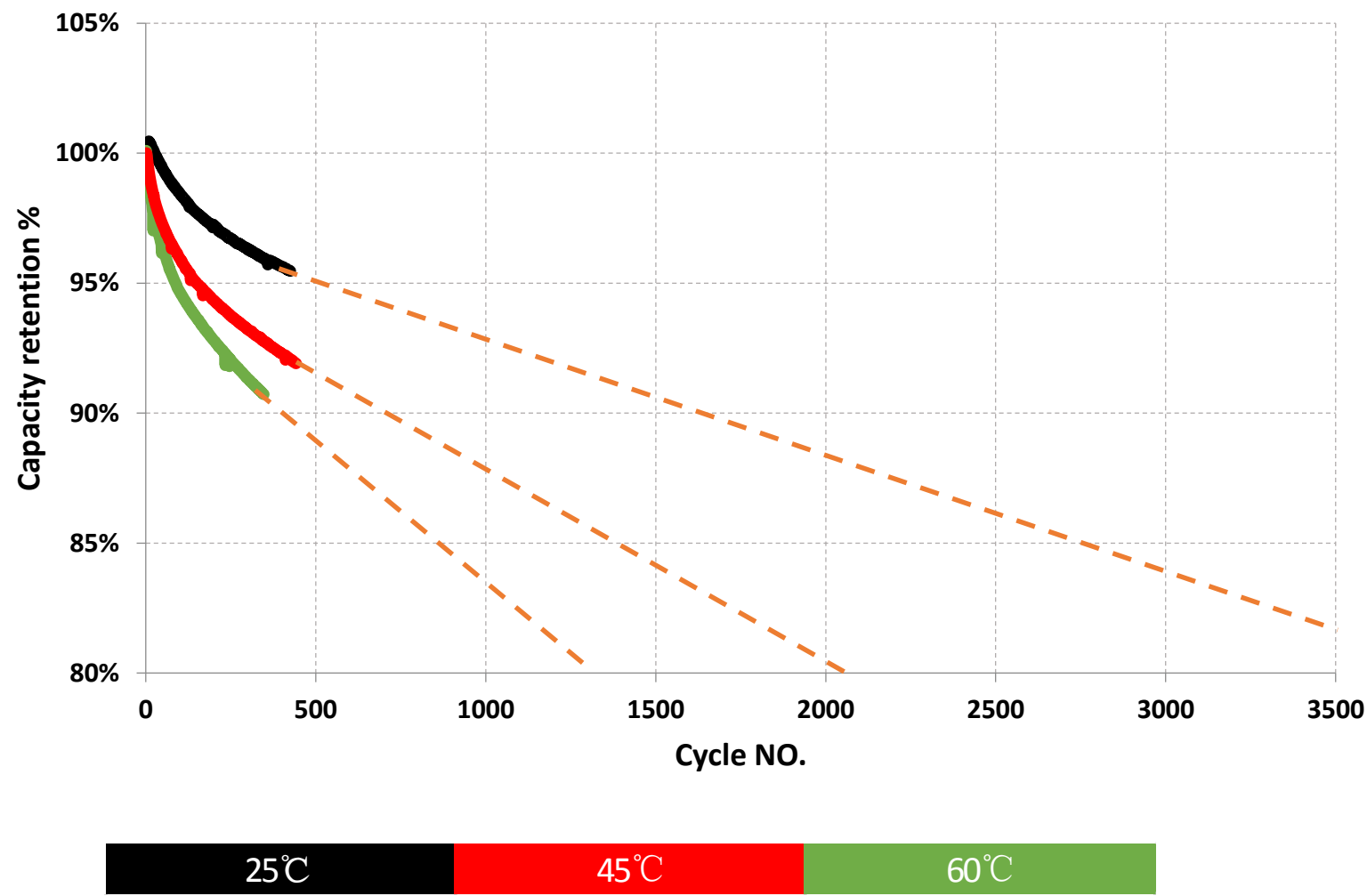
## Discharge method

1. Standard charge at 25°C (SOC = 100%), rest 3 hrs
2. Temperature change (25°C to -25°C) 3. Soaking (5h), rest 1hr
4. Room Temperature Change (-25°C to 25°C, soaking 2hrs)
5. Adjustment of SOC: Discharge by 5% SOC with 0.1C, rest 3 hrs
6. Repeat step 2~5 until SOC=0% or until to meet limit voltage.

| SOC  | 25°C    | -25°C   |
|------|---------|---------|
|      | OCV (V) | OCV (V) |
| 100% | 3.357   | 3.389   |
| 90%  | 3.342   | 3.329   |
| 80%  | 3.340   | 3.327   |
| 70%  | 3.332   | 3.317   |
| 60%  | 3.299   | 3.285   |
| 50%  | 3.293   | 3.281   |
| 40%  | 3.291   | 3.273   |
| 30%  | 3.276   | 3.274   |
| 20%  | 3.244   | 3.252   |
| 10%  | 3.205   | 3.224   |
| 0%   | 2.819   | 2.819   |

# Cycle Life performance

Cycle life performance @1C/1C(2.5-3.65V)



# Abuse Test

| Item             |                        | Test Condition             | EUCAR Level | EUCAR Standard                                                                                                                                                                                                                                       |
|------------------|------------------------|----------------------------|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Mechanical Test  | Nail Penetration       | Φ5~8mm, 25mm/sec , SOC100% | L2          | EUCAR Safety Level<br>Level0 : No effect<br>Level1 : Passive protection activated<br>Level2 : Defect, Damage<br>Level3 : Leakage, Δ mass < 50%<br>Level4 : Venting, Δ mass > 50%<br>Level5 : Fire or Flame<br>Level6 : Rupture<br>Level7 : Explosion |
|                  | Controlled Crush       | X direction, SOC100%       | L4          |                                                                                                                                                                                                                                                      |
|                  |                        | Y+ direction, SOC100%      | L2          |                                                                                                                                                                                                                                                      |
|                  |                        | Y- direction, SOC100%      | L4          |                                                                                                                                                                                                                                                      |
|                  |                        | Z direction, SOC100%       | L4          |                                                                                                                                                                                                                                                      |
| Thermal Abuse    | Thermal Stability      | 150°C, 5°C/min, SOC100%    | L2          |                                                                                                                                                                                                                                                      |
| Electrical Abuse | Overcharge             | 1C/5V or 200%SOC           | L3          |                                                                                                                                                                                                                                                      |
|                  | External Short Circuit | 5mohm, 10mins              | L3          |                                                                                                                                                                                                                                                      |

# Environmental Test

| Item                                  | Test Conditions                                                                                                                      | Requirement                    |
|---------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------|--------------------------------|
| Drop                                  | 1m height, onto concrete floor, 6 directions, SOC100%                                                                                | < L2, capacity and power > 80% |
| Vibration                             | 21h per axis, X/Y/Z, random vibration, SOC100%                                                                                       |                                |
| Thermal Shock                         | 2h/60°C ↔ 2h/-40°C, 100cycle                                                                                                         |                                |
| Damp Heat, Steady-state               | 60±2°C, 93% humidity, 56days, SOC 100%                                                                                               |                                |
| Chemical Resistance with Electrolytes | Dipping into electrolyte, and the drying                                                                                             |                                |
| Ozone Resistance                      | Ozone Concentration : 50±5 ppm, Temperature : 40±2°C, Duration time : 48h                                                            |                                |
| Salt spray                            | Salt concentration : 5%, room temp. ( 8hr spraying period --> 4hr dormant period ) X 6cycles -- totally 72hr, without voltage supply |                                |
| Additional shock Test                 | SOC100%, Acceleration in ±x: -60g half sine, Acceleration in ±y & ±z -35g half sine, Duration 30ms.                                  |                                |

# Thanks

感谢观赏

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