

## Battery Pack Performance and Life Testing

Millbrook's battery test capability includes life testing and functional validation (including life, power, internal resistance and BMS functionality) to standards including ISO 12405 and GB/T 31484-2015. It has invested in a major new battery test facility, with 12 dedicated battery pack climatic test chambers.

Millbrook delivers safe battery validation and verification testing and has a thorough understanding of battery and safety standards.

### Battery cycler:

- 20V to 1,100V, up to 2,800A and 1,000kW continuous (1,200 kW peak)
- Under control of the REPS automation system the output can be changed every 10ms if required to track complex test profiles
- High speed, typ. < 2ms current rise time from 10-90%
- Constant voltage, current or power operation modes
- High accuracy eg < +/-0.35A error at 700A, typically < 0.1A

### Environmental chamber:

- W 3.0m x L 3.5m x H 2.2m (23.1m<sup>3</sup>)
- Operating temperature: -40°C to +90°C
- Up to 3K/min rate of cooling and heating
- Humidity controllable from 10% to 95% r.h. from +5°C to +85°C (+5 to +88 °C dew point)
- EUCAR Hazard Level 6
- Maximum battery weight – 1,000kg

### Battery conditioning:

- Operating temperature: -40°C to +80°C
- Control accuracy typ. +/-0.2°C
- 5.4kW heating power
- 8kW cooling power
- Up to 30 litres/min fluid flow rate



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## Battery Pack Performance and Life Testing

Millbrook routinely tests Li-ion cells, modules, packs and vehicles (class M1-M3 and N1-N3) and will consider other chemistries including Lithium-metal.

### Automation:

- Millbrook's REPS cell automation software
- Software allows tests to be configured to customer requirements (including real-time interactions with the pack's BMS)
- Extensive logging capabilities and almost unlimited storage
- One test chamber is now fitted with a "dual REPS" system - two packs or modules can be tested independently (via separate cyclers) in a single test chamber
  - Two test sequences can be interlocked if required – e.g. before a chamber temperature change

### Remote access:

- Secure staff and customer access to details of running tests
- Secure communication between test facilities: data stream, camera and video conferencing

### Connectivity:

- Palletisation of battery test trolley to allow test preparation outside the test chamber to include:
  - Instrumentation
  - Fluid
  - HV
  - LV / CAN

### Data acquisition:

- Up to 100 data channels, sampled at up to 1kHz, including a range of:
  - Voltage
  - Current
  - Temperature
  - Pressure
  - Flow
- Thermal and visual cameras



## Battery Pack Performance and Life Testing

### Protecting Facility:

- Integral safety PLC for full building control
- Fire suppression
- Connection to fire alarm system
- Millbrook's own emergency response team and fire engine

### Protecting DUT:

- Water mist fire suppression system
- Nitrogen (Inert Gas) purge system
- Gas detection including HC, O<sub>2</sub>, CO, HF and H<sub>2</sub>
- Visual and thermal imaging

### Protecting People:

- Risk assessments
- Training
- Safe systems of work
- PPE

