Vacuum Test

User Manual

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1. INTRODUCTION

1.1. WHEN THE TEST WILL TAKE PLACE

This test will be performed once after the vibration test.

1.2. IMPORTANCE

A vacuum test is performed to ensure the battery's integrity before using it and prevents potential safety hazards.

2. EQUIPMENT

- Vacuum Chamber

A vacuum chamber is a sealed enclosure from which air and other gases are removed to create a low-pressure environment that simulates conditions like high altitudes or outer space. When testing a Li-ion battery, the vacuum chamber allows engineers to observe how the battery performs under extreme pressure changes, such as those experienced in aerospace applications. This helps evaluate the battery's structural integrity, safety, and electrical behavior in low-pressure environments, ensuring it can operate reliably in conditions far different from normal atmospheric pressure.

- Vacuum Pump

A vacuum pump is a device that removes air and gas molecules from a sealed space to create a vacuum. In the context of testing a Li-ion battery, the vacuum pump is used to evacuate the air from a vacuum chamber, simulating low-pressure environments such as high altitudes or space. This setup allows researchers to test how the battery responds to reduced pressure, including potential swelling, leakage, or changes in performance. The vacuum pump is essential for creating controlled conditions that help ensure the battery's safety and reliability in extreme environments.

- Pressure Gauge

This tool is used to measure the difference in pressure between the device and the surrounding atmosphere. This tool is going to go on and be apart of the Vacuum Pump.

- Timer

This tool is used to ensure the test is done for a precise and defined duration.

- Insulated Battery Tray

This tool prevents the battery from shifting and moving and prevents any damage to the battery that is not caused from the altitude or pressure

- Microscope

This is optional but can be used to better the inspection of the battery

- Multimeter

This is used to measure voltage before and after the test

3. PROCEDURE

3.1. SET UP

First do a OCV test and then a visual check of the battery, look for any damage, swelling, corrosion, or leakage. Also, make sure that the battery is not fully charged. It should be about 30-60% charged.

3.2. PREPARING THE VACUUM CHAMBER

Place the battery in the vacuum on a non-conductive, flat surface. Use a tray to isolate the battery from direct contact with the metal of the vacuum.

3.3. SET UP INSTRUMENTS

Connect the vacuum pump to the chamber, make sure the pressure gauge is zeroed, ensure the chamber is sealed and their is a pressure relief system.

3.4. VACUUM TEST

Start the vacuum pump and gradually reduce the pressure inside the chamber. Bring the pressure down to around 11.6 kPa (87 mmHg) this is simulating about 50,000 feet of altitude. Maintain the vacuum for at least 6 hours.

3.5. MONITOR AND OBSERVATION

Make sure to check for physical deformation like swelling, gas formation like bubbling or hissing, and leaks or ruptures. Utilize the camera and/or microscope for a more precise oberservation.

3.6. RESTORE PRESSURE

After 6 hours, slowly return the chamber to atmospheric pressure. A quick pressure change can stress the battery which would mess with the results.

4. RESULTS

After the test, ensure there is no mass loss, leakage, venting, rupture, fire, or visible deformation. The voltage should remain within acceptable limits.