

Effects of vibrations on cylindrical lithium ions or primary cell batteries

The area of application of lithium-ion or primary cell batteries is very versatile and includes a wide variety of requirements, such as reliability against vibrations. Lithium ion cell batteries must therefore be sufficiently robust to withstand this. Depending on the application, the vibrations can occur to varying degrees and should not be dismissed lightly because of long-term, continuous exposure. We know from our own project experience what destructive effects vibration can have on the cylindrical design. Roughly described lithium-ion cells consist of a cathode and an anode. The two poles are separated from each other by a separator layer that prevents direct contact. The material of this separator layer typically consists of polymers. Research has shown that this polymer layer can crack or even break under dynamic loading conditions. A study (Somerville et al.) has now shown that structural damage to the separator material has a negative impact on the performance and service life of the lithium-ion battery.

In our own project experience, the cylindrical primary cell used shows a massive loss of capacity after approx. 2-3 months. However, capacity and consumption were such that replacement should only take place after 5 years at the earliest. The strong vibrations encountered in this application were not taken into account. Only after several tests and cause exclusion procedures was a clear connection apparent.

In another study (Brand et al.), sinusoidal vibrations according to the UN38.3 T3 standard and mechanical shocks according to the UN38.3 T4 standard were examined over a period of 6 months.

It was found that the cathode rod or stacking mandrel loosened in some cases after just 10 runs. After 6 months, almost all cells showed internal damage while externally they appeared completely intact. The long-term vibration and shock tests were then not passed.

In another study (Zhand et al.) the effects of vibrations on the Z-axis were primarily examined. A significant increase in internal resistance and a decrease in battery capacity were noted.

Before selecting the lithium battery, the requirements in the application should be checked. Prismatic or pouch cells are more suitable when exposed to strong vibrations over longer periods of time. Comparative tests have shown no internal damage or loss of performance.