

Balancing in Traction Batteries – Why It Is Crucial for Longevity and Safety

Balancing maximizes usable capacity, protects against premature aging and therefore reduces the risk of serious cell defects. Independent battery diagnostics specialist AVILOO explains how intelligent balancing within the Battery Management System (BMS) ensures the performance and safety of modern electric vehicles.

Denver January 28th 2026 - Modern electric vehicles rely on high-performance traction batteries consisting of hundreds to thousands of individual cells. These cells are connected in series and in parallel to provide the voltage and capacity required for vehicle propulsion. While a single cell delivers only around 3.0 to 4.25 volts, electric vehicles require system voltages of 300 volts or more. To achieve this voltage, numerous cells are connected in series. To deliver the desired driving range, additional cells are connected in parallel to increase the overall capacity.

Patrick Schabus, Chief Product Officer at AVILOO, gives a typical example: “Three cells are connected in parallel to form a cell group (cell level). Of these cell groups, 108 are connected in series – resulting in a total of 324 cells in a single traction battery. In parallel-connected cells, the state of charge equalizes automatically, but this is not the case with cells connected in series. This is where a critical technology comes into play: balancing.”

Why Is Balancing So Important?

But why is this process so important? Balancing refers to equalizing the states of charge (SoC) of the individual cell levels within a battery pack. Without balancing, differences in the state of charge cannot compensate for themselves. Even minimal deviations during initial assembly, or factors such as manufacturing tolerances, thermal differences, aging effects, and uneven load distribution, lead to imbalance over time. The result: individual cells reach full charge or depletion earlier than others – and the weakest cell ultimately determines the usable energy of the entire pack.

An imbalanced battery system can have far-reaching consequences. Imbalance not only reduces driving range, but can also result in an incorrect state-of-charge indication and, consequently, a significant overestimation of range. Even more critical is the fact that imbalance can accelerate battery aging, potentially leading to secondary damage and, in extreme cases, cell defects with an increased risk of fire.

How Does Balancing Work?

In electromobility, top balancing is the standard approach: at the end of the charging process, the states of charge of the cells are equalized to ensure accurate range calculation and maximum usable energy extraction. Without this process, the performance of modern electric vehicles would continuously decline. The importance of balancing increases with system complexity. In 800-volt architectures, twice as many cells are connected in series compared to 400-volt systems – a challenge that can only be managed through reliable balancing.

Balancing and State of Health (SoH)

Balancing is closely linked to the diagnosis of cell condition. The battery management system (BMS) records key parameters such as capacity loss, internal resistance, and charging behavior. AVILOO uses this data in combination with the FLASH Test to precisely determine both the balancing status and the state of health of a battery. To this end, cell voltages are read out, states of charge are calculated, and the results are visualized in a heat map – ranging from green (optimal) to red (critical).

Conclusion

In summary, balancing is indispensable for the safety, long service life, high performance, and thus maximum driving range of a traction battery in electric vehicles. Without balancing, a modern battery pack would be virtually unusable. It is the invisible technology that ensures electric vehicles operate reliably, efficiently, and safely, as Schabus explains: “For drivers, good balancing means greater range, longer battery life, and maximum safety. With our diagnostic tools, we make this complex process transparent and measurable.”

For EV drivers, it is therefore advisable to perform a FLASH Test at 100 percent state of charge (SoC) in order to identify and counteract potential risk factors affecting the traction battery at an early stage.

Balancing in Detail

At a 100% state of charge, the capacity to be balanced is determined for each cell level. Subsequently, each cell level is discharged via a balancing circuit for a defined period until the individual target capacity is reached. This process can also take place while the vehicle is in operation.

In NMC and NCA battery chemistries, imbalance within the battery pack can be reliably detected at state-of-charge levels above 80%. In contrast, with LFP batteries, this is only possible at state-of-charge

About AVILOO

AVILOO started in 2017 with independent battery diagnostics for EV and plug-in hybrid vehicles and has since established itself as the global industry standard and market leader. Founded near Vienna, Austria, the company operates worldwide and has also been active in the United States since 2024 with a location in Denver, Colorado. The company develops and markets precise, fast, and manufacturer-independent tests to detect the State of Health (SoH) and defects in drive batteries of used vehicles. The company started its business with the AVILOO PREMIUM Test, the world’s most comprehensive battery test for individuals. Based on thousands of conducted PREMIUM tests and the resulting world’s largest database, the AVILOO FLASH Test was developed to provide a quick assessment of the battery’s state within 3 minutes – ideal for fleets and remarketing. By covering over 96 % of all available brands, the FLASH Test is currently the fastest comprehensive diagnostic solution on the global market. All analysis methods and certificates are TÜV and CARA certified, ensuring complete transparency and safety for used car buyers, sellers, and users—both commercial and private.

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