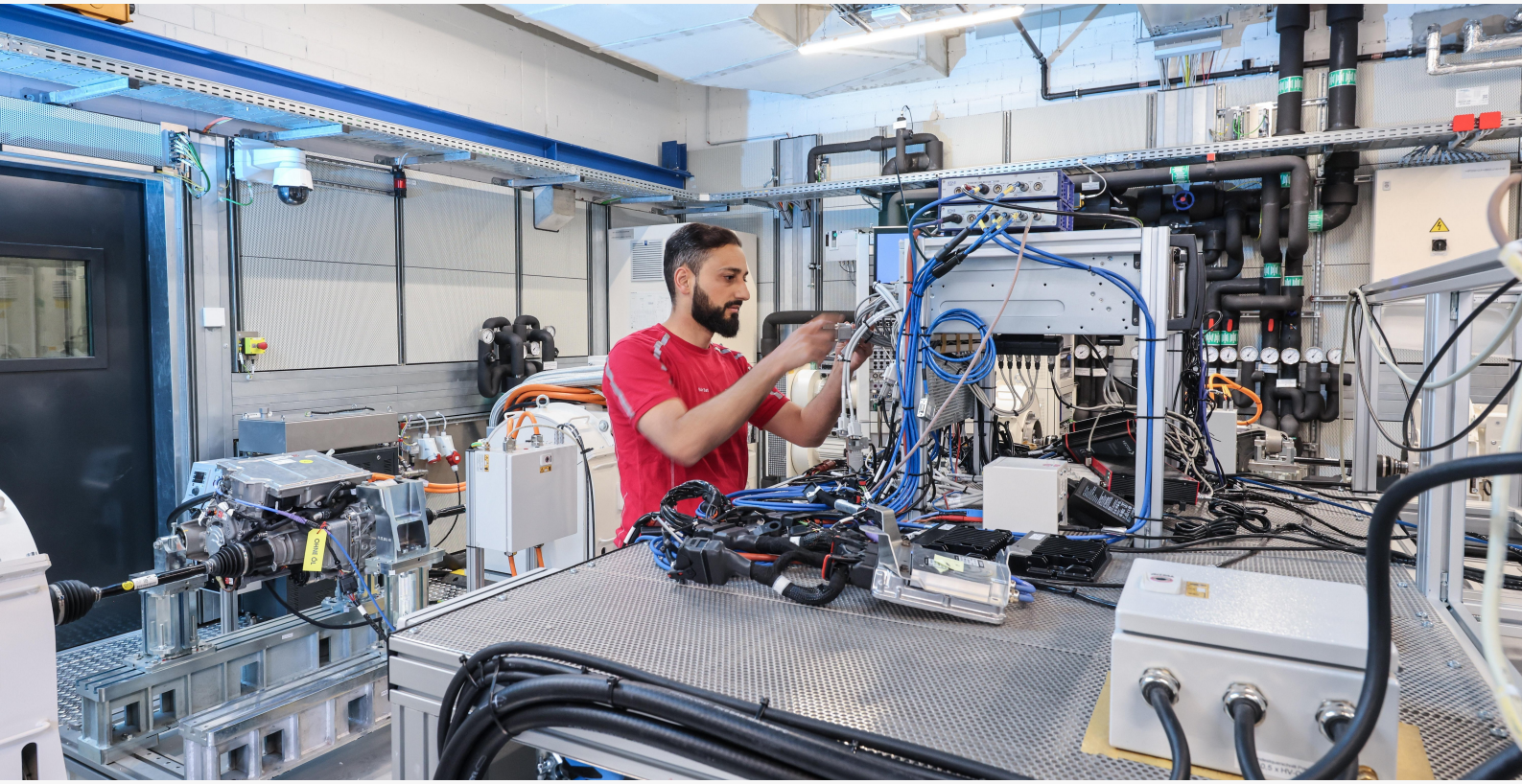

Cell research at Porsche: durability by design

09/12/2025 Drive batteries are the heart of electric vehicles. At Porsche, the lifespan and reliability of its high-voltage systems are engineered to match those of combustion engines: at least 15 years or 300,000 kilometres.

The ageing process of a battery is inevitable but it can also be influenced. In the first two to 12 months, a lithium-ion cell typically loses one to five per cent of its capacity. Experts refer to this as the 'initial drop', and Porsche takes this physical effect into account – by ensuring that newly produced batteries have an energy content that already takes this reduction into account. As a result, the battery's effective state of health (SoH) declines much more slowly.

Key parameters include battery temperature, charge and aging state, and charging current. Optimal conditions have been found to be temperatures below 30 degrees Celsius and a charge level below 90 per cent (when the car is parked for longer periods). To achieve this, Porsche uses patented fast-charging technology in its electric sports cars for monitoring and control.

Within a battery cell, electromechanical processes influence the aging process. During charging, lithium ions move through the membrane from the cathode to the anode, where the particles spread out. During discharging, the process is reversed, and the anode particles contract. The electrical resistance of a cell increases during charging as the battery becomes more fully charged. During discharging it decreases as the charge level reduces.

Battery technology explained

“Batteries actually want to be discharged. They have to be forced to charge,” explains Carlos Alberto Cordova Tineo, who works in battery cell development and fast charging at Porsche. “When we talk about fast charging, we mean introducing lithium into the anode.”

To illustrate this, he uses the example of a restaurant. “First, we define opening hours. Then there are different scenarios. Either it’s a spontaneous decision to visit the restaurant, or there’s already a reservation. With a reservation, you get direct entry without waiting in line at the door. With a spontaneous decision, several factors come into play: the restaurant’s capacity, how many free seats are available, the size of the door to determine how many people can enter simultaneously, and whether there’s already a queue.”

If these aspects were assigned to the different characteristics of the charging process, the restaurant's opening would be comparable to temperature. “The higher the temperature, the wider the door opens, allowing more people to enter simultaneously. As the temperature drops, the opening narrows, making simultaneous entry more difficult.”

Another point of comparison is the battery’s age. Continuing the example: “The restaurant’s capacity has been reduced from 100 to 80 seats. If many people decide to visit this restaurant at the same time, a queue forms because there aren’t enough seats available.” The battery’s state of charge can be compared to the already-occupied seats in the restaurant. Both factors make the queue at the door longer and longer. And the longer the queue, the less motivation there is to visit the restaurant at all.

“This, for lithium-ion batteries, is the deposition of metallic lithium, which is no longer available for energy storage,” he continues. “This is referred to as ‘lithium plating’. Mechanical stress on the particles when the battery is used intensively can lead to cracking of the particle shell or destruction of the particles, resulting in lithium loss. This, in turn, also reduces the battery’s capacity.”

Maximising battery life

For Porsche, it has always been – and remains – important to find a key to make access to the metaphorical ‘restaurant’ as easy as possible. This means avoiding negative effects to guarantee the longevity of the batteries. Intelligent battery management and robust cell chemistry are the perfect keys.

Porsche has developed a control algorithm for this based on customer habits. “We know that customers only choose fast charging in about 15 per cent of cases,” continues Cordova Tineo. “However, in our stress tests, we go far beyond that and fast charge the battery in 50 per cent of all cycles.” The lifespan tests also simulate changing ambient temperatures and dynamic driving behaviours. Extreme conditions such as heat exposure from 60 to 100 degrees Celsius are also tested. Finally, a very large number of charging cycles are simulated at different distances between 160,000- 300,000 km.

For the current Taycan, the intensive work in testing has already paid off. Its improved cells offer increased performance and reduced resistance. To optimise temperature control, passive cooling was integrated into the cell modules. A new cooling plate with increased cooling capacity from six to 10 kW enhances robustness at high temperatures. New busbars for the electrical connection of the cells allow higher currents. The result is that the fast-charging time from 10 to 80 per cent has been reduced from 21.5 minutes for the first-generation Taycan to 18 minutes for the current model, despite the increased capacity. Charging power has also increased from 270 to up to 320 kW. In addition, the minimum starting temperature for fast charging has been lowered from 25 to 15 degrees Celsius.

Short charging times, superior performance, maximum safety

Short charging breaks ultimately reduce travel time. In addition to long battery life, a minimal CO2 footprint, maximum safety, and the always paramount driving dynamics, these have been clear goals for Porsche's developers of e-mobility.

A significant boost in driving dynamics was achieved by increasing the discharge current from 860 to 1,100 amperes. This enables faster and more powerful acceleration. Despite the higher gross battery capacity, from 93.4 to 105 kWh, the weight was reduced from 634 to 625 kilograms, which also benefits the car’s handling.

Safety is of utmost importance at Porsche. High-voltage batteries must withstand extreme stresses. One such test is the immersion test, where the battery is submerged about one metre deep in a flooded tank. Even after extended periods, no water must be able to penetrate the hermetically sealed battery housing. In the corrosion test, the battery pack is exposed to various substances, especially saltwater solutions of varying concentrations. For crash safety, occupant protection is the top design priority, regardless of vehicle or drive type. To ensure this, Porsche has derived additional strict internal requirements with increased crash severity for hybrid and battery electric vehicles.

“We place all high-voltage components in areas where there is the minimal risk of damage,” says Simon Maurer, Governor of the Porsche Cayenne and Macan safety system. “Additional sensors detect critical stresses very early. After crash detection, electric motors and auxiliary units are automatically disconnected from the high-voltage battery, and the remaining stored energy is discharged dynamically. This prevents electric shock.”

Component tests, such as with battery modules, are also conducted. These parts are subjected to

significantly higher loads than would normally be experienced in a crash involving the full vehicle. Even in these tests, no fire must occur. The combination of structural optimisation, strict requirements, and comprehensive safety systems ensure the greatest possible protection for the entire system. Crash tests with a Macan in Weissach's state-of-the-art test facility demonstrate how well the battery is protected; after a violent side impact against a solid pole, there is virtually no deformation of the high-voltage battery.

A behind-the-scenes look at battery development shows that all Porsche test procedures are designed to be more rigorous than any vehicle's lifetime. There are no compromises when it comes to fast charging, fast travel with optimal performance, or safety – and no compromises when it comes to reliability or long battery life. This is how Porsche meets the expectations of its fans.

Info

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Image Sublines

Path: Cell research at Porsche: durability by design/Images/img_1.jpg
Title: Rolling Chassis Macan, Cell research, 2025, Porsche AG
Subline: The chassis of a Porsche Macan with all-wheel drive: The high-voltage battery, including power electronics, with a gross capacity of 100 kWh is positioned between the two axles. The drive motors are installed on the front and rear axles.

Path: Cell research at Porsche: durability by design/Images/img_2.jpg
Title: High-voltage battery composite test bench, Porsche Development Centre Weissach, Cell research, 2025, Porsche AG
Subline: In addition to extensive road testing, the high-voltage battery and all associated components must undergo specific test procedures at Porsche on a high-voltage battery system test bench without any faults. During this process, all components are checked together on a test bench.

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