

DEKRA  
Battery Test  
for Electric Cars

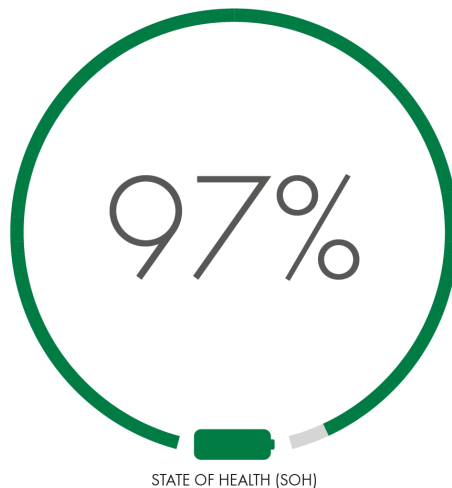


DEKRA SE/Handwerkstr. 15/70565 Stuttgart

Battery Test Location  
Customers place

DEKRA No.: HV/A57651/2023-00000000d081c4ee/G023125602

05.01.2023



Vehicle Information	
Manufacturer:	Mercedes
Model:	GLC 300de 4Matic (253.911) 9.3/13.5kWh 05/2020-
VIN:	
License plate:	
First registration date:	01.04.2021
Mileage:	51012 km

In Car Data		
SOC (State of Charge):	22.7	%
SOH (State of Health):*	97	%
Voltage:	354.95	V
Nominal capacity	13.5	kWh
Cell temperature min:	10.0	°C
Cell temperature max:	10.0	°C
Cell voltage min:	3.55	V
Cell voltage max:	3.56	V

## Explanation

### Why do high voltage batteries age?

With time and usage of the battery the available capacity is irreversibly decreasing. As a consequence, the decreased capacity isn't the same as the original capacity of the battery in the state new anymore. The reason for this is the ageing of a battery due to both time (calendric ageing) and usage (cyclical ageing).

Batteries consist of several layers in which ions are stored. If the battery is charged or discharged, this leads to migration of the ions in these layers. This causes wear and tear, whereby the layers slowly lose the original structure of the new battery. Due to the loss of the original structure, the space in which the ions can be stored is gradually reduced and the electrical resistance of the cells also increases slowly. The effect of a significantly aged cell can be experienced in the form of reduced performance, faster heating and reduced storage capacity of the battery.

Environmental conditions like temperature, but also charge/discharge current have an effect on battery ageing as well.

### What does State of Health mean?

The SoH (State of Health) describes the actual condition of a battery. In detail it gives information about the state of ageing of the battery. It is defined as the ratio between the remaining capacity of the battery in the moment of test, to the capacity in its new state. The SoH is given in percent. It is non-linear and highly dependent on the use of the HV battery.

To determine the SoH by definition, the battery must be discharged with a defined discharge rate and ambient conditions. In practice, the battery capacity that can be obtained depends heavily on the behavior of the Battery management system, the temperature of the battery and of course the discharge rate (in other words it depends significantly on the driving speed).

### What does the DEKRA SOH evaluate?

Until now, the only way to independently estimate the remaining capacity was to completely discharge the battery and measure the capacity during a full charge cycle under defined ambient conditions. In few of the vehicle models, the SOH is available through the diagnostic function. However, the calculation of the SOH value, which may be available from the manufacturer via diagnostics, is not standardized and for external users not transparent. This value may also include a lifetime buffer, which is built-in to conserve the battery or extend the lifetime with full range. Depending on the boundary conditions and premises when determining the remaining capacity,

the DEKRA-SOH shows the aging of the battery over its lifetime independently and comparably with minimal effort. DEKRA uses the relevant ambient conditions and the battery behavior during electrical excitation as an indicator for the current capacity, in other words the SOH. This current capacity shows the SOH as an independent value compared to a new battery regardless of any boundary conditions.

### Limitations of all Fast-Track-Methods:

All evaluation methods can only see a fraction of the complete behavior of the battery.

Rapid evaluation methods reflect the aging of the battery block, regardless of the behavior of the battery management system, which may release a lifetime buffer for aged batteries or additionally limit the available capacity for battery protection. Rapid evaluation methods also cannot account for capacity changes due to software updates. However, rapid evaluation methods can determine the aging state of the battery pack independent of the influence of the battery management system.

In individual cases, the capacity of the battery block may also be limited by the unexpectedly rapid aging of a single battery cell. When a single aged cell represents a capacity limit of the overall battery, test methods have limited ability to determine this. Only an extended analysis can usually determine this independently. The influence of the single aged cell is indicated by the DEKRA system, but with a much lower influence.

Please take into consideration that the warranty promise might require a test according to individual agreements.

### How to boost the battery life?

The capacity of the battery decreases continuously during use and over time. If the following points are taken into account, aging during use can be minimized. Lithium ion batteries prefer medium temperature range and charge level for storage and use. At exceptionally high and low charge levels and temperatures, aging is higher. A high charge and discharge rate, e.g. through rapid charging and particularly fast driving, also leads to increased aging and hence it should be limited wherever possible

If the battery is heavily stressed once, it does not lead to measurable aging. However, if the battery is heavily stressed continuously, enhanced aging can be measured.