

**Operating Principle of HV System (129/15)**

Vehicle Type: **Panamera S E-Hybrid and Cayenne S E-Hybrid**

Model Year: **As of 2014**

Subject: **Operating principle of HV system**

**Information on the discharge protection function of the battery management system (BMS)**

Subject: **Discharge protection function of the battery management system (BMS) in order to extend the service life of high-voltage and low-voltage batteries**

Note: The Panamera S E-Hybrid and Cayenne S E-Hybrid models offer a completely new driving experience thanks to their increased electric range and the newly developed lithium-ion high-voltage battery with its high energy density and power density. To maintain this over the service life of the vehicle, it is important - among other things - to prevent damage to the high-voltage battery as a result of exhaustive discharge. For this purpose, the S E-Hybrid models have an energy management system and an operating strategy, which control the state of charge of the battery and the flow of energy in the vehicle electrical system. If the state of charge of the high-voltage battery or low-voltage battery reaches certain discharge thresholds, the energy management system controls the flow of current in the vehicle in such a way that further discharge of the two batteries is prevented.

**Background:**

Under normal operating conditions, the energy management system and operating strategy control the charging and discharge processes in the high-voltage system and in the low-voltage vehicle electrical system in order to prevent a critical state of charge in one of the two batteries. To do this, the operating strategy can start the combustion engine, for example, in order to charge the high-voltage battery or actively recharge the low-voltage battery from the high-voltage system.

However, if one of the two batteries reaches a critical state of charge because of a malfunction or because the vehicle was parked up for a very long time, various measures are also used to prevent exhaustive discharge. These measures are activated and controlled by the battery management system (BMS) depending on the actual discharge threshold.

The discharge thresholds of the high-voltage and low-voltage battery are categorised as follows:

<ul style="list-style-type: none"> <li>• <b>High-voltage battery</b></li> </ul>
<p><b>Warning threshold</b> (state of charge approx. 12% *)</p> <ul style="list-style-type: none"> <li>• All high-voltage components are switched off.</li> <li>• Fault entry "POA7D00 "High-voltage battery – state of charge (SOC) too low" in the fault memory of the high-voltage battery control unit.</li> <li>• 0 km (0 miles) electric range shown in the instrument cluster.</li> </ul>

- ⇒ Purely electric driving is no longer possible once the warning threshold is reached.
- ⇒ The remaining capacity of the high-voltage battery is sufficient to start the combustion engine.

**Alarm threshold** (state of charge approx. 8% \*)

- Yellow warning message "Hybrid system fault" is displayed in the instrument cluster.
- Fault entry POA7D00 "High-voltage battery, state of charge (SOC) – below limit value" in the fault memory of the high-voltage battery control unit.
- High-voltage contactors are opened (this disconnects the high-voltage battery from the vehicle electrical system).

- ⇒ After the ignition is switched off and on again, the combustion engine can be started.

**Error threshold** (state of charge approx. 6% \*)

- Red warning message "Hybrid system fault" is displayed in the instrument cluster.
- Fault entry POA7D00 "High-voltage battery, state of charge (SOC) – fault" in the fault memory of the high-voltage battery control unit.
- The high-voltage system is switched off completely.

- ⇒ **The vehicle cannot be driven again until the high-voltage system is reactivated.**

\* The specified values relate to the absolute state of charge. The actual usable state of charge range for customers is less than the absolute range because of battery technology. For example, an absolute state of charge of approx. 15% corresponds to a customer state of charge of approx. 0%.

• **Low-voltage battery**

**Discharge threshold 1** (state of charge approx. 12%)

- Interior lighting is switched off.

**Discharge threshold 2** (state of charge approx. 8%)

- Ignition is switched off (term. 15).
- Emergency lighting remains active.

- ⇒ After the ignition is switched off and on again, the combustion engine can be started.

**Discharge threshold 3** (state of charge approx. 4%)

- The low-voltage battery is disconnected from the vehicle electrical system (term. 30 is switched off).

- ⇒ **The vehicle cannot be driven again until the low-voltage system is reactivated.**

**If one of the three fault entries mentioned above occurs on the high-voltage battery, the cell voltage of the high-voltage battery must be read out:**

Work Procedure: 1 Connect a battery charger or power supply, suitable for AGM type batteries, recommended current rating of 70A fixed voltage 13.5V to 14.5V to the jump-start terminals in the engine compartment.

- 2 **9900 - PIWIS Tester III** must be connected to the vehicle communication module (VCI) via the USB cable. Then, connect the communication module to the vehicle and switch on the PIWIS Tester.
- 3 Switch on the ignition.
- 4 Switch to the Control unit selection menu in **9900 - PIWIS Tester III**.
- 5 Select the **high-voltage battery** in the **Control unit selection** menu.



**Information**

- 6 Switch to the **Actual values/input signals** tab and display the **Momentary minimum cell voltage: Voltage**.

**To reactivate vehicles with a flat high-voltage or low-voltage battery, complete the following steps:**

Work  
Procedure:

- **High-voltage battery**
  - 1 Connect Porsche Universal Charger (high-voltage) to the vehicle and the power supply. Start charging the high-voltage battery on the Porsche Universal Charger (high-voltage).
  - 2 Connect a battery charger or power supply, suitable for AGM type batteries, recommended current rating of 70A fixed voltage 13.5V to 14.5V to the jump-start terminals in the engine compartment.
  - 3 **9900 - PIWIS Tester III** must be connected to the vehicle communication module (VCI) via the USB cable. Then, connect the communication module to the vehicle and switch on the PIWIS Tester.
  - 4 Switch on ignition. Read out and erase the fault memories of all control units using the PIWIS Tester. Then, switch off the ignition and disconnect the PIWIS Tester from the vehicle.
  - 5 Switch off the battery charger (low-voltage) and disconnect it from the jump-start terminals in the engine compartment.
  - 6 Continue to charge the high-voltage battery using the Porsche Universal Charger (high-voltage) until a state of charge of **at least 30%** appears on the charger display.
  - 7 Lock the vehicle and unlock it again after a waiting time of **at least 5 minutes**.  
The waiting time allows all vehicle systems to enter sleep mode so that automatic on-board diagnosis of the hybrid system can be carried out.  
**The vehicle cannot be started until on-board diagnosis is completed successfully.**
  - 8 End the charging process on the Porsche Universal Charger (high-voltage) and disconnect the charger from the vehicle.
  - 9 Calibrate electric machine.

- 9.1 Press the brake pedal and keep it pressed.
- 9.2 Turn the ignition key in the ignition lock to position 2 (terminal 50 – engine start) and hold it at this position for about 2 to 3 seconds.  
Calibration of the electric machine is clearly audible. Calibration is complete once the calibration noise can no longer be heard.
- 9.3 Release the ignition key and switch off ignition.
- 9.4 Turn the ignition key in the ignition lock to position 2 (terminal 50 – engine start) again to start the engine.

Work  
Procedure:

- **Low-voltage battery**

- 1 Connect a battery charger or power supply, suitable for AGM type batteries, recommended current rating of 70A fixed voltage 13.5V to 14.5V to the jump-start terminals in the engine compartment and charge the low-voltage battery.
- 2 Switch on the ignition and wait **approx. 2 seconds** before switching it off again.
- 3 Lock the vehicle and unlock it again after a waiting time of **at least 5 minutes**. Start the vehicle. The waiting time allows all vehicle systems to enter sleep mode so that automatic on-board diagnosis of the hybrid system can be carried out.  
**The vehicle cannot be started until on-board diagnosis is completed successfully.**
- 4 Switch off and disconnect the battery charger (low-voltage).



#### Information

If the battery management system detects a flat low-voltage battery (discharge threshold 3), the low-voltage battery is disconnected from the vehicle electrical system to protect against exhaustive discharge.

Learning and adaptation values stored in the control units can therefore be deleted when discharge threshold 3 is reached.

- 5 Restore the learning and adaptation values of the control units ⇒ *Workshop Manual '2X00IN Work instructions after disconnecting the battery'*.

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