

# Research on fault diagnosis and maintenance of electric vehicle power battery

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**Abstract:** with the rapid development of social economy, China's industrial productivity has been significantly improved, but the environmental situation is still not very optimistic. Therefore, the electric vehicle industry needs to fully integrate with the current environmental situation and timely reform the shortcomings of the traditional production mode. After a series of reforms, although the production and sales of electric vehicles have significantly increased, the maintenance and after-sales are still not ideal. Through the analysis of the opinions put forward by consumers, it is found that most of the problems are power battery fault diagnosis caused by maintenance. Therefore, enterprises should combine with new ideas and technologies and make corresponding adjustments. Based on this, this paper studies the fault diagnosis and maintenance of electric vehicle power battery, in order to provide reference for relevant R & D and maintenance personnel.

**Key words:** electric vehicle; Power battery; Fault diagnosis; service

With the vigorous promotion of the state, the electric vehicle industry has achieved vigorous development, and its production and sales have also developed rapidly. However, there are some deficiencies in the power battery fault diagnosis and maintenance of electric vehicles, which has become one of the key factors restricting the further development of electric vehicles. Therefore, electric vehicle enterprises should pay special attention to this problem, identify the main causes of power battery failure, and actively optimize the maintenance technology of power battery failure, so as to improve the stability of power battery and ensure the safe driving of electric vehicles, so as to lay a solid foundation for the sustainable development of the electric vehicle industry.

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## 1. Research on disassembly of electric vehicle power battery pack

### (1) Preparation before disassembly

When disassembling the power battery pack, the maintenance personnel need to combine with the actual situation and needs of the electric vehicle to ensure that the needs before disassembly can be met. In this regard, in the preparation process before disassembly, it is necessary to check whether the tools in the kit are complete, and the lifting equipment corresponding to the actual situation of electric vehicles should be prepared. At the same time, it is also necessary to set up safety warning signs to ensure that the disassembly of power battery pack can be carried out safely. In addition, the protection work of maintenance personnel should also be done well, and safety training should be done in advance. Both maintenance personnel and managers should wear protective equipment. In addition, reasonable allocation of maintenance personnel (two or more people), including at least one person who has received professional training and obtained a certificate, can ensure the orderly disassembly of electric vehicle power battery pack.

### (2) Battery pack disassembly

The disassembly of electric vehicle power battery pack mainly consists of the following five links, as follows:

First, vehicle placement. It is necessary to maintain the battery repair or vehicle maintenance in a stable state, remove the vehicle key, and ensure that personnel, vehicle and key are separated. After these contents are completed, safety warning signs shall be set up near the removed lead-acid batteries.

Second, remove the parts that interfere with each other. Maintenance personnel need to check whether the battery pack is connected with the chassis or other parts. For example, when there is a connection between the brake line and the power battery pack, the maintenance personnel need to adjust the removal screws, corresponding devices, etc., until the two sides are no longer connected.

Third, remove the maintenance switch and connector. In this link, the maintenance personnel need to follow the correct way and remove various plug-ins and switches in turn according to the communication sequence. In particular, they should pay attention to the removal of the cooling water pipe. First, they should pull out the cooling water pipe to ensure that the coolant in the water pipe can be drained, so as to ensure that the cooling water pipe is dry.

Fourth, dismantle the key battery pack. Before disassembly, the maintenance personnel use the pre set lifting equipment to fix the battery pack to ensure that its center of gravity can be placed on the equipment. When removing the fixing screws, two personnel need to cooperate with each other to slowly remove the equipment until it is completely removed, which can improve the safety of key battery pack disassembly operations.

Fifth, when placing the dismantled battery pack, the dismantled battery pack should be properly protected to ensure that it will not come into contact with dust and other objects. Warning signs should also be placed in a reasonable maintenance area to prevent other people from touching or moving by mistake.

## 2. Research on common problems of electric vehicle power battery

First of all, due to the short duration of the fault of monomer voltage jump, it is difficult to collect data, and there are relatively many causes of the fault, which makes it difficult for maintenance personnel to make accurate judgment. Therefore, when analyzing such faults, the maintenance personnel need to be familiar with the specific operation principle of the line on the basis of understanding the specific conditions of the cell, and ask the driver about the specific conditions of the fault. In this way, it is convenient for maintenance personnel to accurately analyze and collect information and historical data, and quickly find the potential location of power battery failure of electric vehicles. In case of maintenance failure, the maintenance personnel can effectively solve the fault of monomer voltage jump by combining the repair of the pressure line, the contact repair of the pressure line and the repair of the battery management system.

Secondly, in terms of monomer undervoltage, the main cause of this fault is the quality of the cell. In the power battery of electric vehicle, if a battery cell has low voltage, first judge whether the vehicle has been used for a long time. The aging of the vehicle will lead to the low voltage fault of the whole battery cell. However, the service time of the vehicle is not very long. The maintenance personnel should ask the driver for specific information. In this way, we can quickly understand the cause of this fault. In addition, when repairing the fault, the maintenance personnel should pay attention to the number of undervoltages per unit, and also ensure that the battery pack power is consistent, which can ensure that the balanced demand can be met. When the electric vehicle has insulation fault, no output of high-voltage pool group, relay adhesion and other faults, maintenance personnel need to adhere to the principle of specific analysis of specific problems. For example, in judging

When there is no high-voltage output of the battery pack, it is necessary to determine the problems of its communication and low-voltage power supply lines, and conduct specific tests on the unpacked capacitor bank.

In addition, temperature fault is also one of the common faults of power battery. The temperature fault is usually manifested in the following two cases: first, the internal resistance of the battery module is too large and hot; Second, sensor failure leads to signal. In the actual operation process, when the power battery has abnormal temperature fault, it often shows that the sensor is abnormally low (or high), and the temperature difference is too large (or high). According to the actual investigation, the battery temperature is too high, mainly because the battery internal resistance has problems in the self discharge level, and the maintenance personnel need to replace the battery module. In addition, if the temperature fault is caused by the sensor, it is necessary to check whether the temperature sensor is faulty. If the temperature sensor is not faulty, it is necessary to replace the acquisition module, so as to effectively solve the temperature fault in the power

battery of electric vehicles.

This time, the power battery cooling system is also prone to failure. Maintenance personnel should reasonably control the temperature control system in battery management, control the temperature to a reasonable range, and use liquid cooling or air cooling to cool down. In the heat dissipation control, the water pump, fan and air conditioning system can be combined to adjust the temperature to avoid fire accidents caused by untimely heat dissipation. At the same time, to ensure the stable operation of these systems, the first prerequisite is to ensure that the battery water pump and cooling fan can operate normally. Therefore, the battery management system needs to dissipate heat according to the temperature value set by the battery and ensure the normal operation of the battery pack.

### 3. Battery pack fault diagnosis and maintenance

#### (1) Fault diagnosis process

The faults of different models and types of electric vehicles are also different. Therefore, the maintenance personnel should know enough about the relevant information of the vehicle when repairing the fault, so as to quickly and accurately find the fault point. The specific process is as follows:

First, “learning”. Before troubleshooting, maintenance personnel need to learn relevant contents of power battery system, such as battery pack parameters, electrical principle, structure, safe operation specifications, etc. In addition, the contents of the maintenance manual related to the power battery pack need to be fully understood, especially the parameters of the battery pack and cell, such as working voltage range, capacity, number of series and parallel connection, pack structure, etc; In addition, the working principle, alarm strategy and electrical component specifications of the battery pack should be fully understood, and the process of “one look, two judgments, three measurements and four operations” should be well remembered. In addition, master the use of various test tools. In this way, when the maintenance personnel master enough solid theoretical knowledge, they can get twice the result with half the effort in fault maintenance.

Second, “listen”. Before troubleshooting, the maintenance personnel need to ask the driver in detail about the time of the car failure and the specific situation before and after the failure. During the inquiry, the maintenance personnel should listen carefully and make records. By listening to the driver’s description of the fault, it is convenient for the maintenance personnel to quickly find out the fault, but it is necessary to distinguish the accuracy of the feedback information, so as to make the maintenance personnel fully understand the situation of the faulty vehicle.

Third, “look”. Check the fault information reported by the power battery pack on the instrument and T-box, and record the information when the battery pack fails for reference when finding the fault. Pure electric vehicle instruments have battery pack power, voltage, current, fault alarm and other information, and some have minimum, maximum temperature, monomer voltage and other information, which can quickly troubleshoot some faults. If possible, you can log in to T-box to view the battery pack data and determine the fault.

Fourth, “prevention”. When troubleshooting high-voltage lines and other faults, maintenance personnel should do a good job of anti electric shock protection, and strictly follow the safe operation specifications to carry out electric work. At the same time, they should also conduct troubleshooting in strict accordance with the electric work and electric vehicle maintenance process, so as to effectively protect the physical and mental health of maintenance personnel.

Fifth, “measurement”. Check the details of the power battery pack, such as the fault information monitored by the diagnostic instrument or usbcan and other equipment. According to the fault information, the corresponding fault point can be found. Information that cannot be reflected in the instrument can be collected by special tools, such as diagnostic instrument, usbcan, insulation meter and other special instruments. For information that cannot be obtained, it can be obtained by retrieving historical data, tracking test and other methods.

#### (2) Troubleshooting

After the above troubleshooting process is completed, the fault location of the battery pack is determined. When unpacking the battery pack for inspection, when the maintenance personnel open the upper cover, they need to maximize the integrity of the sealing ring to avoid damage to the sealing ring. In addition, a multimeter and other tools can be used to determine the faulty parts and replace the faulty parts. During the maintenance process, one person can operate and one assistant can avoid two people operating at the same time.

### 4. Common fault analysis and maintenance of electric vehicle power battery pack

As the electric vehicle is still in the development stage, various technologies need to be optimized, and there are relatively many deficiencies in the power battery pack. At present, the common faults mainly include unit undervoltage, unit voltage jump, etc., as follows:

#### (1) Monomer undervoltage

The most common failure of the power battery is the undervoltage of the single cell. At present, although the quality of the battery cell has been improved, the power battery pack needs a large number of single cells. Take Tesla as an example, a 60kwh model is composed of 6216 single cells. If one cell shows low voltage, the battery will age with the use of the vehicle, It may cause the low voltage of the string in which this cell is located. Relatively speaking, it is easy for maintenance personnel to judge the undervoltage fault of a single unit, but they need to effectively master the undervoltage standard, alarm threshold, working range of cell voltage, etc. specified by the manufacturer, and focus on asking the driver whether the vehicle mileage is shortened, and how much power is left when the vehicle is unable to drive or at a speed limit. If the instrument has the lowest and highest unit voltage display, you can quickly check the instrument to determine the specific value and the number of strings; If not, use usbcan and other tools to retrieve historical data for confirmation. In addition, the following items should be followed when repairing the fault: first, determine the number of single undervoltages, and there are several strings of

undervoltages; Secondly, how to ensure the consistency with the battery pack. For the first one, it can be obtained by reading historical data or end of discharge data; The second processing method is to replace the low-voltage monomer under the full power state, or use the equalization device to equalize the entire battery pack.

#### (2) Unit voltage jump

In the power battery fault, the unit voltage jump is also one of the common faults, but because this kind of fault has the following characteristics: difficult to collect data, short duration, many causes and so on, the troubleshooting of this kind of fault is somewhat difficult and cumbersome. To repair this fault, the maintenance personnel should not only understand the working range of the cell voltage and the contents beyond the alarm threshold, but also be familiar with the voltage collection principle and circuit of the battery pack, and ask the driver whether the vehicle has been restarted after the fault occurs, whether the phenomenon has occurred after the restart, whether the remaining power has changed, the working condition when the fault occurs, and the alarm when the instrument fails, etc. The historical data can be read through special software or equipment, or the data of T-box platform can be retrieved. If there is no T-box platform and no function of reading historical data, only the real vehicle road test can be intercepted through the upper computer monitoring software to determine the serial number of the fault. Because there are many reasons for single voltage jump, maintenance personnel need to check one by one, so as to improve the maintenance quality of single voltage jump fault.

### Summary:

In a word, although it is difficult to maintain the power battery fault of electric vehicles, the maintenance personnel accurately master the key points of battery pack disassembly, fault information acquisition, etc., and are familiar with the basic operating parameters of power battery pack, and master the diagnosis and maintenance methods of common faults such as unit undervoltage and unit voltage jump, The maintenance personnel can accurately find out the fault of the power battery of the electric vehicle, and then complete the fault maintenance with high quality.

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