

Research on Fault Diagnosis and Maintenance Mstrategy Based on Automobile Engine Electric Control System

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Abstract: With the wide application of automobile engine electric control system, in order to solve the adverse effects of system faults on vehicle performance, this paper takes the automobile engine electric control system as an example for in-depth study. Through the analysis of common faults, the diagnosis and maintenance strategy is proposed, including fault code analysis, circuit detection, software update, and component replacement and adjustment. These strategies are expected to improve the accuracy and repair efficiency of fault location, providing practical guidelines for relevant practitioners. The research aims to promote the development of technology in the field of automotive electronic control system and improve the level of maintenance, in order to provide beneficial reference and guidance for automotive engineers and maintenance personnel.

Keywords: Fault Diagnosis; Maintenance Strategy; Analysis of Fault Code

Introduction

In the modern automobile industry, the electronic control system of vehicle engine, as the key control unit of vehicle performance and efficiency, is particularly important with the continuous development of vehicle electronization. However, the system failure may lead to problems such as reduced performance and incomplete combustion, so the study of its fault diagnosis and maintenance strategies has become an urgent need to improve the level of vehicle maintenance. This study takes in-depth analysis of common faults of electronic control system, aiming to provide systematic solutions for engineers and maintenance personnel, improve the accurate diagnosis and efficient maintenance ability, in order to promote the progress of automotive electronic technology and improve the reliability of the vehicle.

1. Common faults in the electronic control system of automobile engines

1.1 Sensor failure

Sensors play a key role in the engine electronic control system, responsible for measuring various parameters, such as oxygen concentration, coolant temperature, air flow, etc. If the sensor fails, the system will receive incorrect data, resulting in decreased engine performance, incomplete combustion, emissions problems, etc. Common sensors include oxygen sensors, water temperature sensors, air flow sensors, and so on.

1.2 Actuator failure

The actuators in the engine electric control system include fuel injectors, throttle actuators, ignition coils, etc., which adjust the fuel injection, air intake, and ignition timing according to the information provided by the sensor. If the actuator fails, it may cause the engine to operate properly, drop power, or even fail to start. These failures may be caused by circuit problems, mechanical damage, or connection problems.

1.3 Circuit fault

The engine electric control system relies on complex circuits to transmit information and execute commands. Circuit faults may include wiring harness break, loose connector, short circuit, etc. These failures may disrupt communication between the sensor and the actuator, preventing the engine electric control system from working correctly. Circuit faults often require careful electrical inspection and troubleshooting.

2. Fault diagnosis of automobile electric control engine ignition system

2.1 Ignition coil fault

The ignition coil is one of the core components of the ignition system, which is responsible for converting the low voltage power to the high voltage to ignite the spark plug. Coil failure may cause insufficient ignition energy, unstable sparks, resulting in abnormal engine operation, power drop, or even unable to start. The diagnosis of ignition coil failure usually requires the use of professional test equipment to check the coil resistance, insulation status, and output voltage compliance.

2.2 Ignition control module failure

The ignition control module is the electronic device that controls the operation of the ignition system. If the module fails, it may lead to inaccurate ignition timing, decreased engine performance, and even cause serious ignition problems. Diagnosis of the ignition control module fault usually requires connecting to the diagnostic interface of the vehicle, and using the fault diagnosis tool to read the module fault code, while conducting real-time data flow monitoring to determine the specific cause of the problem.

2.3 The ignition sensor problem

Some modern cars are equipped with ignition sensors that monitor engine speed and position to ensure precise control of ignition timing. Failure of the sensor may result in incorrect ignition timing and therefore affect engine performance. Problems related to the ignition sensor can be diagnosed and solved by checking the sensor resistance, signal output and the connection status.

3. Fault maintenance technology of automobile electric control engine system

3.1 The fault diagnosis and fault code analysis

After reading the fault code, the technician needs to accurately understand the meaning of each code. This includes knowing the standardized interpretation of fault codes as well as manufacturer-specific code interpretations. Fault codes usually include a combination of numbers and letters, and numbers indicate the main fault type, while letters indicate detailed fault information. On the basis of understanding the fault code, technicians need to quickly and accurately locate the possible fault points. This may require further inspection, including inspection of the relevant sensors, actuators, circuit connections, etc. Sometimes, multiple failures can lead to similar fault codes, which requires in-depth fault diagnosis skills in analyzing information. In-depth troubleshooting may involve real-time data flow monitoring, observing the actual value of the sensor through the instrument to compare the expected values, thereby troubleshooting or confirming specific components^[1]. In addition, technicians may need to conduct further professional tests, such as circuit tests, sensor output tests, etc., to confirm the specific cause of the failure.

3.2 Circuit detection and repair

In the face of electronic control system failure, technical personnel should have the skills to be skilled in using various tools, including multimeters and other professional equipment. The application of these tools can help technicians quickly and accurately detect the state of the circuit to determine the problem. For circuit testing with a multimeter, the technician may first perform a continuity test to check the circuit for open circuit. This helps to confirm that the signal travels smoothly without the interruption. In addition, technicians may conduct resistance tests to check for any resistance abnormalities, which can help identify potential short-circuit or grounding problems. Once a circuit fault is found, the repair work may include re-welding the connection point to ensure that the connection is firm and reliable. For failure of circuit components, the technician may need to replace the affected components to ensure they meet specifications and works properly.

3.3 Software update and calibration

Technicians should access the manufacturer's official channels to get the latest software updates. This may include online platforms, software update tools provided by the manufacturer, or specialized diagnostic equipment. Once the update is obtained, the technician needs to accurately perform the software upgrade steps according to the guidelines provided by the manufacturer. When reviewing and upgrading the software, the technician usually backs up the current ECU settings in case of accidents during the upgrade. This helps to roll back to the previous version and avoid system instability. Some failures may not be caused by hardware failures, but by deviations in the system parameters. In this case, recalibrating the system parameters may be an effective means to solve the problem. Calibration usually requires professional diagnostic equipment to ensure that the individual sensors and actuators work within the standard range^[2]. Technicians need to follow the manufacturer's guidelines to calibrate with the correct tools to ensure the accuracy and performance of the system.

3.4 Part replacement and adjustment

When performing parts replacement, the first task of technicians is to ensure that the selected alternative parts meet the automobile manufacturer's specifications and standards. This means that the new parts need to have the same specifications, performance parameters as the original parts, and meet the corresponding technical requirements. This can be done by carefully consulting the car manufacturers' technical manuals, accessory catalogues, or using professional part identification tools. As the part replacement is completed, the technician must perform the proper calibration. This may involve the use of professional diagnostic tools to ensure that the new components work in concert with the entire engine electric control system. For example, recalibrate the zero point of the sensor or the action range of the actuator to ensure that the system can accurately read and respond to relevant parameters during normal operation. Facing a more complex situation needs adjustments to be made to optimize the performance of the system. For example, the technician may need to adjust the calibration of the throttle position sensor to ensure that the amount of engine air entry matches the fuel injection ratio. Adjusting the timing of ignition is also common to ensure that the ignition event coincides with the requirements of engine operation^[3].

Conclusion: Through the in-depth study of the automobile engine electric control system, it provides a comprehensive and practical strategy for fault diagnosis and maintenance. This will help to improve the efficiency of vehicle maintenance, reduce costs, and promote continuous innovation in automotive electronic technology. In the future, it is expected to further optimize the health monitoring and maintenance means of the electronic control system under the development trend of intelligent and autonomous driving. At the same time, with the rise of new energy vehicles, the need for the stability and reliability of the electronic control system will be more urgent, and we will continue to promote the research and innovation of related technologies, and contribute to the future development of the field of automotive engineering.

References

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