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ЭФФЕКТИВНЫЕ МЕТОДЫ ДИАГНОСТИКИ АВТОМАТИЧЕСКИХ КОРОБОК ПЕРЕДАЧ

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EFFECTIVE DIAGNOSTIC METHODS FOR MODERN AUTOMATIC TRANSMISSION

This article is devoted to the analysis of various diagnostic methods for modern automatic transmissions (automatic transmissions).We considered traditional approaches and up-to-date technologies used to identify malfunctions and perform preventive maintenance of automatic transmissions. The research is to highlight the advantages and disadvantages of each method, as well as their applicability depending on the type of automatic transmission, the nature of the malfunction and the available equipment.

The purpose of this article is to study and systematize existing diagnostic methods for automatic transmissions, evaluate their effectiveness and applicability in modern conditions and identify promising areas for improving transmission diagnostics and repair.

The relevance of the article is due to several key factors:

1. Increasing the number of automatically transmitted cars: modern cars are increasingly equipped with automatic transmissions, which makes their diagnosis important to ensure the reliability and safety of vehicles.
2. Technology complexity: modern automatic transmissions have complex electronic control systems, which requires the use of high-tech diagnostic methods. This makes it relevant to study and develop methods that can effectively identify and eliminate malfunctions.
3. Economic aspects: incorrect diagnosis or ignoring problems with the gearbox can lead to serious breakdowns, which entails significant financial costs for repairs. Effective diagnostic methods help to reduce the time and money for car maintenance
4. Environmental requirements: modern cars are subjected to strict environmental standards. Malfunctions in the transmission can lead to an increase in emissions of harmful substances, which makes the issue of timely diagnosis and troubleshooting relevant.

5. Development of existing technologies: the emergence of new technologies, such as diagnostic systems based on artificial intelligence and big data, opens up new opportunities to improve the efficiency of transmission diagnostics.

6. Education and training of specialists: with the increasing complexity of cars, the need for qualified specialists capable of diagnosing and repairing modern automatic transmissions increases. The study of diagnostic methods is an important aspect of the training of such specialists. Thus, the topic of automatic transmission diagnostics remains relevant both for research activities and for practical application in the automotive industry and after-sales service.

We should mention that checking the level and quality of the automatic transmission fluid is vitally essential.

No doubt, the level and condition of the fluid are extremely important for the correct operation of the automatic transmission. The quality of the fluid directly affects the overall condition of the transmission. A lack or excess of fluid can lead to many malfunctions in the automatic transmission. A low level of hydraulic fluid can cause the pump to suck air, which leads to cavitation, a decrease in system pressure and slipping of the clutches, which, in turn, causes them to overheat and serious wear of key gearbox components. In addition, a lack of fluid can cause extraneous noise.

Figure.1 - Low oil level

On the other hand, excess hydraulic fluid can cause it to foam due to the rotation of the gears. The foamed liquid loses its heat-conducting properties, which leads to overheating of the entire system. In combination with the loss of lubricat-

ing and hydraulic characteristics it disrupts the operation of automatic transmission control elements such as clutches and valves.

Figure.2 - Optimal transmission fluid level

We consider that it can be difficult to assess the state of modern transmission fluids by smell and color. The color can vary from transparent to dark red, and some liquids may discolor or darken during operation. By the composition and presence of wear particles or foreign liquids in the sample taken from the hydraulic system, it is possible to conclude about the condition of various components or parts of the unit.

So, checking the condition of the transmission fluid is one of the main diagnostic methods available to most motorists. Although such diagnostics provide sufficient information about the condition of the automatic transmission, it often turns out to be underestimated.

Moreover, we also determine computer diagnostics of automatic transmission as a very significant diagnostic method too.

Modern cars are equipped with electronic control units (ECUs) that can control the operation of the automatic transmission. The use of diagnostic scanners allows to read error codes and transmission operation parameters. The process includes:

- Connecting the scanner to the OBD-II connector.
- Reading error codes.
- Real-time data analysis.

Figure.3 - OBD 2 Scanner

Scanner Diagnostics helps to identify malfunctions quickly and accurately. We should note that it is difficult or sometimes impossible to identify the trouble visually (only using traditional methods). The scanner reads data from the electronic control unit (ECU) of the automatic transmission, providing information about the operating parameters of the gearbox, oil pressure, shaft rotation speed and other important indicators. This method allows to localize the problem much faster than with traditional troubleshooting.

Many automatic transmission malfunctions manifest when the car is moving. Inpatient diagnostics may not reveal such problems since the box operates in a gentle mode. Diagnostics in motion makes it possible to check the operation of the automatic transmission in real operating conditions, under load, which is crucial for identifying many malfunctions.

While driving, you can evaluate the operation of the automatic transmission in all modes (D, R, N, P, etc.), as well as at different speeds and driving styles. This allows you to identify problems that may occur only in certain operating modes or under certain conditions.

The data obtained while driving more objectively reflects the condition of the automatic transmission than the data obtained during static testing. The behavior of the car, reactions to acceleration and braking, smooth gearshift - all these parameters provide valuable information about the condition of the box. The combination of in-motion diagnostics and static diagnostics allows to get the most complete picture of the condition of the automatic transmission. The results of stationary diagnostics (reading error codes) can be compared with observations of the behavior of the car in motion. This significantly increases the accuracy of diagnosis and reduc-

es the likelihood of an incorrect diagnosis. In some cases, in-motion diagnostics can allow to figure out the problem faster, eliminating the need for prolonged static testing and disassembly of the automatic transmission.

However, it should be added that diagnostics in motion cannot replace a complete stationary diagnosis and is not always necessary. A combined approach involving both static and dynamic diagnostics is often more effective.

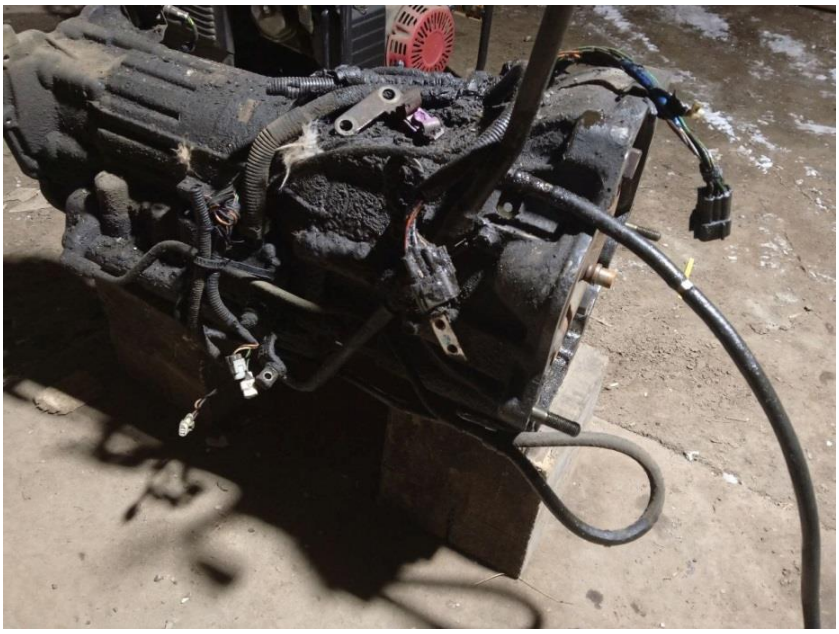

Figure.4 - Experimental setup

In conclusion, it should be stressed on that effective diagnosis of an automatic transmission is a multifaceted process that requires the use of various methods and technologies. Visual diagnostics, the use of scanners, component testing, field testing, computer diagnostics and thermography – all these methods have their advantages and disadvantages. The choice of a particular method depends on the nature of the problem, the available equipment and the qualifications of the specialist.

Given the constant development of diagnostic technologies, it is important to stay up to date with the latest methods and tools to ensure reliable operation of automatic transmissions and prevent expensive repairs in the future. Regular diagnostics will help car owners to keep their cars in excellent condition and extend the service life of the automatic transmission.

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