

**THE IMPORTANCE OF DIAGNOSTICS IN IMPROVING THE TECHNICAL  
CONDITION AND RESOURCE OF VEHICLES**

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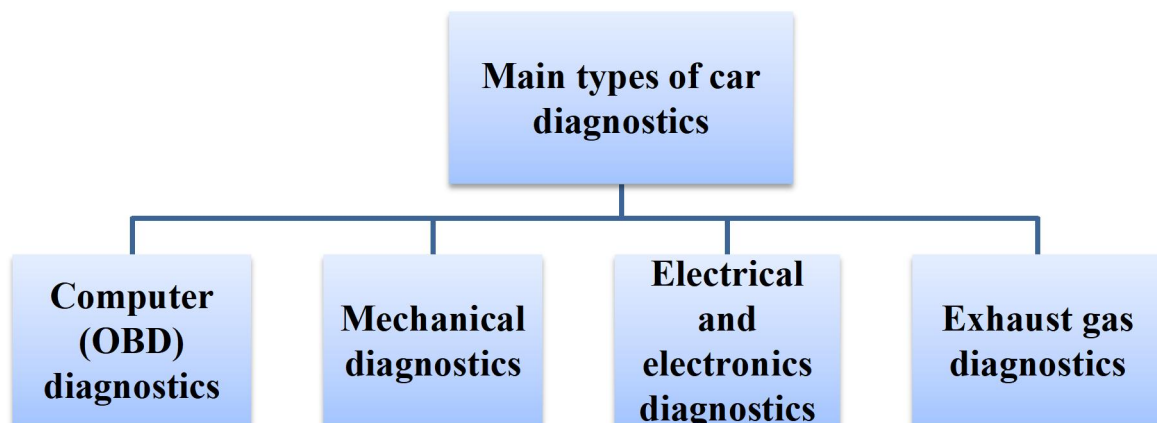
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**Introduction.** Modern cars consist of complex mechanical, electrical and electronic systems, and regular technical monitoring is necessary for their uninterrupted and safe operation. Diagnostics is the process of scientifically examining all car systems and identifying malfunctions, which is an integral part of technical maintenance.

The development of diagnostic systems has revolutionized the automotive industry: manual checks have been replaced by computers and digital devices. Today, diagnostics allows not only to find malfunctions, but also to prevent them, reduce fuel consumption and extend the entire service life of the car.

Theoretical part. Based on the existing literature and the work of car diagnostics carried out at car service stations, we can assume that there are the following main types of it.

1. Computer (OBD) diagnostics
2. Mechanical diagnostics
3. Electrical and electronic diagnostics



4. Exhaust gas diagnostics

Figure 1. Main types of car diagnostics

Computer diagnostics (OBD). OBD (On-Board Diagnostics) is an on-board diagnostic system that allows a car to self-diagnose. Since 1996, the OBD-II standard has been mandatory for all cars.

- Reading engine control unit (ECU) data
- Determining fault codes (DTC — Diagnostic Trouble Code)
- Monitoring sensor readings in real time
- Checking the fuel and exhaust gas systems

Mechanical diagnostics. Mechanical diagnostics involves direct inspection of the moving parts of the car. This method is performed by experienced mechanics.

- Checking the brake system (disc, pads, trunk)
- Suspension system (shock absorbers, levers, balls)
- Steering mechanism and steering system
- Checking the transmission and gearbox

Electrical and electronic diagnostics. Modern cars have hundreds of sensors, inter-unit bus lines (CAN-bus, LIN-bus) and control modules. Electrical diagnostics ensure the correct operation of these systems.

- Checking the condition of the battery and generator
- Diagnostics of lighting and signaling systems
- Airbags and active safety systems
- Checking the air conditioning and heating system

Exhaust gas diagnostics. To comply with environmental standards, checking the composition of exhaust gases is mandatory. This type of diagnostics also indirectly indicates the condition of the engine.

- Measuring the amount of CO, CO<sub>2</sub>, HC and NO<sub>x</sub> gases
- Assessing the efficiency of the catalyst
- Checking the operation of the lambda probe (oxygen sensor)

Research part. The reliable and safe operation of cars directly depends on their technical condition. Diagnostics is of great importance in monitoring and timely determining the technical condition. Diagnostics is the process of checking and assessing the operating condition of vehicle units, systems and mechanisms using special equipment and methods.

With the help of diagnostics, hidden malfunctions in the engine, transmission, brake system, steering and other important systems are detected early. This helps to prevent major breakdowns.

If faults are detected in time, they can be eliminated through minor repairs. As a result, major and expensive repairs are reduced.

The diagnostic process checks the main safety systems of the car - brakes, steering, lighting and electronic control systems. This ensures the road safety of the vehicle.

If there is a malfunction in the engine or fuel system, fuel consumption increases. Diagnostics identifies these problems and ensures that the engine operates in optimal mode.

Regular diagnostics and maintenance reduce excessive wear of vehicle components. This extends the overall service life of the car.

Based on the results of diagnostics, it is determined when the car needs to be serviced or which parts need to be replaced. This helps to use the vehicle effectively.

Road safety is one of the most important tasks of diagnostics. Many road accidents occur due to technical malfunctions of the car.

1. Brake system failures account for 30% of road accidents (according to international statistics).
2. Suspension system failures make it difficult to control and lead to tire bursts.
3. Lighting system defects dramatically increase the level of danger at night.
4. Sudden engine shutdown poses a serious risk of accidents on highways.

Timely diagnostics can prevent major financial losses. Regular inspections are essential to prevent a minor problem from turning into a major repair.

Table 1

Problem type	Early diagnosis cost	Delayed repair cost
Brake pad	150,000–300,000 so‘m	1,500,000–3,000,000 so‘m
Oil chain (engine)	200,000–400,000 so‘m	5,000,000–15,000,000 so‘m
Shock absorber	400,000–800,000 so‘m	2,000,000–6,000,000 so‘m
Cooling system	100,000–250,000 so‘m	3,000,000–10,000,000 so‘m
Fuel injector	180,000–350,000 so‘m	800,000–2,500,000 so‘m

An improperly adjusted engine, dirty air filter or a poorly functioning ignition system can increase fuel consumption by 15–30%. With the help of diagnostics:

- The engine operating mode is optimized
- The condition of the lambda probe and air mass meter is checked
- The fuel injector spray amount is adjusted
- Tire pressure and brake dragging problems are identified

A technically defective car causes more harm to the environment. Through diagnostics, the amount of CO<sub>2</sub> and toxic exhaust gases is controlled, as a result of which:

- Air pollution is reduced
- Complete fuel combustion is ensured
- The requirements of ecological technical inspection (TO) are met

Professional car diagnostics are carried out in the following stages:

1. Initial inspection: Appearance, oil level, fluids and wheel condition are checked.
2. Connecting an OBD scanner: A scanner is connected to the diagnostic socket (DLC) and error codes are read.
3. Live data analysis: Sensor readings are monitored while the engine is running.
4. Mechanical inspection: The chassis and suspension system are inspected on a lift or a channel.
5. Test drive: Problems are identified in real driving.
6. Report preparation: Faults found, recommendations and cost estimates are provided.

Car manufacturers and technical experts recommend following Table 2:

Table 2

Inspection Type		Period	Walking distance
General Diagnostics	Computer	Every 6 months	Every 10,000 km
Oil and Filter Change		Every 6–12 months	Every 7,000–15,000 km
Brake System Inspection		Every year	Every 20,000 km

Inspection Type	Period	Walking distance
Suspension System Inspection	Every year	Every 30,000 km
Full Engine Diagnostics	Every 2–3 years	Every 50,000 km
Transmission Oil Check	Every 2 years	Every 40,000–60,000 km

Nowadays, many manufacturers (Tesla, BMW, Mercedes-Benz) offer the possibility of remote car diagnostics. Through OTA (Over-the-Air) updates and telematics systems:

- Engine error codes are immediately sent to the manufacturer
- Software is updated remotely
- The driver is notified of problems via smartphone

Systems based on AI (Artificial Intelligence) analyze data from vehicle sensors and predict failures before they occur. This technology:

- Detects patterns based on a database
- Calculates the optimal time for replacing spare parts
- Takes into account driver behavior and road conditions

Universal diagnostic devices used in professional service stations support several dozen car brands. The most popular devices:

- Bosch KTS series — professional-grade diagnostic station
- Launch X431 — multi-brand manual diagnostic scanner
- Snap-on ZEUS — equipped with advanced analysis capabilities
- Autel MaxiSys — has the ability to work with AI

Conclusion. Car diagnostics — this is not just a technical procedure, but a modern scientific approach that combines safety, economy and ecology. Timely diagnostics:

- Significantly reduces the risk of traffic accidents
- Saves repair costs by 3–10 times
- Extends the service life of the car
- Optimizes fuel consumption

- Ensures compliance with environmental standards

Based on the above, the main rule for every car owner: it is advisable to carry out diagnostics not after the problem occurs, but to prevent it. Keeping your car in good technical condition with the help of modern technologies and qualified specialists will increase the resource of car parts.

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