Development of a Comprehensive Method for Diagnosing Wheel Bearings of a Car General Characteristics of the Problems of Diagnosing Wheel Bearings of a Car

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ABSTRACT

One of the most important national economic tasks is the modernization of the system of maintenance and repair of motor vehicles. This is largely facilitated by the widespread introduction of modern methods and means of technical diagnostics into the technological processes of maintenance (TO) and repair (R) of motor transport enterprises (ATP) and service stations (SRT).

Keywords: ABS systems, excessive clearance, allowable speed limits, self-adjusting elements, misalignment of rings.

Introduction

Existing approaches and problems of diagnostics of vehicle wheel bearings.

The introduction of methods and tools for technical diagnostics of vehicles can reduce the labor intensity and cost of maintenance (by 5–7%), reduce fuel consumption (up to 8–10%) and spare parts (by 3–5%) [1-3]. As a result of the introduction of methods and means of diagnostics, the specific component of the number of road traffic accidents due to technical reasons is reduced. At present, new methods and diagnostic tools have been developed, recommended for implementation and introduced into the system of maintenance and repair of vehicles at ATP and service stations, providing the necessary accuracy and reliability of measurements of a wide range of diagnostic parameters [4-6].

The main part

Automated diagnostic systems and fundamentally new means of assessing the technical condition of vehicles are widely used. Even with such a high level of equipment for diagnostic processes, material and labor costs for control and adjustment work account for 40% of the total maintenance work. At the same time, the preparatory and final time for installing, connecting and removing diagnostic sensors (transducers) remains high (up to 50% of the duration of diagnostic work) . In this regard, to reduce the cost of control and adjustment work, cars are equipped with built-in diagnostic systems. The most optimal is the combined system of built-in and stationary diagnostics. Specialized verification tools are also used to improve the metrological support of technical diagnostic tools (STD) and increase the reliability of diagnostic information. The issues of durability of car components and assemblies are of interest to both manufacturers and developers, as well as employees of car service enterprises [7-11]. Increasing the reliability of movable interfaces of machines and mechanisms is largely associated with the development and improvement of methods and means of diagnostic technology. Cars are complex combinations of components and mechanisms, with a large number of rotating parts, which are supported by various types of bearings. Bearing condition diagnostics in some cases is associated with labor-intensive operations carried out by qualified personnel.

At the same time, an accurate assessment of wear and the presence of defects using existing methods is not always possible due to the design features of components and assemblies. In particular, wear or damage to wheel bearings, which poses a great danger to all road users, is determined at service stations using visual inspection and measuring the backlash in the diagnosed unit [12-15]. A wheel bearing installed in an assembly is a rather complex object of diagnosis, since its technical condition is determined by a combination of processes and phenomena that are different in nature and have not yet been fully studied in the friction zones of parts. Analyzing the reports of bearing manufacturers, it was noted that about 80% of failed products are the result of incorrect settings (excessive clearance / load, damage during installation / adjustment), damage to the seals during installation, which entails the need to monitor, in particular, the condition of the hub assembly after replacement or repair.

80% Installation and configuration errors - excessive clearance/load, - damage during installation/configuration

8% Damage to seals during installation_

7% Damage to seals during operation

5% Other reasons

From the experience of car service enterprises, there are cases of deliveries of counterfeit products, the resource of which is small. The use of such bearings can lead to great loss or harm to the health of road users. Due to the design features of the chassis of cars, it can be noted that a visual inspection of wheel bearings does not provide complete information about the technical condition, and the design of most bearing assemblies does not provide for disassembly or removal of sealing rings, which completely eliminates the control of the condition of the internal surfaces of the bearing and the state of the lubricant. In this regard, there is a need to use non-destructive methods of control and diagnostics. The analysis shows the presence of a wide range of instrumental methods for monitoring and diagnosing bearings and assemblies, which are based on physical principles of various natures. But each of these methods has a number of disadvantages, which does not allow to fully describing all aspects of the technical condition of the control object. In the hub assembly, the use of single-row bearings has practically ceased or is used for commercial vehicles and special equipment. Since the 1960s, double-row angular contact bearings have been installed on cars, designed to absorb radial and axial loads [15-17]. In terms of speed characteristics, angular contact bearings are not inferior to single-row radial bearings. Increasing the contact angle somewhat reduces the allowable speed limits. And their ability to perceive the axial load is determined by the value of the contact angle, which is the angle between the plane of the centers of the balls and the straight line passing through the center of the ball and the point of contact of the ball with the raceway. It is established that the load capacity will increase with a change in the contact angle. The introduction of the first generation of bearings marked a shift away from single row bearings that require axial clearance (from 0 to 10 μm) as well as post-installation adjustments in the vehicle. First generation wheel bearings - a single, ready-to-install assembly consisting of two angular contact bearings with double (back-to-back) outer rings.

Which design made it possible to integrate the following functional elements:

– sealing devices with sensors of ABS systems;
– lubricants filled for the entire life of the bearing;
– self-adjusting elements.

The transition to first generation wheel bearings was accelerated by the growing popularity of front wheel drive vehicles. Subsequent generations of wheel bearings received improvements related to further functional integration, easier installation and maintenance, and a reduction in the weight of vehicle components. Thus, the nodes of new generations are very specialized devices, which simplifies and reduces the cost of car production technology, but may entail material costs for further maintenance.

Major faults that may occur in the wheel bearings. According to one of the approaches, the classification of rolling bearing defects is carried out by grouping emerging defects according to the time of their occurrence. For example, bearings can be damaged before installation, during installation work or already during operation of the equipment. ZKB specialists determine the following causes leading to defects: manufacturer's fault; errors made at the design stage of the bearing assembly (wrong choice of mounting dimensions, bearing type, lubrication system); incorrect assembly of the node; environmental influence; non-compliance with operating standards. It should be noted that the authors of modern scientific papers on flaw detection and non-destructive testing, consider the stage of the technological process at which this type of defect appeared as the main feature that classifies defects.

a) surface fatigue failure,
b) surface chipping,
c) abrasion,
d) atmospheric corrosion,
e) brinelling,
f) electrical damage,
g) chafing,
h) surface scuffing,
i) assembly damage,
j) misalignment of rings

Conclusion

Many defects occur at the production stage. These include outgrowths, shells, dents, foreign inclusions, gas pores, zonal and dendritic segregations, floods, oxide films, cracks formed during the cooling of the metal. Also, to the list of defects, delaminations, flaws, inclusions of slag, birdhouses, hairs, cracks, sunsets and zakovs formed during pressure treatment are added. During heat treatment, the grain increases, the parts burn out, lose carbon, or vice versa, are saturated with carbon, hydrogen and thermal cracks, flocks appear. Grinding and finishing cracks and burns appear during surface machining.

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