СИСТЕМЫ КОНТРОЛЯ И УПРАВЛЕНИЯ ДАВЛЕНИЕМ В АВТОМОБИЛЬНЫХ ШИНАХ ЧЕРЕЗ TPMS

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Аннотация. В статье представлена подробная информация о системах контроля и отслеживания давления автомобильных шин (TPMS). Правильное давление шины имеет важное значение для безопасности автомобиля, эффективности дорожного движения и оптимального расхода топлива. Система TPMS играет важную роль в обеспечении безопасности транспортного средства, предупреждая водителя при низком давлении шин.
Ключевые слова: автомобиль, давление в шинах, безопасность, расход топлива, шины, дорожная безопасность, износ шин, система управления, техническая неисправность, авария, автомобильная промышленность.

AUTOMOTIVE TIRE PRESSURE MONITORING AND CONTROL SYSTEMS THROUGH TPMS

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Abstract. The article provides detailed information on tire pressure monitoring systems (TPMS). The correct tire pressure is important for vehicle safety, traffic efficiency, and optimal fuel consumption. The TPMS system plays an important role in ensuring the safety of the vehicle, warning the driver when the tire pressure is low

Key words: automobile, tire pressure, safety, fuel consumption, tires, road safety, tire wear, control system, technical failure, car crash, automotive industry.

Introduction. Car tires play a crucial role in the safety and efficiency of a vehicle. Proper tire pressure not only ensures the comfort of driving on the road, but also plays a major role in preventing traffic accidents. Incorrect tire pressure can increase a vehicle's fuel consumption, cause faster tire wear, and even pose a risk of losing control on the road. Therefore, tire pressure monitoring and control systems (TPMS) are of great importance.

Negative and often dangerous factors that affect safety and economy can be easily eliminated with the help of tire pressure monitoring systems (English Tire Pressure Monitoring System) or TPMS.

The main part. In performing the procedures, direct test systems use sensors located inside the tires, which directly measure the pressure and temperature of the gas in the tires. Using a transmitter located inside the sensors, the state of the bus is transmitted via frequency signals. The monitor (receiver) can be located both inside the signal processing unit located on the dashboard and outside it. The signal processing unit informs the driver about the current state of the tire pressure. Indirect (indirect) systems calculate the tire pressure using the ABS system, including wheel pressure sensors and/or accelerometers, and a local computer. Indirect monitoring systems, in turn, are divided into internal - when the module is installed on the rim or tire (Fig.1) and external - the module is mounted on the wheel nipple (Fig.2).

Internal sensors are installed instead of standard nipples in such a way that the sensor is inside the tire, which is very inconvenient, since it requires the installation of additional tires, but at the same time the sensors are protected from external influences and vandalism. However, since the battery life is 5-10 years, you can only deal with the initial dismantling of the tire and installation of the sensor, and the subsequent replacement of the battery is possible when changing tires.

Analysis and process mechanisms. External sensors, unlike internal devices, are mounted on standard nipples and do not require the installation of additional tires. This allows not only to quickly install the system, but also to use it on several vehicles.

For example, dismantle the sensors from an idle vehicle and apply them to a vehicle in a queue. However, such sensors are not immune to environmental influences.

Figure 1. Example of a surveillance system based on internal sensors [3]

Figure 2. Example of a monitoring system based on external sensors.[3]

Recommendations and solutions. Energy saving is a very important aspect of the TPMS wheel module, which does not suggest replacing the battery for 5-10 years. For this, an energy saving system is used in the wheel module system. The meaning of this system is to switch to idle mode when there is no movement and to switch to active mode when moving. There are also time intervals for measuring pressure, so during normal movement, measurements can be once every 45 seconds (depending on the manufacturer), and with a sharp decrease in pressure, the measurement interval occurs once every 15 seconds.

Two types of tire pressure monitoring are currently in use. These are the direct measurement and indirect measurement systems. The direct measurement system directly measures the temperature and pressure of the tires and uses a transmitter. The indirect measurement system checks the tire pressure by differences in wheel speed. Types and examples of internal pressure monitoring systems are presented.[1]

Disadvantages of the TPMS system:

-technical failures. In the event of a malfunction in the TPMS system, the system itself or the sensors may not work, which reduces the safety of the driver.

-integration with other systems. Some cars may integrate additional systems into the TPMS system, which complicates the operation of the system.

-battery operation. TPMS systems in some cases operate on batteries, and if the batteries are not replaced in a timely manner, the system may fail.

The problem in the process and its solutions

Table 1

Problem	Cause	Solution
Low tire pressure	Tires are deflated, due to age or bad weather conditions.	TPMS system gives a warning. Check tires and restore the required pressure.
TPMS system malfunction	Dead battery in sensors or system failure.	Check sensors, replace batteries or reset the system.
Inaccurate pressure display	TPMS system malfunction or sensor calibration error.	Diagnose the system and recalibrate or replace sensors.
Error or malfunction warning	System failure or sensor malfunction.	Check the system and eliminate the malfunction. Replace sensors if necessary.
The need to constantly check the pressure	Forgetting to check tires regularly or TPMS not being activated.	Regularly inspect the vehicle and regularly monitor the condition of the TPMS system.
High fuel consumption	Incorrect tire pressure, especially low pressure.	Ensure correct tire pressure, use the TPMS system.
Faster tire wear	Low tire pressure or incorrect tire balance.	Regularly check tire pressure, regularly monitor based on TPMS system data.

The table above summarizes the main problems and solutions aimed at ensuring the correct pressure of car tires and the operation of the TPMS system.

Monitoring tire pressure is important for improving road safety and extending the service life of car tires.

Conclusion: Tire pressure monitoring systems play an important role in ensuring the safety of the vehicle, improving road safety and saving resources. With the development of the TPMS system, drivers have been able to monitor tire pressure accurately and in real time, which helps to make the vehicle safer and more efficient. Although the system has some disadvantages, its benefits are overall very large, so TPMS technology continues to find its place in the automotive industry.

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