EVALUATION OF THE INDICATORS OF THE ELECTRIC VEHICLE BRAKE SYSTEM TESTING SYSTEM IN IMPROVING TRAFFIC SAFETY

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Abstract: The purpose of this scientific article is to develop the characteristics of the braking system of electric vehicles for testing. In the study, it is important to develop a description of the special devices used in the process of testing the devices used in the service of electric vehicle braking systems.

Key words: Electric car, electricity, energy, power, engine, automobile, transportation, battery, tire, brake, movement, safety, fuel, construction, ecology, environmental.

Аннотация*:* Целью данной научной статьи является разработка характеристик тормозной системы электромобилей для испытаний. В рамках исследования важным является разработка описания специальных устройств, используемых при испытаниях устройств, используемых при обслуживании тормозных систем электромобилей.

Ключевые слова: Электромобиль, электричество, энергия, мощность, двигатель, автомобиль, транспорт, аккумулятор, шина, тормоз, движение, безопасность, топливо, строительство, экология, окружающая среда

Introduction

It is also appropriate to separately consider the description of the devices used in testing the braking system of electric vehicles. In the course of the ongoing practical research, the following devices were used and are recommended for

measuring and recording the main operational indicators of electric vehicles through analysis.

A brake test stand is used to test the braking system of electric vehicles. This stand tests the efficiency of the braking process and the safety requirements of electric vehicles. It is equipped with special measuring instruments designed for evaluation. With the help of this stand, the braking processes of electric vehicles in different modes are determined and the performance indicators of the regenerative braking system are studied.

Figure 1. Test layout of the braking system of the BYD SONG PLUS CHAMPION electric vehicle.

It is also advisable to determine the main tasks of the electric vehicle braking system test bench, which are as follows:

- It performs the task of determining the distribution of braking force on the wheels.

- It checks the braking torques on each wheel by measuring and comparing them.

- It evaluates the characteristics of the electric vehicle during braking and records the results.

- It also performs the task of calculating the amount of energy recovered through the regenerative braking system of electric vehicles.

- It performs the task of determining the braking distance and time of electric vehicles using stages at different speeds.

The sequence of measurement conditions during the test process includes several stages. Initially, sensors installed on each roller determine the braking force, its torque and speed. The resulting signals are transmitted directly to the electronic control unit. Using specially developed software, all indicators are processed and displayed on the screen in graphical form. These processes are illustrated in Figure 2.

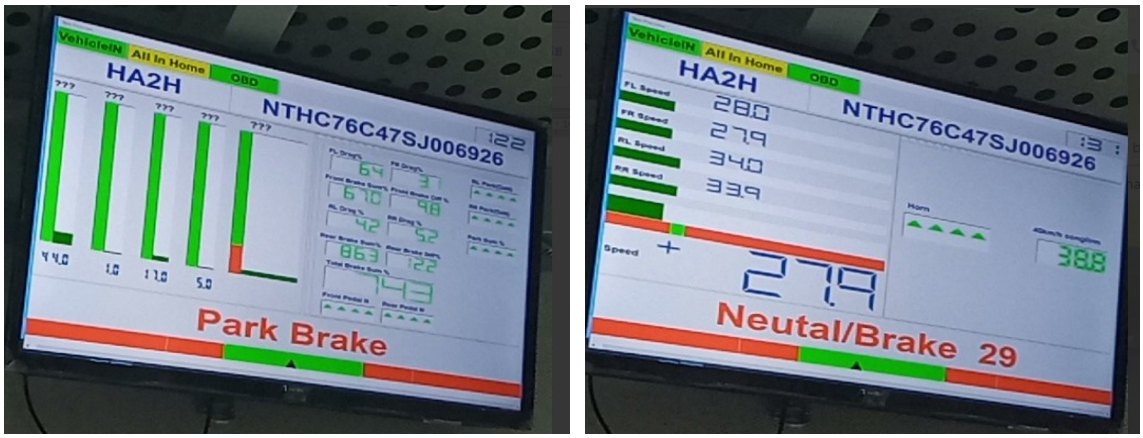

Figure 2. Screen for recording the results obtained.

- According to the test results, the following indicators are obtained and analyzed by recording the data obtained.
- - Maximum braking force (N);
- - Braking onset time (s);
- - Unevenness of force on the wheels (%);
- - Amount of energy recovered by the recuperative system (kWh).

Table of measuring instruments used in applied research and their technical specifications

№	Naming of equipment	Indicators of measurement parameters	Measurement range	Accuracy level
1	Electricity meter	Energy consumed and recovered (kWh)	0 – 500 kVt·soat	0,5
2	Torque and force sensor	Torque (Nm), power (kW)	0 – 500 Nm; 0 – 200 kVt	1,0
3	Speed and	Speed (km/h),	0 – 200 km/h	1,0

	acceleration sensors	acceleration (m/s²)		
4	Battery monitoring system (BMS module)	State of charge (SOC), voltage, current, temperature	0 – 800 V; 0 – 500 A	0,5
5	Environmental control tools	Temperature (°C), humidity (%), pressure (Pa)	-40…+60 °C; 0–100 %	1,0

The distribution of braking force between the front and rear wheels of electric vehicles is depicted in the graphic form shown in Figure 3 below.

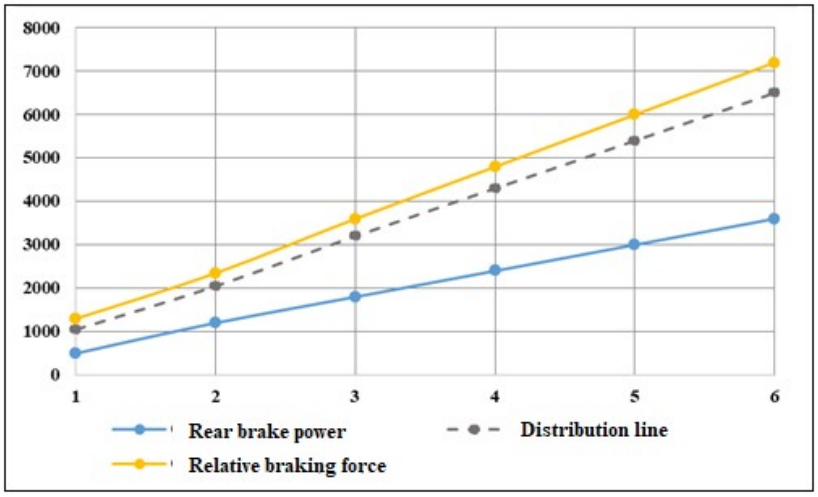

Figure 3. Braking force distribution for front and rear wheels

During the movement of an electric vehicle, during light and moderate braking, the distribution of braking force is ~ 70–85% on the front wheels, and 15–30% on the rear wheels, providing a regenerative advantage (Figure 3.10). During heavy braking, the distribution of braking force is ~ 60–70% on the front wheels, and 30–40% on the rear wheels, increasing the share of the hydraulic brake system. The energy recovered during a constant stop at a speed of 60→0 km/h is ~0.045–0.060 kWh. This indicator is equal to ηchain=0.60–0.80. When the SOC of the battery is in the operating range of 50–70%, the return is stable, and when the SOC

of the battery is 90%, charging is limited. This is due to the fact that it is not able to absorb excess power.

Conclusion

The devices and their metrological support used in the practical research on the test stand of the electric vehicle braking system determine the operational characteristics of electric vehicles and allow for reliable and accurate analysis. The test results show that with the help of high-precision measuring instruments and devices, the energy efficiency and environmental performance of electric vehicles can be fully analyzed. The devices and their metrological support used during the test period increase the reliability of the assessment of the technical performance of electric vehicles in operational conditions.

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