Summary Project Report

A Review of Brake Performance Monitoring Systems

A study of the potential for BPMS to assure roadworthiness

Authors
M. McCarthy, M. Edwards, A. Deans, F. Amadhe

June 2025

Department for Transport

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The research

The challenge:

NOW: Assess the feasibility of improving inspection efficiency and reducing industry costs by substituting the use of BPMS for roller brake tests carried out as part of safety inspections and at periodic technical inspection (PTI).

FUTURE: Assess the longer-term outlook and implications for BPMS in future automated vehicles.

A market review found nine separate BPMS that are available only for semi-trailers and trailers, which measure only service braking efficiency. One further system was found fitted to DAF trucks as part of the electronic braking system, but this did not report service braking efficiency remotely and provided only a driver warning light in the case of reduced service brake efficiency.

Stakeholder engagement comprised tailored questionnaires and interviews covering a range of stakeholder categories and resulted in responses from 22 and 9 organisations respectively. A number of ADS developers were approached but, unfortunately, they could not engage with the project in the required timescales. Future research should engage with more ADS developers to validate the assumptions in this study.

Main findings

Potential use in place of Roller Brake Test

Current BPMS are not suitable for replacement of the Roller Brake Test (RBT) in the MOT for several reasons, the main ones being that only service brake efficiency is measured, whereas the RBT in the MOT assesses a much greater scope of brake deficiencies, and the service braking efficiency of the trailer cannot be disaggregated from that of the truck. However, for operators using these systems, it is typical that they are used in some safety inspections in place of directly measuring service brake efficiency via a RBT.

Among the benefits identified are that BPMSs:

- Provide monitoring of service brake efficiency over time, facilitating predictive maintenance and realising the associated operational and safety benefits.
- Negate the time, resource, and cost with activities associated with performing a laden RBT such as getting vehicle to test facility and loading / unloading it for test:
- As estimated by industry, BPMS could result in a benefit of approximately £100 per trailer per year if they are used as a substitute for 3 laden roller brake trailer tests as part of the safety inspection regime for commercial goods and large passenger vehicles.

Variable functionality

Substantial variability was found between current BPMSs, particularly with respect to system inputs and how valid brake events are determined. There was also variability in system outputs, a lack of consistent verification/validation of function and no third-party check of compliance of the systems with the standard.

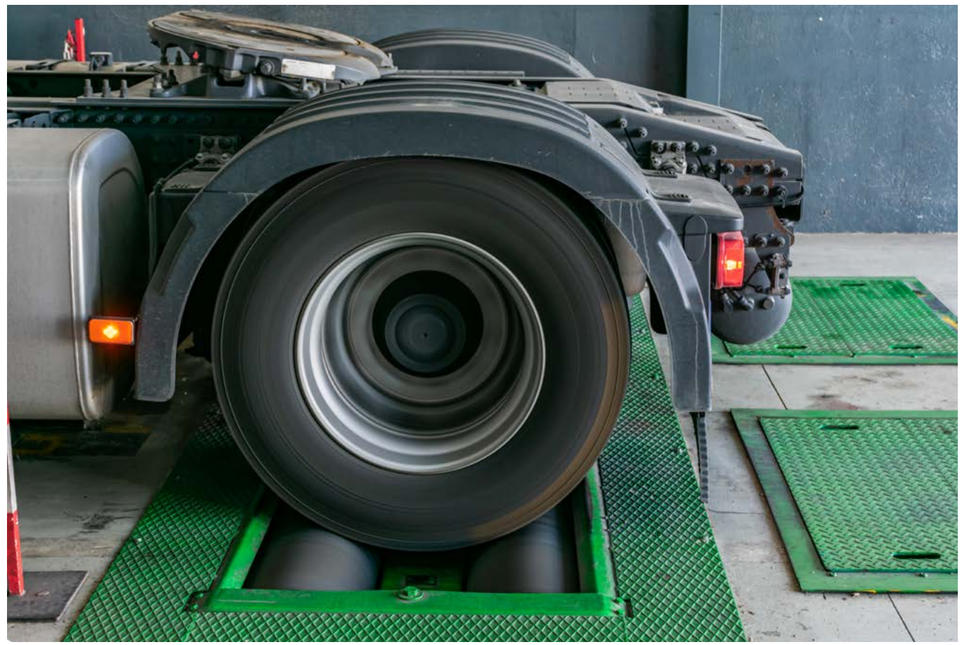
Revised technical requirements for the existing Electronic Brake Performance Monitoring Systems (EBPMS) standard (DVSA, 2024) are recommended to ensure an improved minimum standard for current and near future systems on trailers and semi-trailers. Revised requirements for both system outputs and verification/validation procedures against a laden, graduated RBT with controlled brake delivery pressure are specific areas of the standard that could be modified without impinging on intellectual property rights.

Improved minimum performance levels would likely increase industry confidence in the systems.

Looking ahead – near term

Sensors

In the near-term future, technical developments for current BPMS may include wheel end / brake temperature and additional wheel speed sensors to provide an indication of location of service braking efficiency deficiencies. Temperature measured by tyre pressure monitoring systems (TPMS) could also be utilised as indicative information for location of issues. This may allow some items to be assessed that are not possible for current systems.



Looking ahead – long term

In the longer term, the three major trends of connectivity, automation, and electrification will affect the future of the automotive industry and introduce both new challenges and new opportunities for vehicle braking systems.

Connectivity

For vehicle connectivity, the industry (ACEA) propose a model called the 'Extended Vehicle' (ISO 20077, 2017), which is already deployed by some OEMs. To assure cybersecurity, OEMs are likely to introduce more security measures which could make access to vehicle data by third parties more restricted, in particular in regard to fitment of third-party devices, such as current electronic BPMSs. This could prevent these devices accessing vehicle data in the future. Precisely how this issue may be addressed in the future is unknown at present, but several potential options can be envisaged, including a potential regulatory route.

Electrification

Electrification is considered likely to exacerbate an existing problem with 'sleeping brakes' because of greater use of regenerative braking rather than traditional friction brakes. However, manufacturers have braking strategies to reduce the risk of sleeping brakes developing. For example, if the friction braking force requirement was low, instead of braking all axles at a low force, which would develop sleeping brakes, one axle could be braked at a higher force to exercise individual axle brakes more and reduce the risk.

Looking ahead – long term

Full vehicle automation

Full vehicle automation will likely drive a change to more electronic based roadworthiness testing of vehicles, because at full automation (i.e. SAE level 4 and 5), the automated driving system (ADS) will require verification that the vehicle is in a roadworthy state before (and while) the self-driving functionality is activated, and this will need to be achieved in a cost-effective manner. For the braking system, as well as continuous remote performance monitoring, a self-test performed by the ADS could be a key part of an electronic test suite because it offers greater opportunity for roadworthiness assurance. For example, it could brake individual axles and wheels and thus assess performance at axle / wheel level which is not possible currently for remote performance monitoring systems. However, braking of a vehicle for self-diagnostic purposes on public road would need to be assured to be safe and the enhanced diagnostic capability gained justified before this approach could be implemented.

For a copy of the full report contact:

Mervyn Edwards medwards@trl.co.uk

Mike McCarthy mmccarthy@trl.co.uk

The way forward

While further research is required to understand how to assure and validate the roadworthiness of fully automated vehicles, a potential option is to develop regulation that includes specific technical requirements at a high level. These could be incorporated into secondary legislation developed for the self-driving test which the vehicle must pass to be granted authorisation for use. The self-driving test is enabled via the 'power to authorise' in Section 3(1) of the Automated Vehicles Act (2024). Specific high-level requirements for the ADS to check the vehicle's roadworthiness state to permit its use could be included, along with requirements for data availability so that inspection authorities, such as the Driver & Vehicle Standards Agency, could perform independent validation of the vehicle's roadworthiness.