CITA Topic Area B meeting

8th of October 2025, Norwegian Public Roads Administration, Oslo - Norway

Automated evaluation of brake tests within the central PTI information system

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Who we are

Main Vehicle Authority:



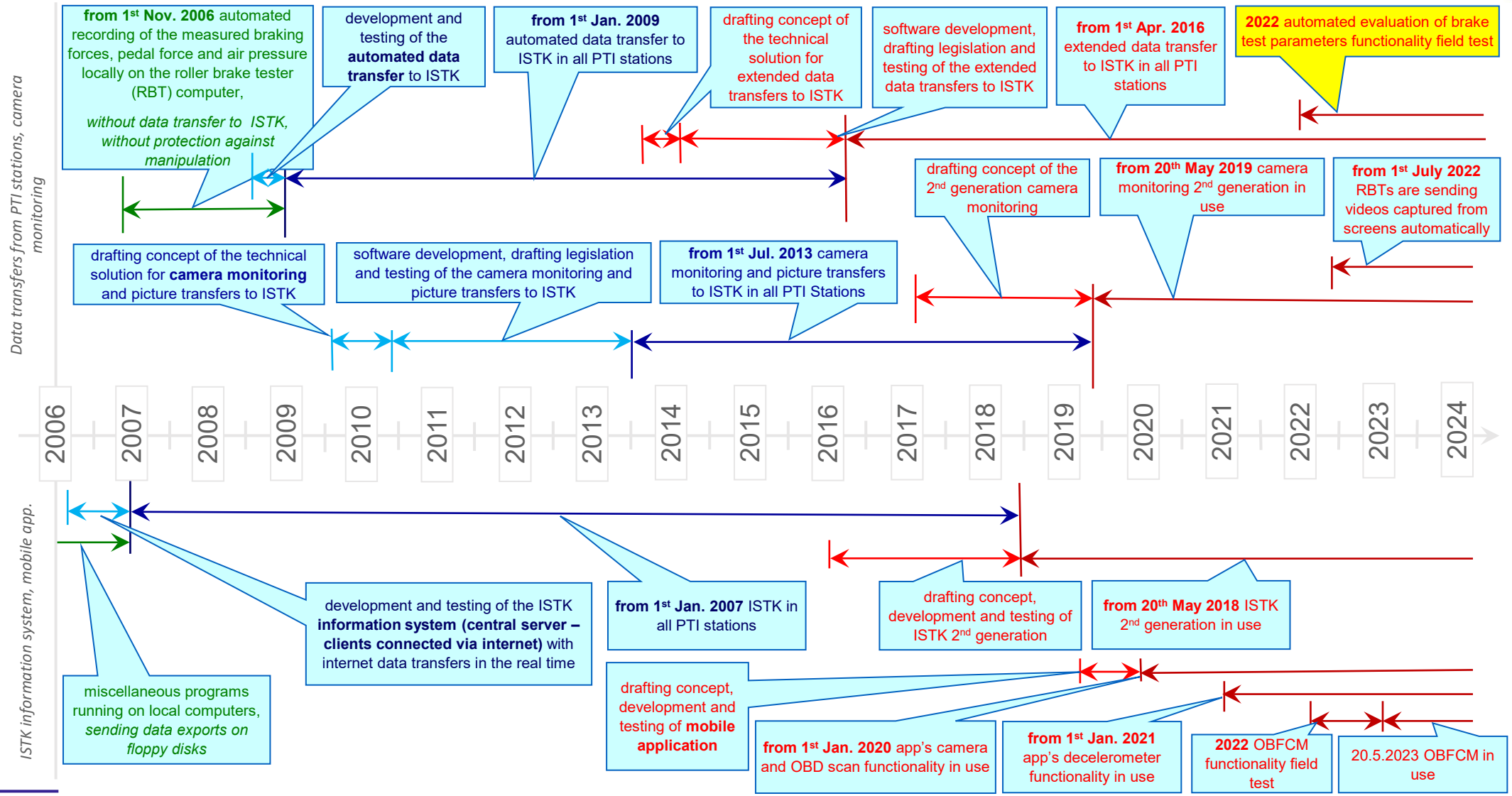
MINISTRY
OF TRANSPORT
OF THE SLOVAK REPUBLIC

Technical Service for Technical Inspections of Vehicles:

- *is assisting the Ministry and providing expert support in the field of vehicle periodic technical inspections (PTI)*
- *to avoid the conflict of interests it is not allowed to directly perform the PTI, nor to be related to the entities performing the PTI*

- *is responsible for:*
  - *research and development of new inspection methods*
  - *verification and inspections of workplaces and equipment*
  - *supervision over workplaces*
  - *education, training and exams of inspectors*
  - *inspection data collection, transmission and analyzing...*

Developing IT tools for efficient vehicle inspections since 2006



Data transfers from roller brake testers

Since 2016, we collect the complete set of standardized raw measured data from every brake test.

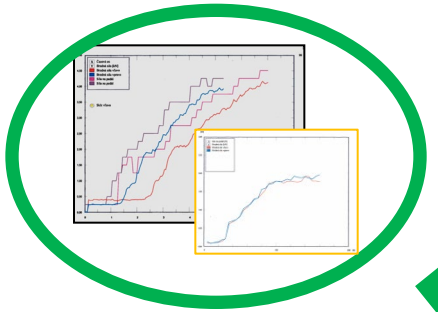
Combining with videos from inspection lane cameras and videos from brake tester screens allows us to reconstruct every brake test at a forensic level.

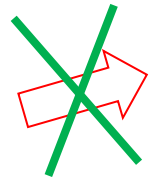
Until now, it has been used primarily for supervision purposes.

Roller brake tester (RBT)



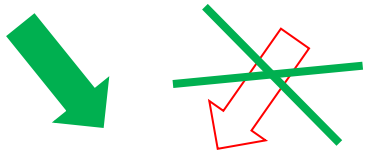
Standardized set of raw measured values







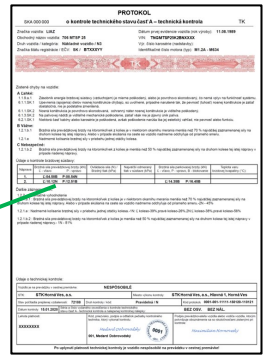
Brake test evaluation by the PTI inspector



PTI central information system (ISTK) server



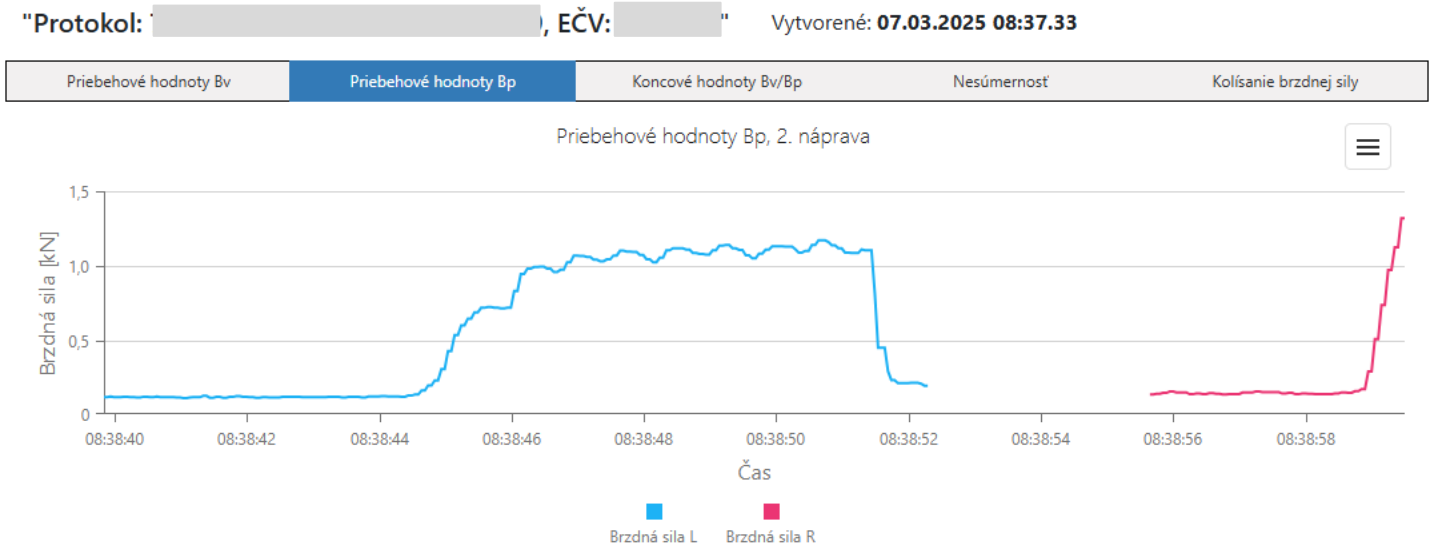
PTI report



Roadworthy

2024 / 2025: A new purpose of the data is to support PTI inspectors through an integrated algorithm that automates brake test calculation and evaluation.

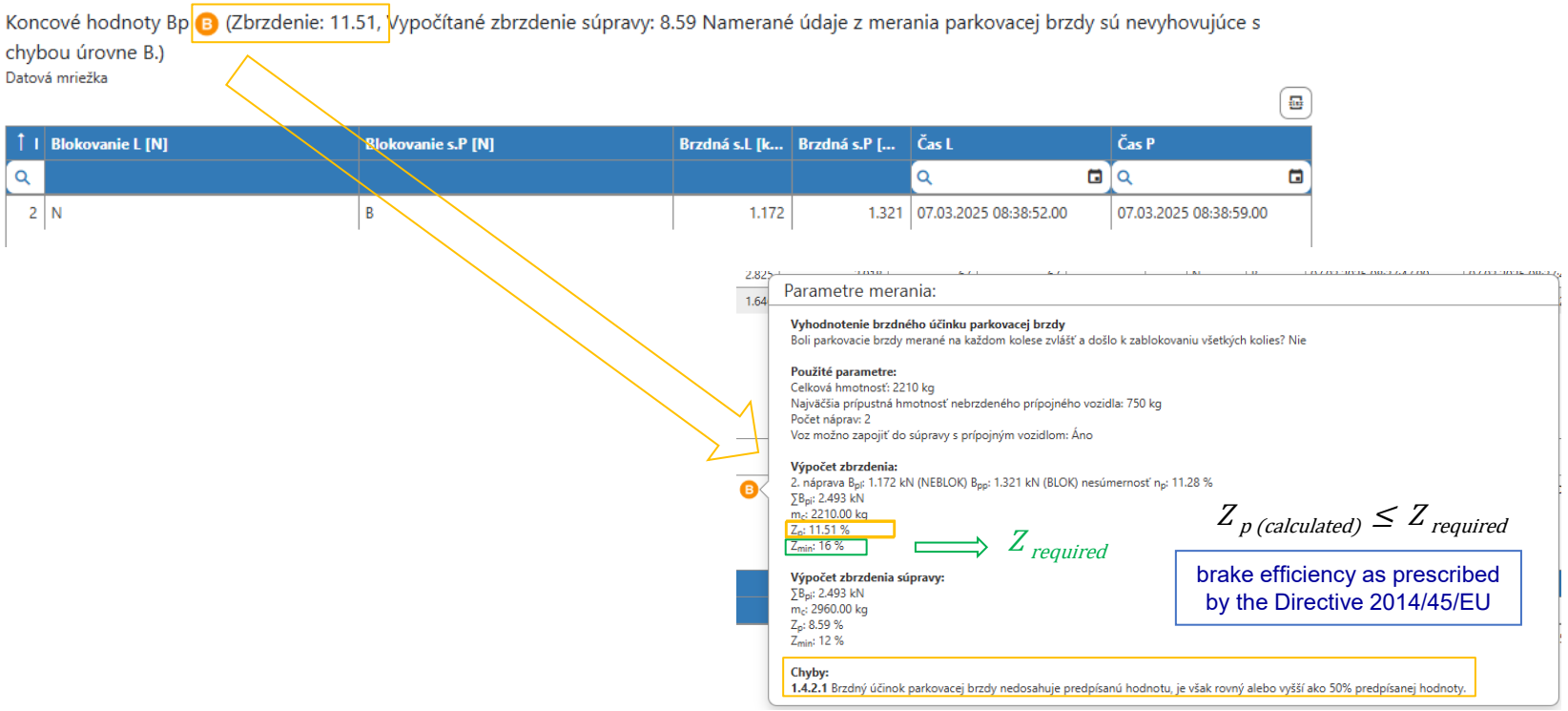
Evaluation of braking ratio – parking brake



Calculation of the braking ratio directly from the maximal brake forces reached during the test on RBT

$$Z_p = 10.2 \frac{\sum F_{b\,measured}}{m_{GVW}}$$

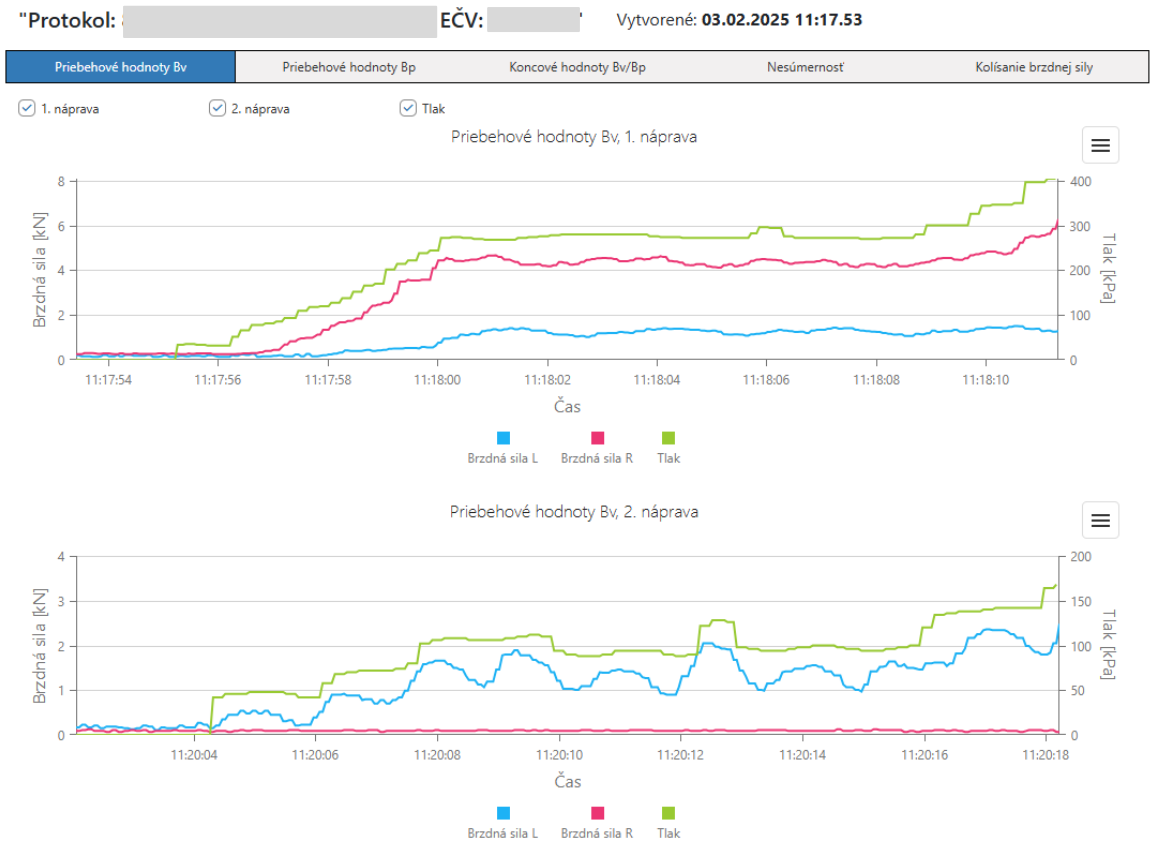
Evaluation of braking ratio – parking brake



The central information system automatically determines the parking brake's braking ratio and pre-selects the related defects as either major (orange) or dangerous (red)

The freedom of choice for the inspectors (to agree or disagree with the automated evaluation) has been kept

Evaluation of braking ratio – service brake



$$z = 10{,}2 \cdot \frac{\sum F_1 . i_1 + \sum F_2 . i_2 + \ldots + \sum F_n . i_n}{m_{GVW}} \qquad (\%)$$

ΣF_i *sum of the braking forces on wheels of the axle i (N)*

m_{GVW} *gross vehicle weight (kg)*

i_i *extrapolation coefficient of the axle i:* $i_i = \frac{p_{A\,lad\,i} - p_{0i}}{p_{A\,i} - p_{0i}}$

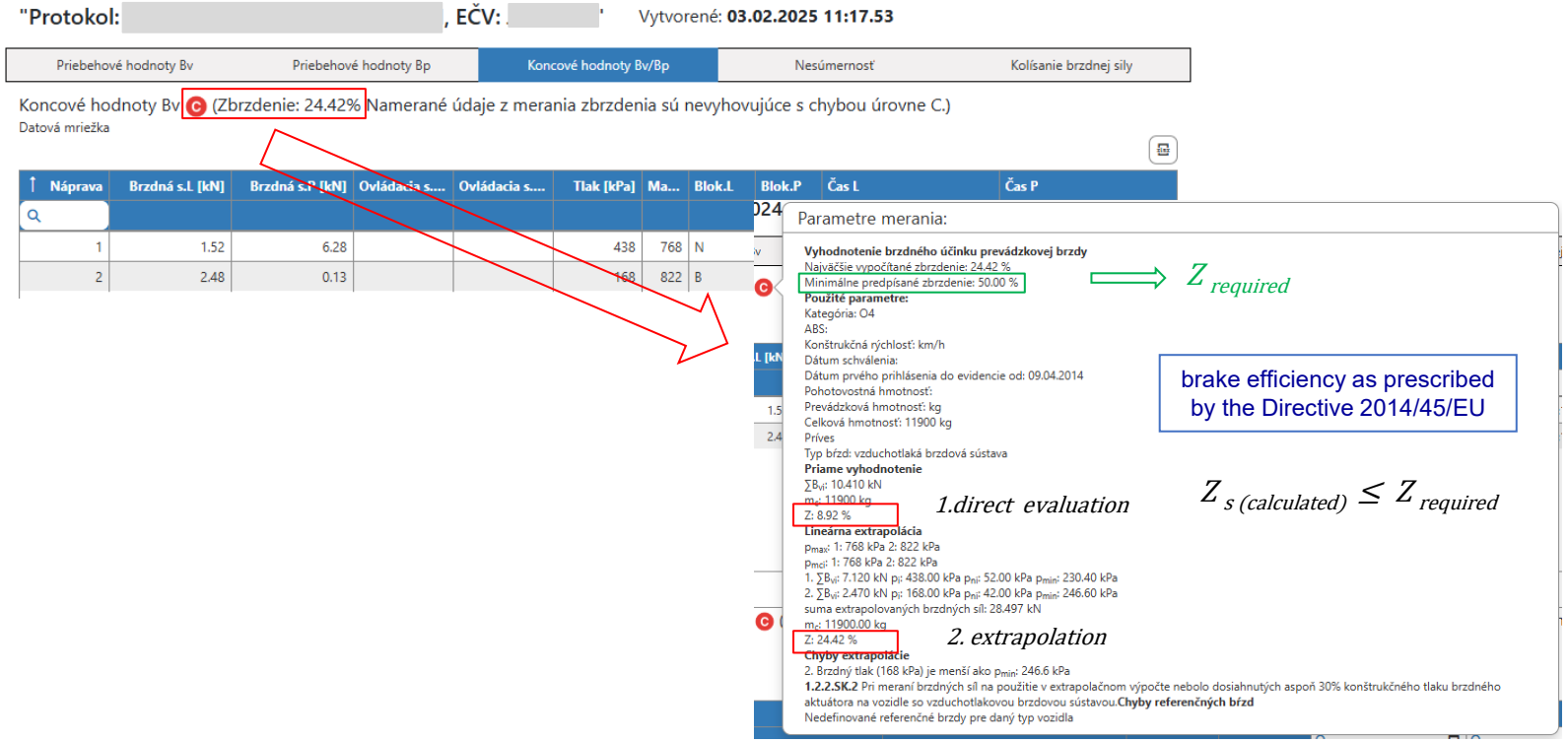
$p_{A\,lad\,i}$ *fully laden vehicle state brake actuator pressure in the circuit of the axle i stated by the manufacturer (kPa)*

p_{0i} *threshold air pressure in the circuit of the axle i (kPa); according to ISO 21069 equal to 40 kPa*

p_{Ai} *brake actuator pressure in the circuit of the axle i corresponding with the highest achievable braking force measured on the RBT (kPa)*

In this example, the extrapolation method was applied to assess the brake efficiency (braking ratio) of a category O4 vehicle with pneumatic brakes, revealing major brake defects

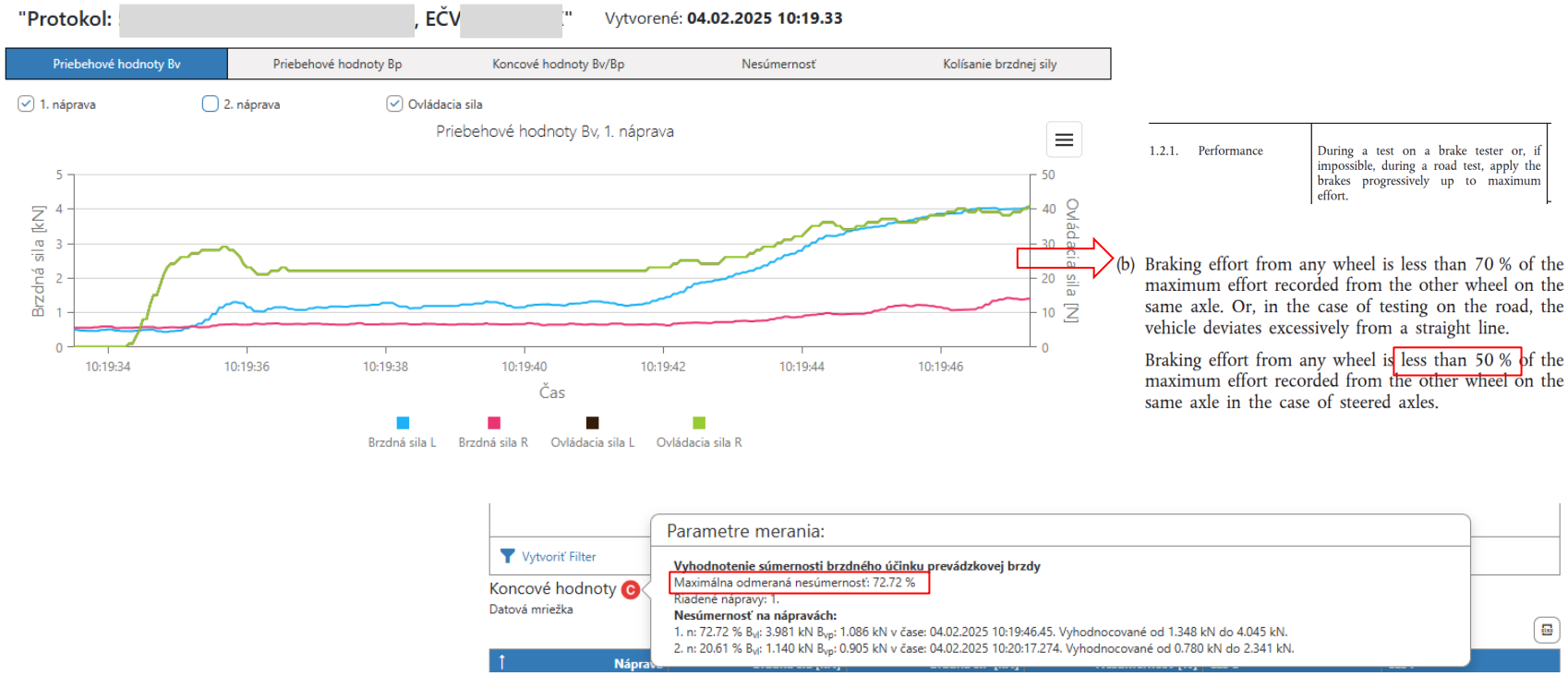
Evaluation of braking ratio – service brake



The central information system automatically determines the service brake's braking ratio and pre-selects the related defects as either major (orange) or dangerous (red)

The freedom of choice for the inspectors (to agree or disagree with the automated evaluation) has been kept

Evaluation of imbalance (left / right) – service brake



1.2.1. Performance	During a test on a brake tester or, if impossible, during a road test, apply the brakes progressively up to maximum effort.

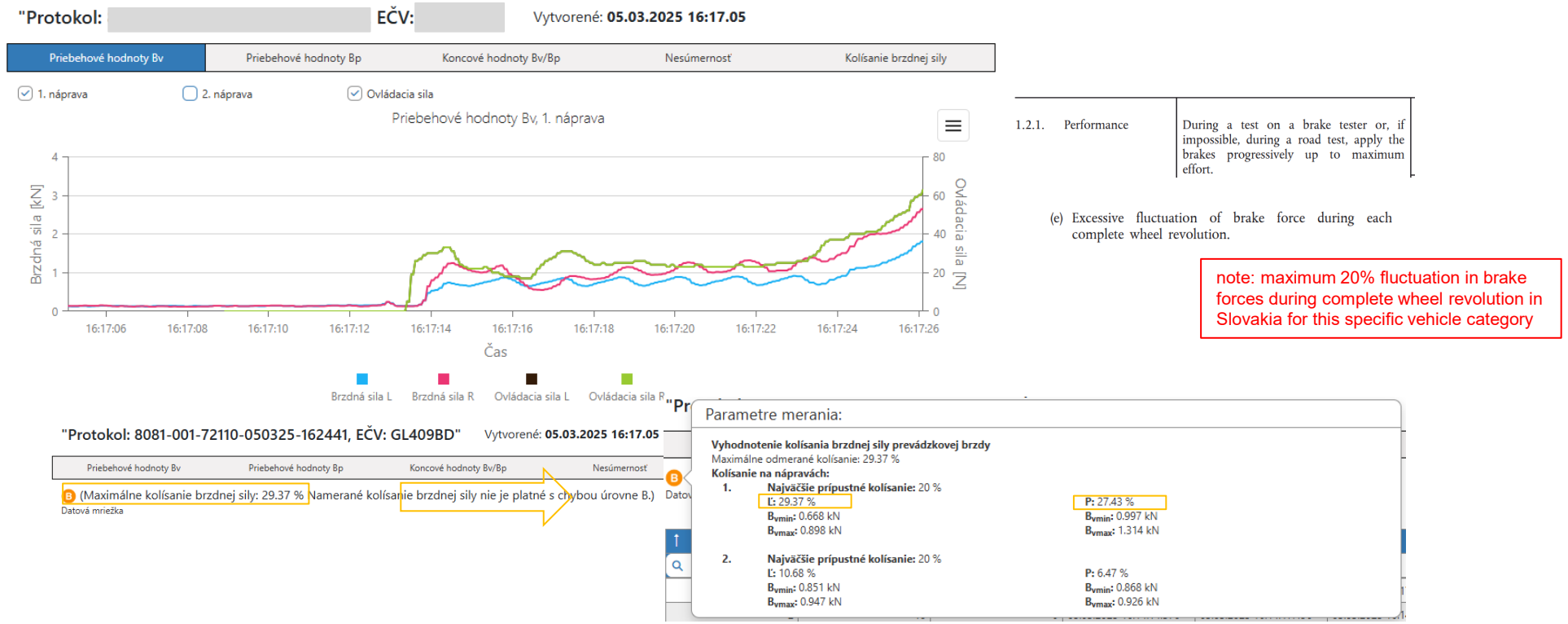
(b) Braking effort from any wheel is less than 70 % of the maximum effort recorded from the other wheel on the same axle. Or, in the case of testing on the road, the vehicle deviates excessively from a straight line.

Braking effort from any wheel is less than 50 % of the maximum effort recorded from the other wheel on the same axle in the case of steered axles.

The central information system automatically determines the service brake's imbalance of brake forces and pre-selects the related defects as either major (orange) or dangerous (red)

The freedom of choice for the inspectors (to agree or disagree with the automated evaluation) has been kept

Evaluation of brake force fluctuation – service brake



1.2.1.	Performance	During a test on a brake tester or, if impossible, during a road test, apply the brakes progressively up to maximum effort.

(e) Excessive fluctuation of brake force during each complete wheel revolution.

note: maximum 20% fluctuation in brake forces during complete wheel revolution in Slovakia for this specific vehicle category

The central information system automatically determines the service brake's brake force fluctuation and pre-selects the related defect as major (orange)

The freedom of choice for the inspectors (to agree or disagree with the automated evaluation) has been kept

Reasons for automated evaluation

- *Various manufacturers and types of roller brake testers are used across Slovak PTI stations. For initial PTI type approval, only the measuring functions specified by MoT regulations are evaluated.* ***The efficiency, imbalance, or fluctuation calculations performed by the tester's internal software are excluded from PTI approval****.*
- *Automated evaluation at the central information system level guarantees* ***consistent brake assessments across all PTI stations****, regardless of tester type, preventing misuse of calculation differences amid competition among PTI station operators*
- *The central information system's automated assessment* ***minimizes human subjectivity*** *in evaluating brake efficiency parameters*
- *The central information system's automated assessment* ***aids inspectors in avoiding calculation errors****, replacing manual tools like Excel sheets and pocket calculators*
- ***Supervision also benefits****, as freed-up resources can be redirected to other aspects of the PTI*

Similar project in Spain

Data integrity | Software Protocol | New Electronics

Applus+ Together beyond standards

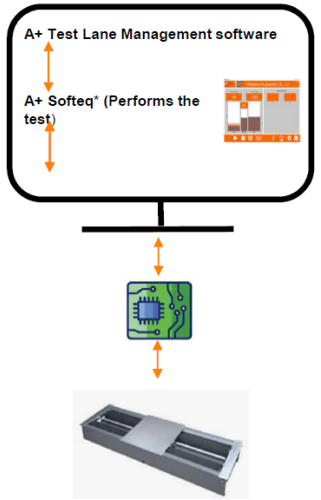
2. Software protocol – Continuous data sending

Solution 2: Receive measured data during the test

- During all the test, manufacturer software sends all measured data to Applus+ Software through a TCP/IP protocol.
- Manufacturer software is background.
- Complete procedure and data are managed by Applus+.
- Same procedure and screens independently of the manufacturer.







Acknowledgement: Víctor Salvachúa, Applus+

Applus+ Together beyond standards

Impact

- *Based on 2024 and 2025 data, we identified several thousand cases where brake efficiency was insufficient, but inspectors did not indicate the corresponding defect*
- ***Most of these issues can be prevented through automated assessment!***
- *On one hand, **support** for automated evaluation is provided by one of the PTI associations and by international organizations operating PTI stations in Slovakia*
- *On the other hand, there is **strong resistance** from another association of PTI station operators and inspectors*

Current State

Due to partly negative feedback from PTI operators, TESTEK sought an independent assessment of the calculation‘s correctness through an expert opinion from the Institute of Forensic Engineering at the University of Žilina.

Results: The automated brake test evaluation implemented by TESTEK is correct and fully complies with Slovak Republic legislation

The automated evaluation is currently in field testing, with inspectors using it voluntarily. The project's future depends on a decision by the Slovak Ministry of Transport

Thanks for your attention

Questions?

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