Danish Road Traffic Authority

RDW

7th International PTI Workshop 2025

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TESTEK

The automated evaluation of brake test results as effective tool against PTI fraud (part of the central PTI information system)

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Who we are

Main Vehicle Authority:



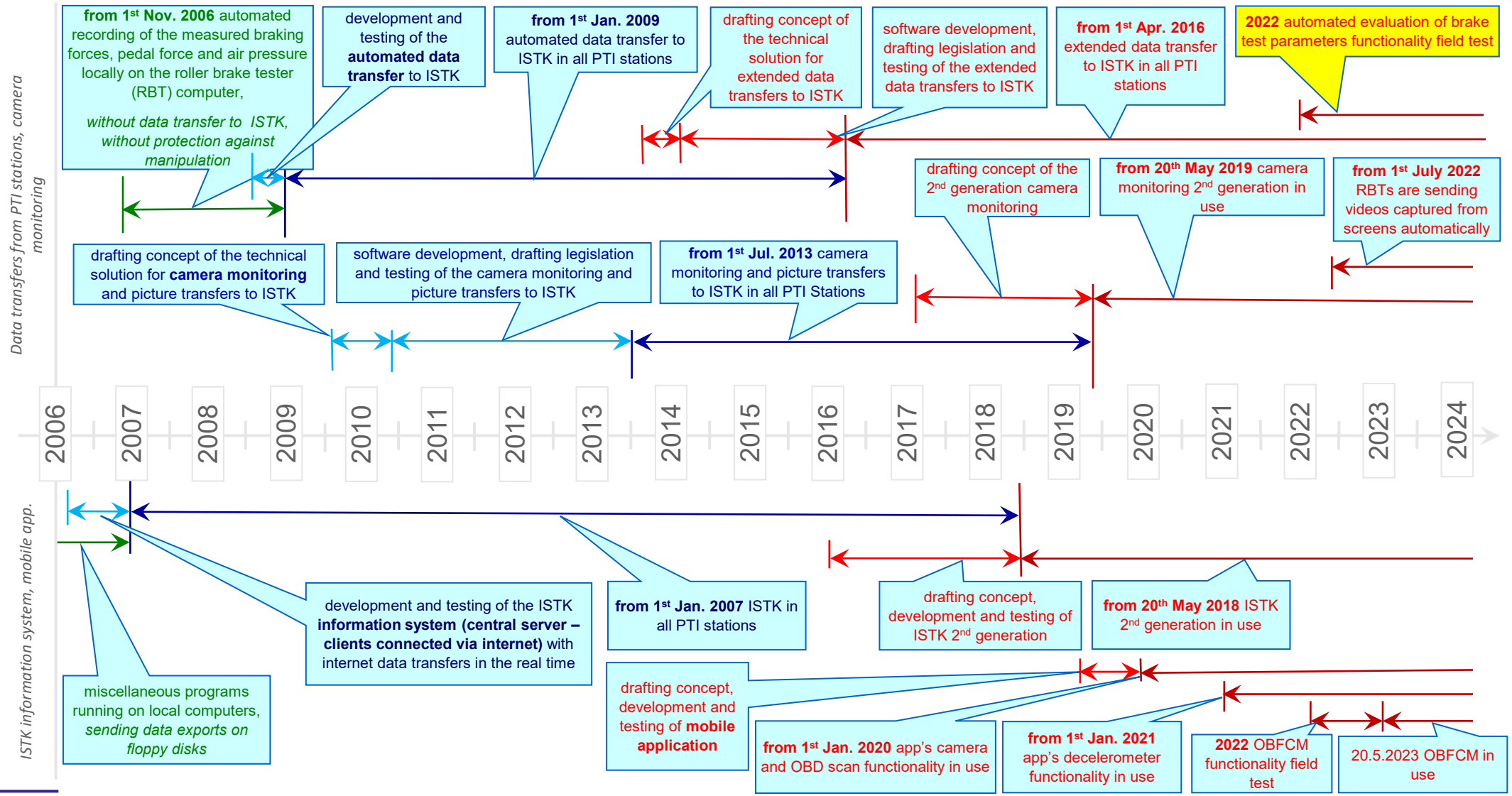
MINISTRY
OF TRANSPORT
OF THE SLOVAK REPUBLIC

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 technical inspections and supervision since 2006



Data transfers from roller brake testers

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

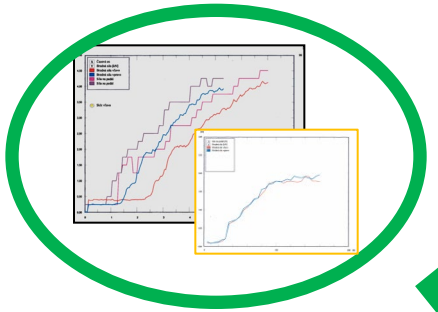
In combination with videos from inspection lane camera monitoring and videos from brake tester's screens we are able to reconstruct every brake test on forensic level.

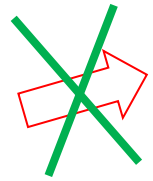
Until now, we have been using it mainly for supervision purposes.

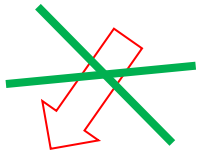
Roller brake tester (RBT)



Standardized set of raw measured values







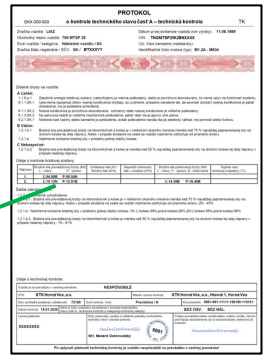


Brake test evaluation by the PTI inspector

PTI central information system (ISTK) server



PTI report

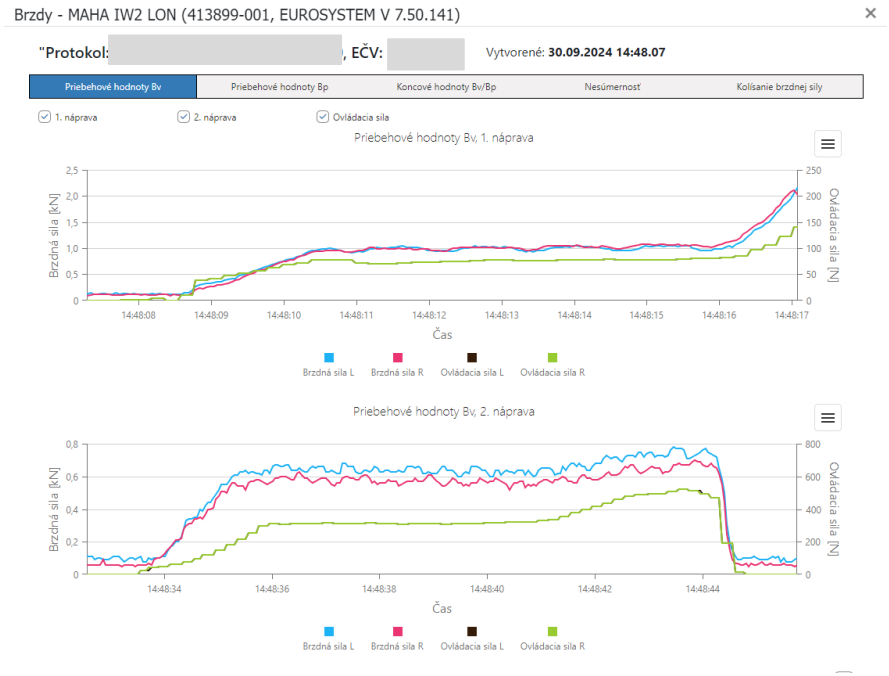


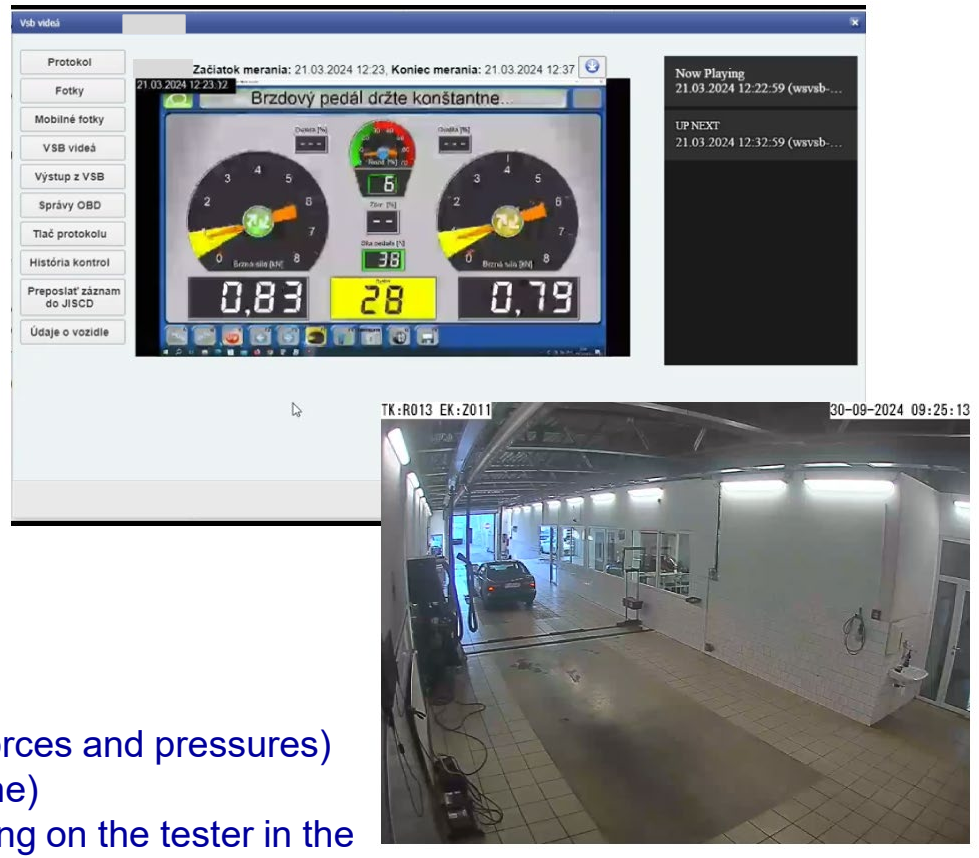
Roadworthy

2024 / 2025: A new purpose of the data - Support for the PTI inspector thanks to the integrated algorithm for automated calculation and evaluation of brake test

Brake test as subject of the analysis in supervision process

A **fundamental requirement** for effective analysis is having access to data transmitted from the brake testers (which are used for reverse analysis in the supervision process).

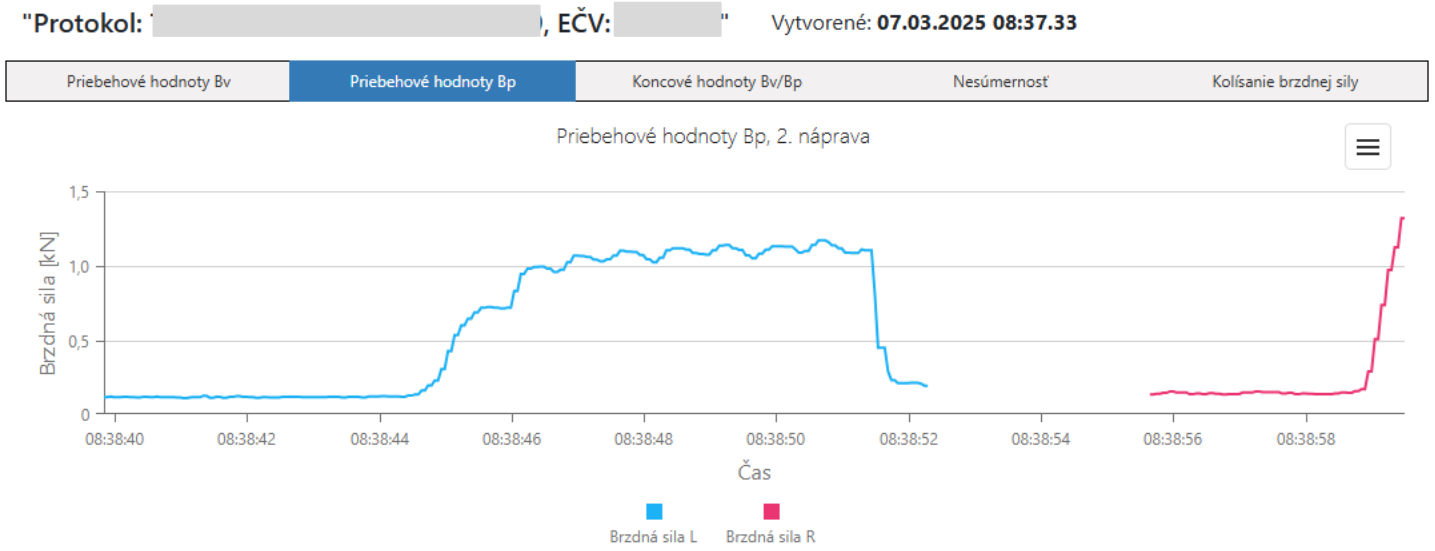




Scope of data transferred from brake testers in Slovakia:

- brake test values in digital form – **final** values plus **intermediate** values (forces and pressures)
- **video** from PTI lane (automated cameras covering the full length of PTI lane)
- **screen capture video** from the brake tester's monitor (by a software running on the tester in the background)

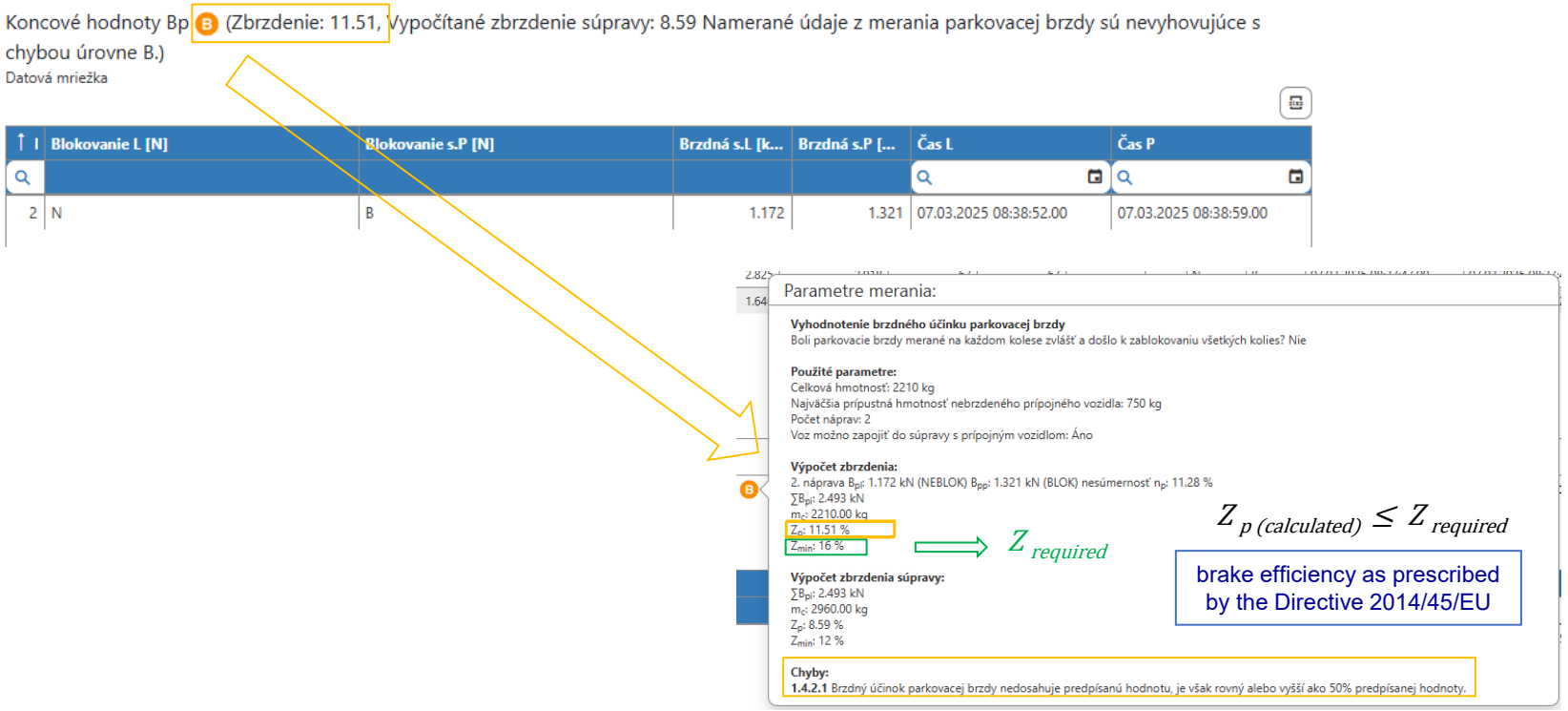
Evaluation of braking ratio – parking brake



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

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

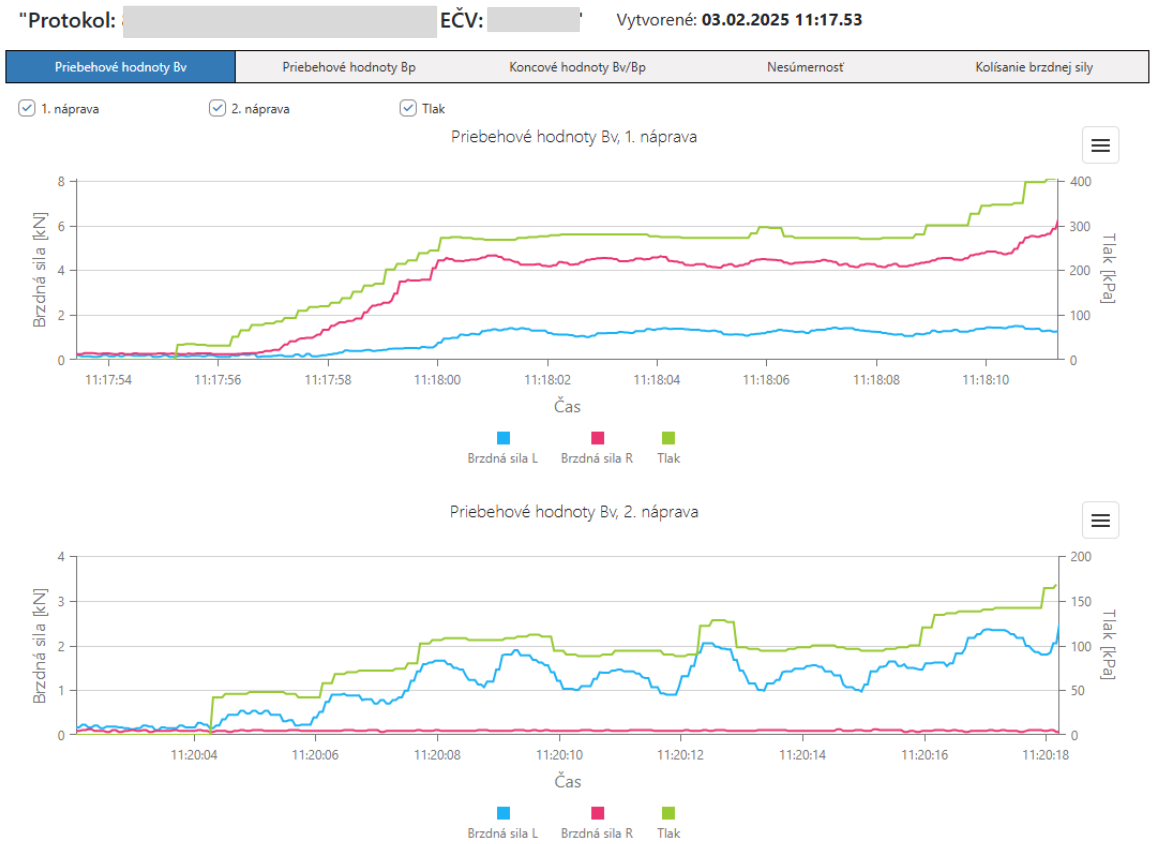
Evaluation of braking ratio – parking brake



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:* $i_i = \frac{p_{A\,lad\,i} - p_{0i}}{p_{A\,i} - p_{0i}}$

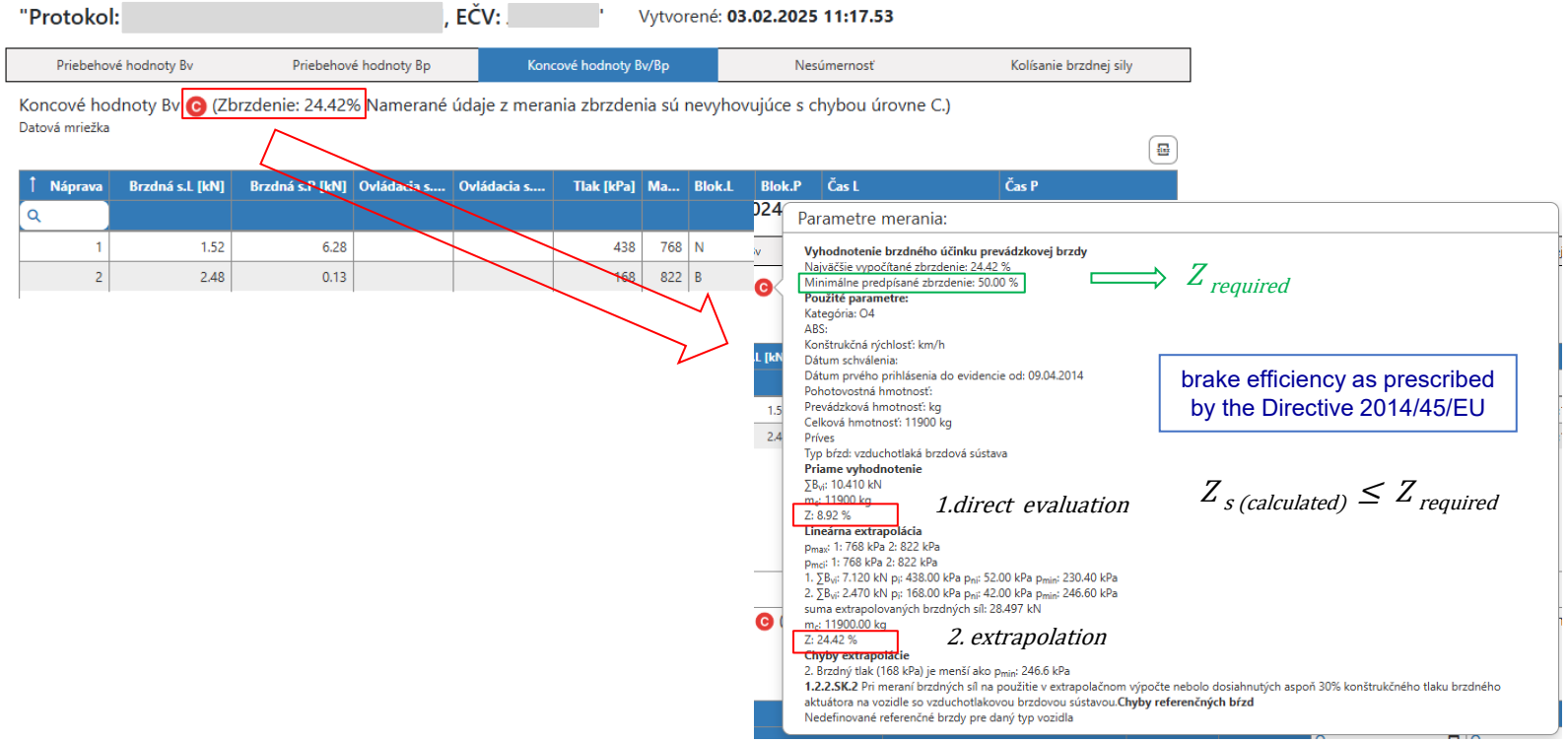
$p_{A\,lad\,i}$ *fully laden vehicle state brake actuator pressure in the circuit of the axle i stated by the manufacturer (kPa)*

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

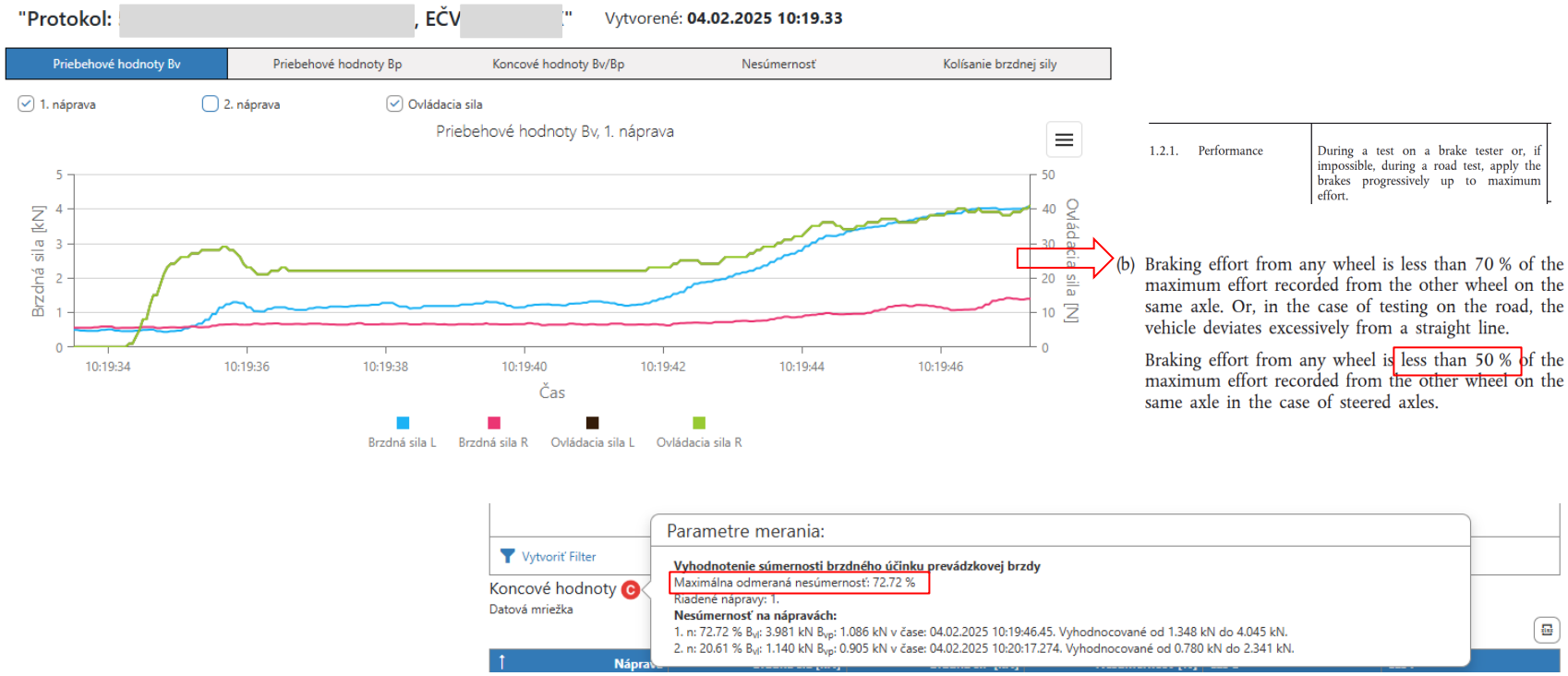
Evaluation of braking ratio – service brake



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.

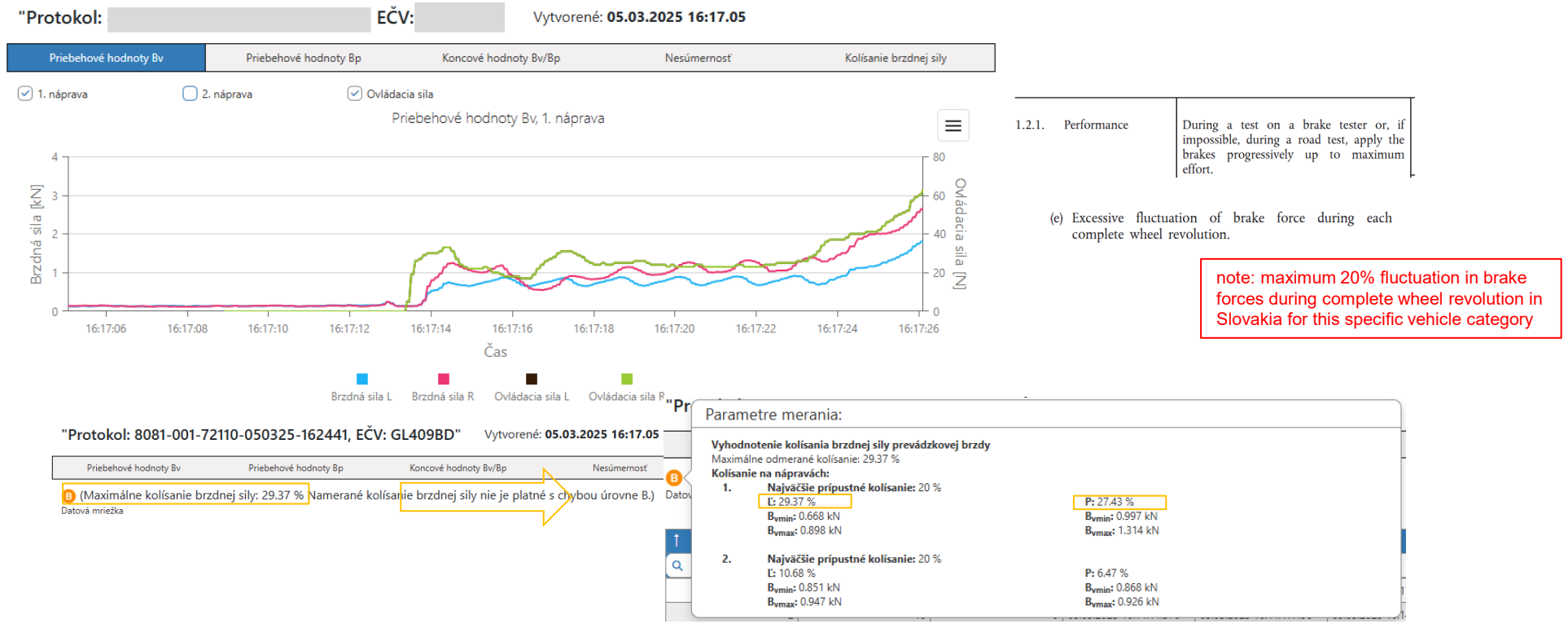
(b) Braking effort from any wheel is less than 70 % of the maximum effort recorded from the other wheel on the same axle. Or, in the case of testing on the road, the vehicle deviates excessively from a straight line.

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

Tool for automatic evaluation of brake test data

Why automated evaluation by the central information system

- Various manufacturers' and types of roller brake testers are utilized throughout Slovak PTI stations. For the initial PTI type approval, only the measuring functions defined by MoT regulations are assessed. The efficiency, imbalance or fluctuation calculations performed by the tester's internal software **are not** included in the PTI approval.
- Automated evaluation at the central information system level ensures **equal and consistent brake assessments across all PTI stations, regardless of the tester type**, thereby preventing potential misuse of differences in calculation procedures amid competition among PTI station operators
- The automated assessment conducted by the central information system can **reduce the influence of human subjectivity in evaluating brake efficiency parameters**
- The automated assessment conducted by the central information system **helps inspectors in preventing calculation errors** (they have been using excel sheets, pocket calculators, etc.)
- Last but not least, **supervision can also benefit from this;** the freed-up supervision resources can be redirected to other aspects of the PTI

Similar project

- Comparable project in Spain

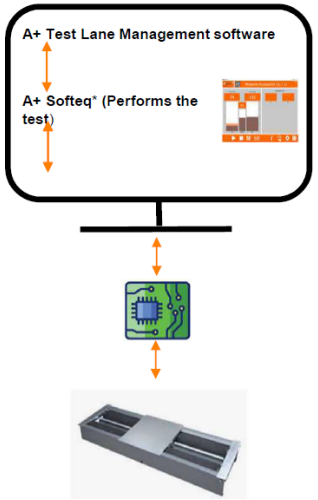
Data integrity | Software Protocol | New Electronics

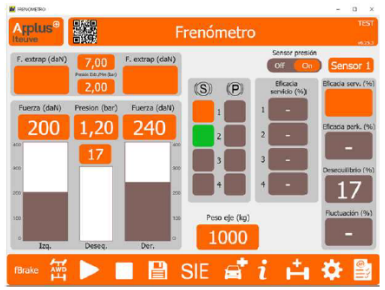
Applus+ Together beyond standards

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.







Applus+ Together beyond standards

Tool for automatic evaluation of brake test data

Acknowledgement: Víctor Salvachúa, Applus+

Impact

- Based on the 2024 data, we have identified several thousand cases where the brake efficiency was not sufficient, yet the inspector did not indicate the corresponding defect.

Most of it could be avoided through automated assessment!

- On one hand, support for automated evaluation by one of the PTI associations and by international organizations operating PTI stations in Slovakia

- On the other hand, extremely strong resistance by another association of PTI station operators and inspectors

Current State

Due to partly negative feedback from PTI operators, TESTEK decided to have the correctness of the calculation assessed by an independent authority through an expert opinion provided by the Institute of Forensic Engineering at the University of Žilina.

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

The automated evaluation is currently undergoing a field test, with inspectors using it on voluntary basis. The future of this project depends on the decision by

The Slovak Ministry of Transport

Thanks for your attention

Questions?

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