

PTI Workshop, Zagreb, 17th - 18th March 2016



Brake Testing according to ISO 21069

An introduction to discussion

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Service brake efficiency testing in the Annex I of the Directive 2014/45/EU



Item	Method	Reasons for failure	Assessment of deficiencies		
			Minor	Major	Dangerous

1.2.2. Efficiency

Test with a brake tester or, if one cannot be used for technical reasons, by a road test using a deceleration recording instrument to establish the braking ratio which relates to the maximum authorised mass or, in the case of semi-trailers, to the sum of the authorised axle loads.

Vehicles or a trailer with a maximum permissible mass exceeding 3,5 tonnes has to be inspected following the standards given by ISO 21069 or equivalent methods.

Road tests should be carried out under dry conditions on a flat, straight road.

Category L (rear wheel brake):
 all categories: 25 % of the total vehicle mass
 Less than 50 % of the above values reached.

X

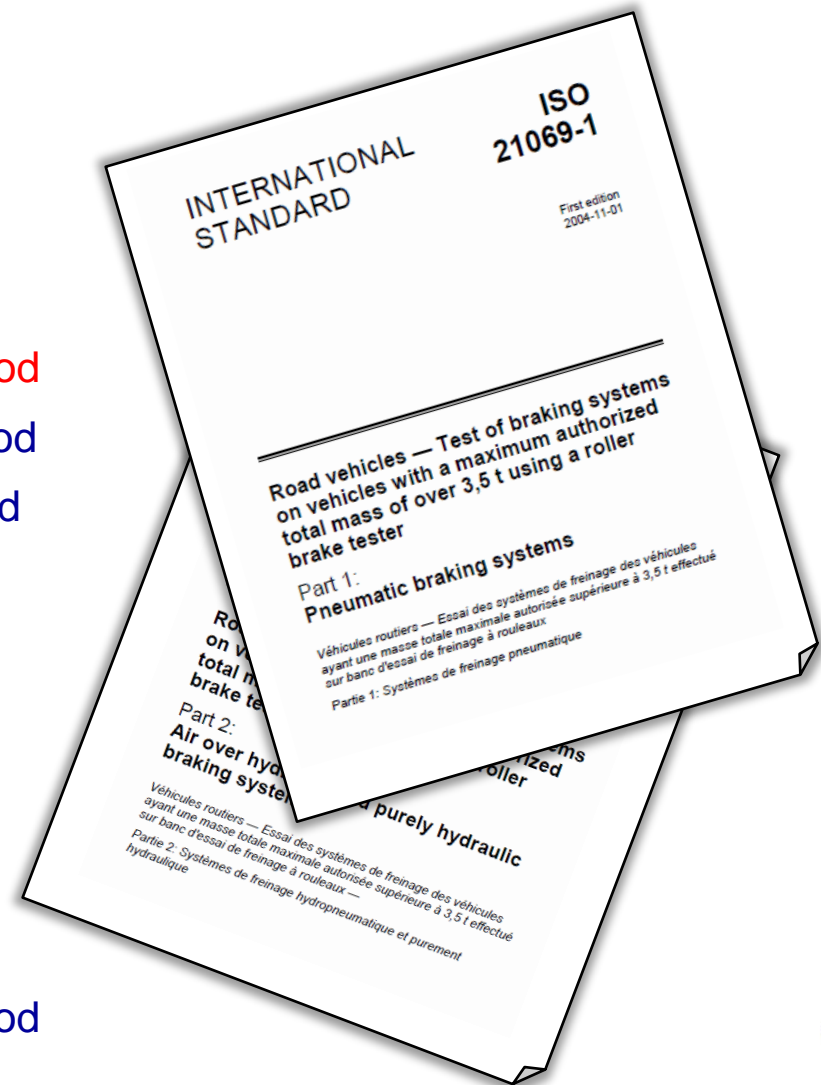
ISO 21069 brake testing methods

Pneumatic braking systems

- Reference braking forces method
- Laden measurement method
- One-point measurement (extrapolation) method
- Two-point measurement (extrapolation) method
- Alternative multi-point measuring methods and calculations (least-square regression)

Air over hydraulic and purely hydraulic systems

- Laden measurement method
- Two-point measurement (extrapolation) method



Direct determination of the braking rate

Calculation of the braking rate corresponding with the fully laden state of the vehicle and the highest achievable braking forces measured during the test on the roller brake tester (RBT).

Corresponds with the *Laden measurement method* according to ISO 21069, but may be used on partly laden vehicles, too.

$$z = 10,2 \cdot \frac{\sum F_i}{m_{GVW}} \quad (\%)$$

$\sum F_i$ sum of the highest achievable braking forces on all wheels of the vehicle (N)

m_{GVW} gross vehicle weight (kg)

One-point extrapolation method

Prediction of the braking rate in the fully laden state of the vehicle, based on measurement of the highest achievable braking forces and the corresponding air pressure beneath the locking limit of the wheels.

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

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

m_{GVW} gross vehicle weight (kg)

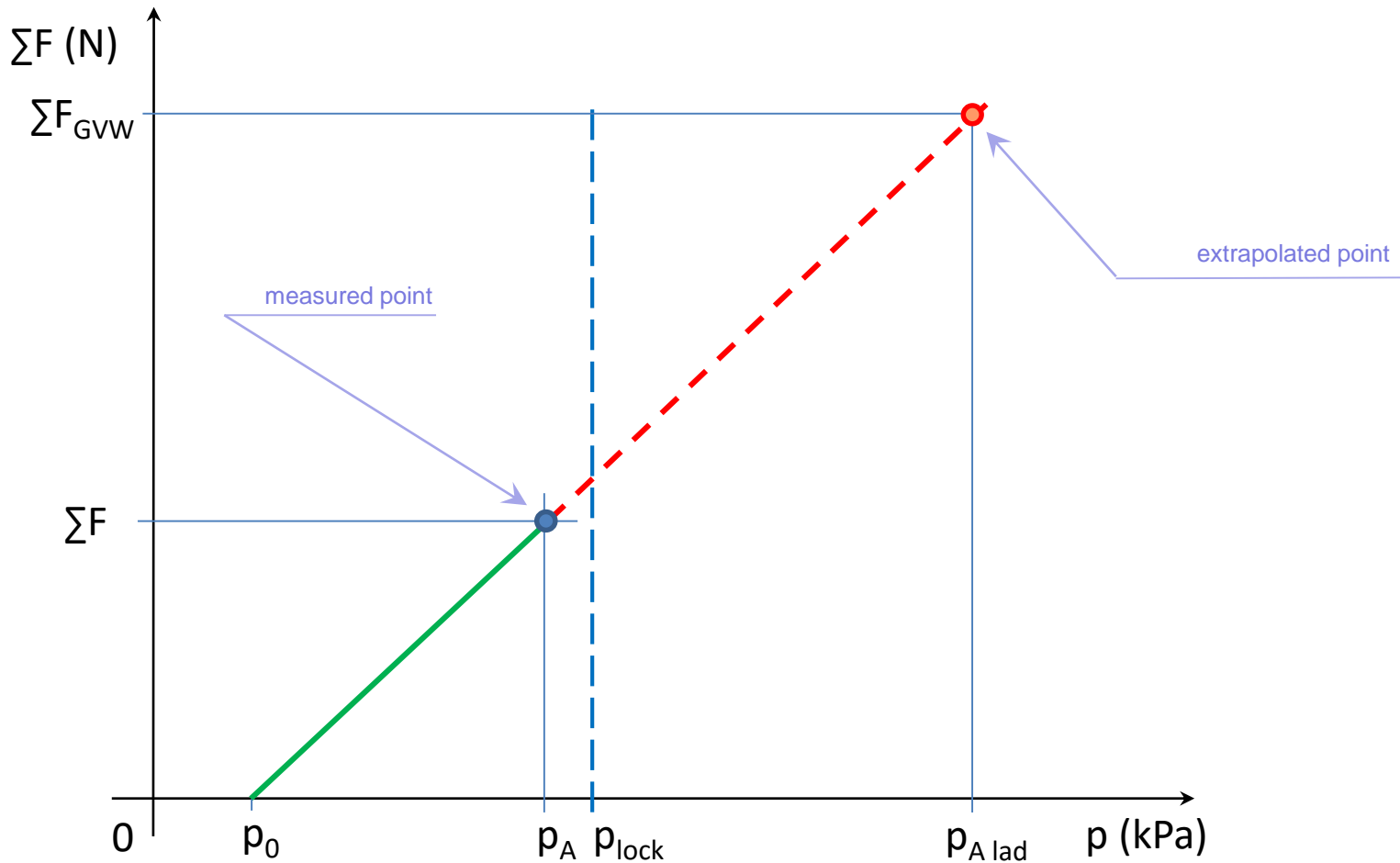
i_i extrapolation coefficient of the axle i : $i_i = \frac{p_{Aladi} - p_{0i}}{p_{Ai} - p_{0i}}$

p_{Aladi} 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)

One-point extrapolation method



threshold pressure 40 kPa (or according to Slovak regulations measured value)

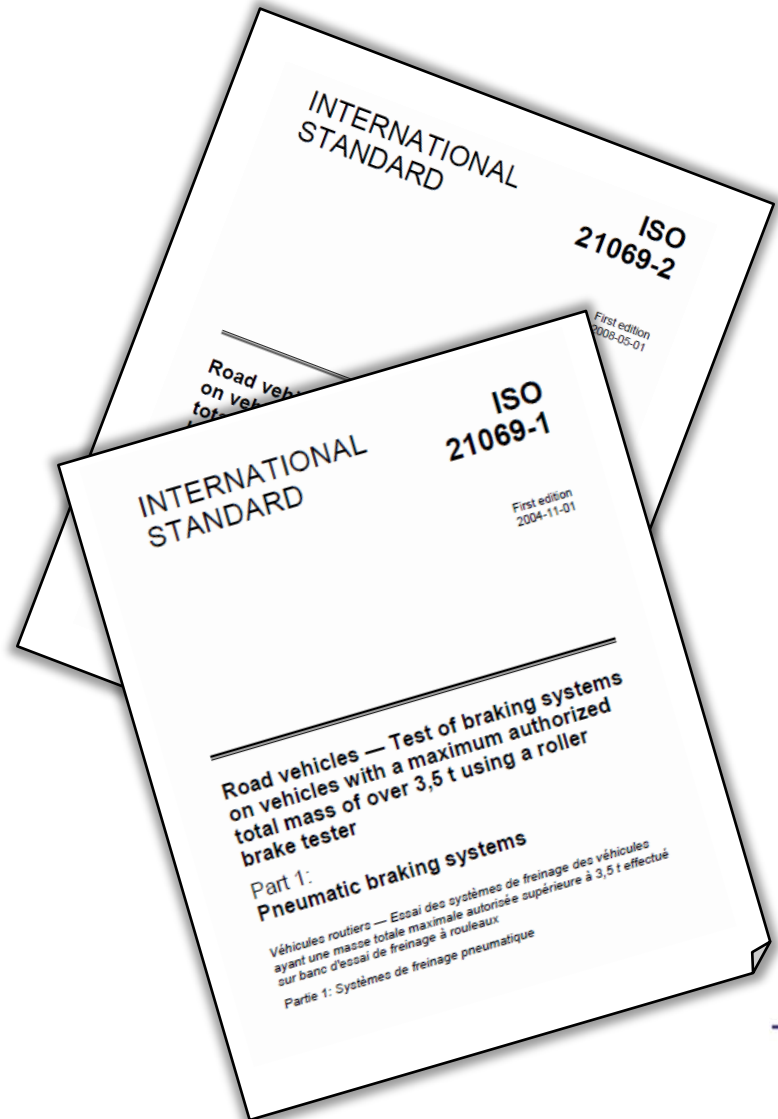
wheel lock pressure

GVW pressure stated by the manufacturer (or according to Slovak regulations 800 kPa for motor vehicle or 650 kPa for trailer if there is no information about the pressure stated by the manufacturer)

Extrapolation in ISO 21069

Extrapolation is mentioned in the ISO 21069 as an alternative to the measuring of the braking forces in the fully laden condition of the vehicle.

For a correct calculation, at least 30 % of the design brake actuator pressure should be achieved during the measuring of braking forces.



In the Slovak Republic

The extrapolation method has been used for service brake efficiency evaluation in the Slovak Republic for more than 30 years.

But without the obligation to reach the 30 % of the design brake actuator pressure.

Extrapolation: How to reach the 30 % of the design brake actuator pressure?

Considered solution in the Slovak Republic:

To equip the RBTs in the PTI stations with load simulators

Problems:

- some vehicle manufacturers do not approve the use of a load simulator
- time demanding in comparison with “normal” brake testing
- 2 inspectors necessary (usually only 1 inspector is performing the PTI)
- additional costs for PTI station owners – modification of RBT and pit, purchase of load simulator
- workplace safety concerns
- shortage of time – for the introduction of a new piece of PTI equipment as obligatory a transitional period of at least 1 year is necessary

*This solution wasn't adopted as obligatory
but is tolerated on a voluntary basis*

Extrapolation: How to reach the 30 % of the design brake actuator pressure?

Considered solution in the Slovak Republic:

To introduce an obligation to present the vehicles over 3,5 t GVW for the PTI in a partly laden state (at least 40 % for trailers and 60 % for motor vehicles)

Problems:

- vehicle owners have to care for loading of their vehicle for PTI
- some vehicles can't be presented for the PTI in laden state (ADR vehicles, livestock transport vehicles, vehicles transporting dead animals, buses ...)
- additional costs for PTI station owners – excessive wear of the RBT rollers and gear boxes

This solution has been adopted and is applicable since 1st February 2012

Reference braking forces method

The measured braking force and corresponding brake actuator pressure are compared with the reference values stated by the vehicle manufacturer

Reaching of the 30 % of the design brake actuator pressure is not necessary

No braking rate calculation necessary

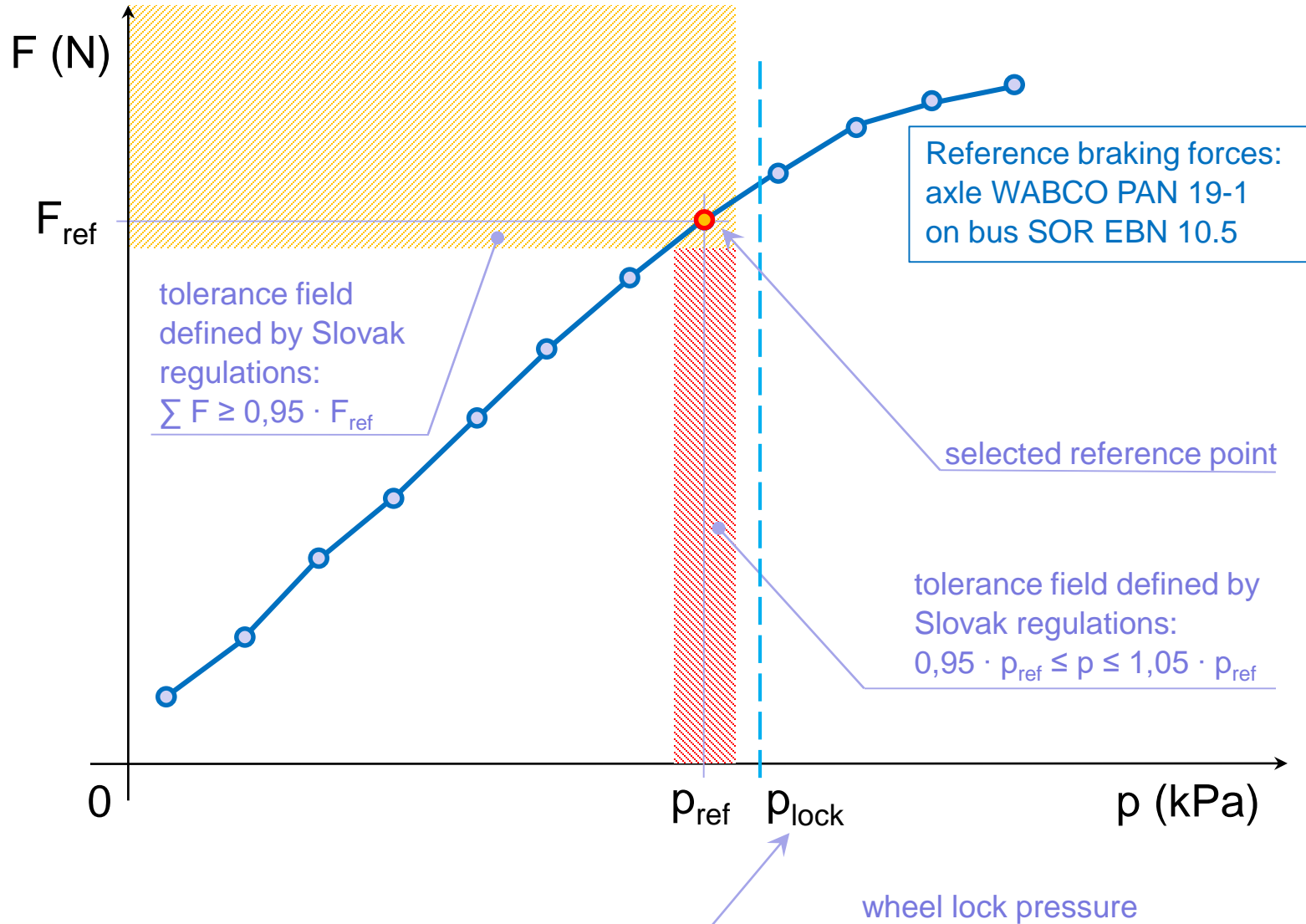
In the Slovak Republic inspectors have access through the information system to the reference braking force values of following vehicle manufacturers:



soon also for:



Reference braking forces method



- Is the ISO 21069 used in your country for inspections of vehicles with a GVW exceeding 3,5 t?
- How to reach the 30 % of the design brake actuator pressure necessary for extrapolation? Simulation vs. presenting laden vehicles
- Experience with reference braking forces method. It is easy to use. But is it precise enough, too?
- ISO 21069 part 1 has been published in 2004 and part 2 in 2008. Is it still up to date? What from it's content should be updated or rewritten?

Thank you for your attention and discussion



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