INTERNATIONAL STANDARD

ISO 21069-2

First edition
2008-05-01

Road vehicles — Test of braking systems on vehicles with a maximum authorized total mass of over 3,5 t using a roller brake tester —

Part 2: Air over hydraulic and purely hydraulic braking systems

Véhicules routiers — Essai des systèmes de freinage des véhicules ayant une masse totale maximale autorisée supérieure à 3,5 t effectué sur banc d'essai de freinage à rouleaux —

Partie 2: Systèmes de freinage hydropneumatique et purement hydraulique

Reference number
ISO 21069-2:2008(E)

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

Published in Switzerland

Contents

Page

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 21069-2 was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 2, *Braking systems and equipment*.

ISO 21069 consists of the following parts, under the general title *Road vehicles — Test of braking systems on vehicles with a maximum authorized total mass of over 3,5 t using a roller brake tester*:

— *Part 1: Pneumatic braking systems*

— *Part 2: Air over hydraulic and purely hydraulic braking systems*

Introduction

At present, UNECE Regulation No. 13 covers only some aspects of the periodic technical inspection of vehicles in use.

In order to fulfil the requirements of UNECE Regulation No. 13, paragraph 5.1.4, this part of ISO 21069 is designed to cover the periodic measurement of braking performance of vehicles in service.

This part of ISO 21069 specifies the test method whereby a roller brake tester is used to measure, evaluate and record the braking efficiency of road vehicles of categories M2, M3, N2, N3, O3 and O4 [as defined in UNECE Consolidated Resolution on the Construction of Vehicles (R.E.3.)] which are equipped with full power air over hydraulic or purely hydraulic braking systems. This part of ISO 21069 is also applicable for electronic braking systems (EBS).

Road vehicles — Test of braking systems on vehicles with a maximum authorized total mass of over 3,5 t using a roller brake tester —

Part 2:
Air over hydraulic and purely hydraulic braking systems

1 Scope

This part of ISO 21069 describes a procedure that generates comparable measurement results in roller brake testing, such that the efficiency of the service braking system can be assessed reliably wherever the roller brake tests are performed.

The following items are covered in this part of ISO 21069:

— symbols and definitions;

— test methods;

— test conditions;

— test equipment required;

— accuracy of test equipment;

— data recording and calculation needed;

— presentation of results;

— assessment criteria for pass/fail.

The procedure described in this part of ISO 21069 is not applicable to passenger cars.

2 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

2.1
braking force
force between the tyre and the rotating roller, produced at the circumference of the tyre during braking, which opposes the force generated at that interface by the roller brake tester in order to cause a rotation of the wheel

2.2
braking force imbalance
difference in the braking forces, measured with running wheels, between brakes on an axle

NOTE Braking force imbalance is expressed as a percentage of the higher force.

2.3
braking force variation
difference between the maximum and minimum values of the braking force, measured over a single wheel revolution with a constant actuation force

NOTE Braking force variation is expressed as a percentage of the higher force.

2.4
roller brake tester
measuring machine consisting of two pairs of powered rollers used for the assessment of a vehicle's braking performance

NOTE The assessment is made by measuring the braking force between tyres and drive rollers for each wheel/twin wheel, either simultaneously or independently, while the wheels of the vehicle axle are being driven and supported by rollers.

3 Symbols

Table 1 — General symbols

Symbol	Definition	Unit
F_{Bi}	extrapolated braking forces at brake actuator pressure p_{A,lad_i}	N
$\sum F_{Bi}$	sum of all F_{Bi} on all axles	N
F_{Hi}	braking force at the circumference of tyres on axle i at brake actuator pressure $p_{A,Hi}$	N
F_i	braking force at the circumference of tyres on axle i	N
F_{Li}	braking force at the circumference of tyres on axle i at brake actuator pressure $p_{A,Li}$	N
F_M	total normal static reaction of road surface on all wheels of the individual motor vehicle, or corresponding to F_i	N
$F_{M,max}$	maximum permissible F_M	N
F_R	total normal static reaction of road surface on all wheels of the individual trailer vehicle	N
$F_{R,max}$	maximum permissible normal static reaction of fully laden trailer vehicle	N
p_A	brake actuator pressure	kPa
$p_{A,Hi}$	high applicable brake actuator pressure on axle i	kPa
p_{A,lad_i}	design brake actuator pressure of laden vehicle on axle i (for extrapolation purposes)	kPa
$p_{A,Li}$	low brake actuator pressure on axle i	kPa
R_f	ratio at the braking force line	—
R_p	ratio at the brake actuator pressure	—
z	braking rate	—
$z_{M,lad}$	braking rate of laden motor vehicle	—
$z_{R,lad}$	braking rate of laden trailer vehicle	—

NOTE Subscript i indicates axles 1, 2, 3, ... n, respectively.

Table 2 — Symbols specific to air over hydraulic (A/H) braking systems

Symbol	Definition	Unit
C_F	conversion factor A/H converter front	—
C_R	conversion factor A/H converter rear	—
p_F	pneumatic pressure at front axle	Pa
p_{HF}	hydraulic pressure at front axle	Pa
p_{HR}	hydraulic pressure at rear axle	Pa
p_R	pneumatic pressure at rear axle	Pa
p_{RATIO}	pressure attenuation ratio of load-conscious valve	Pa/axle load

NOTE All measurements are made with the vehicle stationary.

4 Test conditions and evaluations

4.1 General

The characteristics of roller brake testers shall be as specified in Annex A.

The efficiency test for braking systems shall be carried out with reference to the following:

— legal requirements;

— data provided by the vehicle manufacturer;

— the instruction manual of the roller brake tester.

4.2 Preparation of vehicle and roller brake tester

4.2.1 Rollers and tyres shall be clean.

4.2.2 Tyre pressure shall be adjusted in accordance with the vehicle manufacturer's recommendations.

4.2.3 Additional instrumentation may measure the static axle loading without the rollers running.

4.2.4 Braking testing, for the purposes of official vehicle inspection, is to be carried out on a roller brake tester certified by the technical services. Vehicle data and the measured values shall be recorded in the forward direction.

4.3 Calculation and evaluation of test data

4.3.1 Braking efficiency calculation

4.3.1.1 General

For air over hydraulic and hydraulic braking systems, one of the major problems is to caculate the braking efficiency without using an external pressure transducer on the hydraulic brake system. There is an increased risk of leakages when measuring hydraulic systems, caused by connecting measurement devices.

The braking test may be made in the fully laden state, or in a lightly laden condition at lower actuation pressures, on the assumption that braking forces increase predictably with increasing pressure.

4.3.1.2 Provisions for air over hydraulic braking system

For the front axle, if the air over hydraulic (A/H) conversion factor (C_F) supplying the hydraulic pressure is easily calculated from the measured air pressure (p_F), then

$$p_{HF} = p_F \times C_F \quad (1)$$

In this case, the calculation is similar to the other possible extrapolation methods. A prerequisite is a pneumatic measuring gauge before the A/H converter.

For the rear axle, the calculation is similar, but the function of load sensing valves needs to be taken into account.

The characteristic of the load sensing/conscious valve shall be given in a graph or table, giving the pressure attenuation ratio against load input:

$$p_{HR} = p_R \times C_R \times p_{RATIO} \quad (2)$$

In this case, the axle load needs to be known or measured.

The calculated hydraulic pressures, p_{HR} and p_{HF}, can be used as p_{Ai} is used in Equations (5) and (6).

The actuator pressure and brake force shall be determined simultaneously and in real time.

Extrapolation of brake output forces may be used to predict the laden braking rate. This may be achieved by following one of the following extrapolation methods:

— a minimum of 30 % of the design brake actuator pressure shall be achieved by suitable loading, dead weight of the axle or by load simulation, or

— the distance between the measurement points (the first point at the beginning and the second at the cut-off point) shall be as large as possible in order to ensure the correct gradient of the function of the graph (pressure versus force).

NOTE If it is prescribed in the relevant national requirements, the rolling resistance can be treated accordingly.

A plan of an air over hydraulic braking system is given in Figure 1.

4.3.1.3 Provisions for purely hydraulic braking system

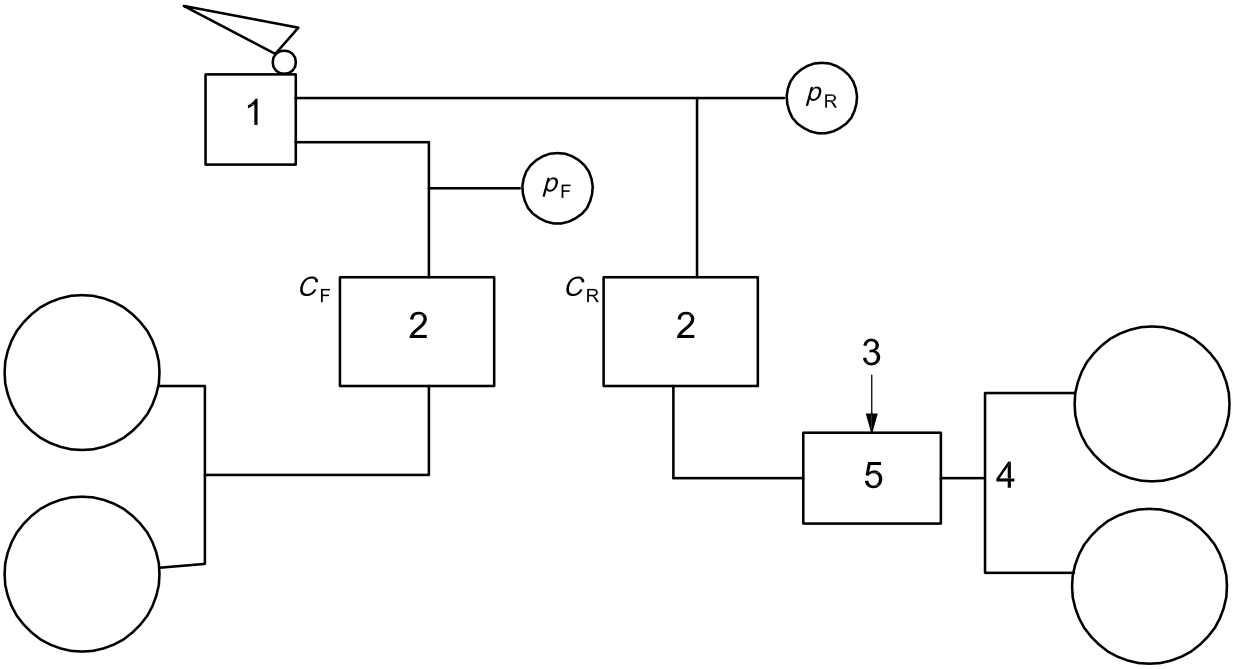
For hydraulic braking systems, it is recommended only to proceed with the test with fully laden conditions. For partly laden conditions, a load simulation is highly recommended. One possible indication for the gradation of brake forces can also be a measurement of pedal forces with special measurement equipment which is suitable for this purpose. This measurement should not be used for calculation.

4.3.2 Determination of braking force or braking rate

The braking force or, alternatively, the braking rate (maximum braking force/vertical wheel load) shall be determined for

— each wheel individually, or

— each axle individually.



Key

1 foot valve
2 A/H converter
3 axle load
4 rear
5 vehicle

Figure 1 — Air over hydraulic braking system plan

4.3.3 Methods of determination

4.3.3.1 Laden measurement method

The braking rate shall be determined directly by measuring the braking forces for the vehicle in the laden condition. The laden braking rate calculation requires no extrapolation, being simply calculated according to Equation (3) in the case of motor vehicles, and according to Equation (4) in the case of towed vehicles:

$$z_{\mathrm{M,lad}} = \frac{\sum F_i}{F_{\mathrm{M,max}}} \tag{3}$$

$$z_{\mathrm{R,lad}} = \frac{\sum F_i}{F_{\mathrm{R,max}}} \tag{4}$$

4.3.3.2 Two-point measurement method

This method is only useful if the pneumatic/hydraulic converter function and the conversion factor are correctly known. In some cases, evaluation using direct measurement of hydraulic pressure is needed to ensure that the conversion factor is calculated precisely.