INTERNATIONAL STANDARD

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Road vehicles — Endurance braking systems of motor vehicles and towed vehicles — Test procedures

Véhicules routiers — Véhicules à moteur et véhicules tractés disposant de systèmes de freinage d'endurance — Procédures d'essai

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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 12161 was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 2, *Braking systems and equipment*.

Introduction

This International Standard applies to complete vehicles and not to endurance braking systems on their own.

Depending on the available test facilities the vehicles equipped with endurance braking systems shall be tested for type approval using one of the following types of tests:

Outdoor tests

— Downhill vehicle test (see Clause 6)

— Vehicle drag test (see Clause 7)

Indoor test (see Clause 8)

— Dynamometer vehicle test

All three tests are evaluated from downhill braking manoeuvres and are to different degrees gradient simulation tests.

Road vehicles — Endurance braking systems of motor vehicles and towed vehicles — Test procedures

IMPORTANT — When using this International Standard, care should be taken to ensure that changes have not subsequently been adopted that affect the test methods or values given.

1 Scope

This International Standard specifies methods for testing the endurance braking systems of vehicles of categories M N and O (excluding M1, N1, O1 and O2) which are designed to comply with ECE-R 13/09 with supplement 1 to 6. The values given in square brackets are taken from ECE Regulation No. 13 for information.

All endurance test procedures are based on the principle of equivalent energy absorption and procedures which are not suitable to support this principle are not considered.

The principle of equivalent energy allows the base test parameters to be adapted to the variations occurring under real conditions compared to theoretical values.

NOTE Typical sources are:

— The variation of the gradient of downhill test track or

— The variation of retarding force during drag tests or indoor test.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 611: 2003, *Road vehicles — Braking of automotive vehicles and their trailers — Vocabulary*

ISO 1176: 1990, *Road vehicles — Masses — Vocabulary and codes*

ISO 3833: 1977, *Road vehicles — Types — Terms and definitions*

ISO 8855, *Road vehicles — Vehicle dynamics and road-holding ability — Vocabulary*

ECE Regulation No. 13, *Uniform provisions concerning the approval of vehicles with regard to braking,* incorporating the series 09 with supplements 1 to 6

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 611, ISO 1176 and ISO 3833 and the following apply.

3.1
vehicle categories
as defined in ECE R.E.3, the Consolidated Resolution on the construction of vehicles:

— category M: power-driven vehicles having at least four wheels and used for the carriage of passengers;

— category N: power-driven vehicles having at least four wheels and used for the carriage of goods

3.2
endurance braking system
total of all devices of a vehicle which enable the driver to reduce the speed or to transverse a long descent at nearly a constant speed without the use of the service brake

NOTE 1 An endurance braking system may contain one or more retarder(s), and may include:

— energy supplying means;

— control device(s);

— transmission means;

— retarder(s);

— energy dissipation device(s);

— auxiliary device(s).

NOTE 2 All retarders are new and fully burnished according to the supplier recommendations.

3.2.1
types of control device used in endurance braking system

3.2.1.1
independent control device
device which controls the endurance braking system independently from the service braking system

3.2.1.2
integrated control device
device applied simultaneously with the service braking systems or with a suitably phased operation

3.2.1.3
vehicle speed control device
device which allows a nearly constant vehicle speed by automatic operation and modulation of the endurance braking system

3.2.1.4
cut-out device
device which allows to apply the service braking system alone or to use the vehicle speed control without actuating the endurance braking system

NOTE This is a combined control device.

3.2.2
retarder
energy transformation device used to provide braking effort allowing control of vehicle speed independently of or as a supplement to the friction brakes

3.2.2.1
categories of retarders

3.2.2.1.1
primary retarder
retarder located on the drive train of a motor vehicle at the engine side of the gearbox (torque converter)

3.2.2.1.2
secondary retarder
retarder located on the drive train of motor vehicles between the gearbox (torque converter) and the drive axle(s)

NOTE Retarders can be connected to non-driven axles and are also classed as secondary retarders.

3.2.2.1.3
other retarders
retarders which are not categorized in 3.2.2.1.1 or 3.2.2.1.2 (e.g. aerodynamic retarders)

3.2.2.2
types of retarders

3.2.2.2.1
combustion engine retarder

3.2.2.2.1.1
engine braking
means whereby the engine drag resulting from the reduction of the fuel input and the throttling of the induction air supply whilst the engine is linked to the driving wheels retards the vehicle (see 5.5.3.1.3.1 of ISO 611:2003)

3.2.2.2.1.2
engine retarder
mechanism in which an increased retarding effect is obtained by changing the valve timing to increase the internal resistance (drag) of the engine (see 5.5.3.1.3.2 of ISO 611:2003)

3.2.2.2.1.3
exhaust retarder
mechanism in which an increased retarding effect is obtained by blocking the flow of the exhaust gas to increase the internal resistance of the engine (see 5.5.3.1.3.3 of ISO 611:2003)

3.2.2.2.2
electric traction motor retarder
mechanism in which the electric traction motor, linked to the driving wheels, exercises a retarding effect on the moving vehicle, for example, by functioning as a current generator (see 5.5.3.1.3.4 of ISO 611:2003)

3.2.2.2.3
hydraulic retarder
retarder in which a retarding effect is obtained by the action of liquid on rotating/pumping components linked to one or more wheels

3.2.2.2.3.1
hydrodynamic retarder
hydraulic retarder in which the power absorption is based on the principle of specific kinetic energy of a fluid

3.2.2.2.3.2
hydrostatic retarder
hydraulic retarder in which the power absorption is based on the principle of specific kinetic energy of a fluid

3.2.2.2.4
electric retarders

3.2.2.2.4.1
electromagnetic retarder
retarder in which a retarding effect is obtained by the action of an electromagnetic field on a rotating component (eddy current, hysteresis) linked to one or more wheels

3.2.2.2.4.2
permanent-magnetic retarder
mechanism in which a retarding effect is obtained by the action of a permanent-magnetic field on a rotating component (eddy current, hysteresis) linked to one or more wheels

3.2.2.2.5
regenerative braking retarder
any type of retarder which recovers the vehicle's kinetic energy through the braking torque in order to restore it to a vehicle energy reservoir

3.2.2.2.6
aerodynamic retarder
mechanism in which a retarding effect is obtained by causing an increase in the air resistance, for example, by the deployment of movable surfaces

[ISO 611:2003]

3.3
vehicle loading

3.3.1
laden vehicle
vehicle laden to its maximum technically permissible mass as specified by the vehicle manufacturer and acknowledged by the technical services

3.4
energy

3.4.1
dissipated energy
amount of energy dissipated through braking during any braking operation of a vehicle or vehicle combination taking into account a rolling resistance of 1 % of g

$$W_{\text{diss}} = W_{\text{pot}} - W_{\text{rr}}$$

$$W_{\text{pot}} = m \times g \times \Delta H$$

$$W_{\text{rr}} = m \times g \times \left(\frac{\Delta H}{\tan \alpha} \times 0{,}01 \right)$$

3.4.2
equivalent energy $W_{\text{equ,II}}$
energy of a vehicle dissipated while braking downhill when this dissipated energy is equivalent to that dissipated in the same period of time with the vehicle driven at an average speed of 30 km/h on a [6 %] down-gradient for a distance of [6 km]

$$W_{\text{equ,II}} = W_{\text{diss,II}} = f\left(\tan \alpha = 6\ \%, l = 6\ km\right)$$

4 Symbols and abbreviated terms

For the purposes of this International Standard, the symbols given in Table 1 apply.

Table 1 — Symbols

α	angle of the down gradient (from the horizontal)	rad
a_m	mean deceleration	m/s^2
d_m	mean fully developed deceleration	m/s^2
E	wheelbase	m
F	towing force	N
F_{rr}	rolling resistance	N
l	length of the test “track” or equivalent	m, km
l', l''	modified length of the test “track” or equivalent	m, km
m	mass of the vehicle or vehicle combination	kg
M	torque, braking torque, driving torque of dynamometer	Nm
m', m''	modified mass	kg
N	number of measurement samples	-
P	power	W
P_{ret}	retarding power resp. braking power	W
P_{rr}	dissipated power due to the rolling resistance while braking	Nm/s or W
r	radius	m
t	time	s
T	duration of the test	s
T_{req}	required duration of the test	s
$tan\ \alpha$	gradient of the down slope	%
$tan\ \alpha_m$	average gradient of the downhill test road	%
$tan\ \alpha_m'$	modified average gradient of the downhill test road	%
v	vehicle speed	m/s
v_{aver}	average speed	m/s
v_{req}	required test speed	m/s
v', v''	modified vehicle speed	m/s
W_{diss}	dissipated energy while braking	Nm or W
W_{pot}	potential energy while downhill braking	Nm or W
W_{rr}	dissipated energy due to the rolling resistance while braking	Nm or W
ΔH	difference of altitude	m
$\Delta H', \Delta H''$	modified difference of altitude	m

5 General test conditions

5.1 Ambient conditions

5.1.1 Wind speed

The tests shall be performed when there is no wind liable to affect the results.

5.1.2 Air temperature

The air temperature shall be noted in the test report.

5.1.3 Road surface condition

Any test road shall be smooth, hard-surfaced and free of loose material, and thereby provide a sufficient peak coefficient of adhesion to prevent excessive wheel slip.

5.2 Test site

Any test site should be of adequate size and length and without obstacles, and be able to provide a safe testing environment.

The length of the test track shall be established by suitable means of distance measurements with a tolerance of ± 1,0 %.

5.3 Vehicle preparation

5.3.1 Instrumentation

The test vehicle (and the towing vehicle if appropriate) shall be prepared for testing by the installation of additional instruments and/or calibration of the existing standard vehicle instruments, as required.

All the instruments shall be checked to ensure correct function and, with the vehicle stationary on the test surface, all the instruments shall be set.

The instrumentation shall be able to measure the following parameters.

5.3.1.1 Vehicle speed

If the recording of the vehicle speed is required, a separate speed measuring device independent of any wheel slip shall be used.

5.3.1.2 Duration of the test

The duration of the test shall be measured by means of a chronometer or electronic timing equipment.

5.3.1.3 Engine speed

For monitoring the permissible engine speed, the instrument on the dashboard is sufficient.

5.3.1.4 Temperatures

For surveying the permissible temperature of the engine cooling system the instrument on the dashboard is sufficient.

Separate temperature measuring means shall be used when stabilized operating conditions are required.