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EAST AFRICAN STANDARD

Motor vehicle safety specification — Braking — Part 1: General

EAST AFRICAN COMMUNITY

Foreword

Development of the East African Standards has been necessitated by the need for harmonizing requirements governing quality of products and services in East Africa. It is envisaged that through harmonized standardization, trade barriers which are encountered when goods and services are exchanged within the Community will be removed.

In order to meet the above objectives, the EAC Partner States have enacted an East African Standardization, Quality Assurance, Metrology and Test Act, 2006 (EAC SQMT Act, 2006) to make provisions for ensuring standardization, quality assurance, metrology and testing of products produced or originating in a third country and traded in the Community in order to facilitate industrial development and trade as well as helping to protect the health and safety of society and the environment in the Community.

East African Standards are formulated in accordance with the procedures established by the East African Standards Committee. The East African Standards Committee is established under the provisions of Article 4 of the EAC SQMT Act, 2006. The Committee is composed of representatives of the National Standards Bodies in Partner States, together with the representatives from the private sectors and consumer organizations. Draft East African Standards are circulated to stakeholders through the National Standards Bodies in the Partner States. The comments received are discussed and incorporated before finalization of standards, in accordance with the procedures of the Community.

Article 15(1) of the EAC SQMT Act, 2006 provides that "Within six months of the declaration of an East African Standard, the Partner States shall adopt, without deviation from the approved text of the standard, the East African Standard as a national standard and withdraw any existing national standard with similar scope and purpose".

East African Standards are subject to review, to keep pace with technological advances. Users of the East African Standards are therefore expected to ensure that they always have the latest versions of the standards they are implementing.

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Introduction

Covers the requirements for and the performance of the braking devices of motor vehicles and their trailers (including semi-trailers) designed for use on the roads, and that have a maximum design speed exceeding 25 km/h and that fall into any of the categories defined, except that it does not cover the braking devices of any vehicle propelled by electric power derived from batteries and that is pedestrian controlled, or any vehicle of mass not more than 230 kg specially designed and constructed, i.e. not merely adapted, for the use of any person suffering from some physical defect or disability and used solely by such person, or agricultural tractors and machinery, and any vehicle that runs on rails.

Draft for comments only — Not to be cited as East African Standard

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Motor vehicle safety specification — Braking — Part 1: General

1 Scope

This part of the specification covers the requirements for and the performance of the braking devices of motor vehicles and their trailers (including semi-trailers) designed for use on the roads, and that have a maximum design speed exceeding 25 km/h and that fall into any of the categories defined, except that it does not cover the braking devices of

- a) any vehicle propelled by electric power derived from batteries and that is pedestrian controlled, or
- b) any vehicle of mass not more than 230 kg specially designed and constructed, i.e. not merely adapted, for the use of any person suffering from some physical defect or disability and used solely by such person, or
- c) agricultural tractors and machinery, and any vehicle that runs on rails.

2 Definitions

2.1 For the purposes of this part of the specification the following definitions shall apply:

automatic braking

braking of the trailer(s) that occurs automatically when there is separation of the components of a combination of coupled vehicles, including separation caused by the failure of a coupling that does not result in the effectiveness of the braking of the remainder of the combination being destroyed

brake

part in which the forces opposing the movement of a vehicle develop

brake types

electrical brake

brake in which the forces are generated by electro-magnetic action between two parts of the vehicle moving relative to, but not in contact with, one another

engine brake

brake in which the forces transmitted to the wheels are derived from an artificial increase in the braking action of the engine

fluid brake

brake in which the forces are generated by the action of a fluid situated between two parts of the vehicle moving relative to one another

friction brake

brake in which the forces are generated by friction between two parts of the vehicle moving relative to one another

braking device

combination of parts, i.e. the control, the transmission, and the brake proper, and whose function is to reduce progressively the speed of a moving vehicle, or to bring it to halt, or to keep it stationary if it is already halted

component of a braking device

one of the individual parts that, when assembled, constitute a braking device

continuous braking

braking of a combination of vehicles by means of a device that has the following characteristics:

- a) it has a single control that the driver actuates progressively from his driving seat, using a single movement;

- b) the energy, which may be the muscular energy of the driver, used for braking the vehicles constituting the combination, is furnished by the same sources; and
- c) the braking device ensures simultaneous, or suitably phased, braking of all the constituent vehicles of the combination, whatever their relative positions

control

part actuated directly by the driver or, in the case of some trailers, by an assistant, to furnish to the transmission the energy required for braking or for controlling the braking action, which may be the muscular energy of the driver, or energy from another source controlled by the driver, or in appropriate cases the kinetic energy of a trailer, or a combination of these various kinds of energy

graduated braking (by a braking device)

braking during which, within the normal operating range of the device, i.e. during application or release of the brakes,

- a) the braking force can be easily and precisely regulated,
- b) the driver can at any moment increase or decrease the braking force by acting on the control, and
- c) the braking force varies proportionally with the action on the control

inertia (overrun) braking

braking by utilizing the forces generated by the movement of a trailer towards the drawing vehicle

initial speed

V

speed in kilometres per hour at the moment when the driver begins to actuate the control of the braking device

laden vehicle

unless inconsistent with the text, a vehicle laden to its maximum mass but, in the case of a passenger vehicle, with a 68 kg mass on each unoccupied passenger seat

load

that which is carried or is to be carried by a vehicle

maximum mass of a vehicle

maximum mass of a vehicle as stated by the manufacturer of the vehicle

maximum permissible vehicle mass (of a bus or goods vehicle)

mass of such bus or goods vehicle as laid down in the Road Traffic Ordinance for its operation on a public road

retarder

device whose function is

- a) to stabilize the speed of the vehicle on a long down-gradient without making use of any other braking device or of the normal braking effect of the engine, or
- b) to contribute to such stabilization with the assistance of the other braking device(s) or braking effect

semi-continuous braking

braking of a combination of vehicles by means of a device that has the following characteristics:

- a) it has a single control that the driver actuates progressively from his driving seat, using a single movement;
- b) the energy used for braking the vehicles constituting the combination is furnished by two different sources, one of which may be the muscular energy of the driver; and

- c) the braking device ensures simultaneous, or suitably phased, braking of all the constituent vehicles of the combination, whatever their relative positions

service brake

braking device, normally a foot brake, used in the ordinary course of events by the driver of a vehicle to reduce its speed or to stop it

stopping distances

S

distance, in metres, covered by a vehicle between the moment when the driver begins to actuate the control of a braking device and the moment when the vehicle stops

transmission

combination of components between the control and the brake and that links them functionally

The transmission may be mechanical, hydraulic, pneumatic, electrical, or any combination of these. Where the braking power is derived from, or is assisted by a source of energy independent of the driver but controlled by him, the reserve of energy in the device is also part of the transmission.

type of braking device

type based on differences in such essential respects as

- a) component characteristics,
- b) the characteristics of the materials from which the components are made, or the shape or size of the components,
- c) the assembly of the components

unladen vehicle mass

mass of a vehicle, ready to be driven, including a full tank of fuel at the start of the test schedule plus a driver and an observer and the necessary test equipment and accessories

vehicle

self-propelled vehicle or a trailer, or a vehicle that has, as integral or as attached parts, pedals and an engine, and that is designed or adapted to be propelled by means of the pedals or the engine or both

category L vehicles

motor vehicles having less than four wheels and comprising:

- a) category L₁. Two-wheeled vehicles having an engine cylinder capacity not exceeding 50 cm³ and a maximum design speed not higher than 40 km/h
- b) category L₂. Three-wheeled vehicles having an engine cylinder capacity not exceeding 50 cm³ and a maximum design speed not higher than 40 km/h
- c) category L₃. Two-wheeled vehicles having an engine cylinder capacity greater than 50 cm³ or a design speed higher than 40 km/h
- d) category L₄. Vehicles having three wheels asymmetrically arranged in relation to the longitudinal median axis and an engine cylinder capacity greater than 50 cm³ or a design speed higher than 40 km/h
- e) category L₅. Vehicles having three wheels symmetrically arranged in relation to the longitudinal median axis and a maximum mass not exceeding 1 000 kg, and having an engine cylinder capacity greater than 50 cm³ or a design speed higher than 40 km/h

category M vehicles

motor passenger vehicles having at least four wheels and comprising:

- a) category M₁. Vehicles used for the carriage of passengers and containing not more than eight seats in addition to the driver's seat
- b) category M₂. Vehicles used for the carriage of passengers and containing more than eight seats, in addition to the driver's seat, and having a maximum mass not exceeding 5 t
- c) category M₃. Vehicles used for the carriage of passengers and containing more than eight seats, in addition to the driver's seat, and having a maximum mass exceeding 5 t

category N vehicles

motor goods vehicles having at least four wheels, or having three wheels and a maximum mass exceeding 1 t, and comprising:

- a) Category N₁. Vehicles used for the carriage of goods and having a maximum mass not exceeding 3.5 t
- b) Category N₂. Vehicles used for the carriage of goods and having a maximum mass of more than 3.5 t and not more than 12 t
- c) Category N₃. Vehicles used for the carriage of goods and having a maximum mass exceeding 12 t

In category N, the maximum mass of a tractor designed to be coupled to a semi-trailer, which must be taken into consideration when the vehicle is classified, is the operational mass of the tractor plus that portion of the mass of the semi-trailer borne by the tractor and, where appropriate, the maximum mass of the tractor's own load. The masses of equipment and fittings found on certain special vehicles, e.g. crane vehicles, workshop vehicles, etc., are considered to be part of the load.

category O vehicles

trailers, including semi-trailers, and comprising:

- a) category O₁. Trailers, other than semi-trailers, having a single axle and a maximum mass not exceeding 750 kg
- b) category O₂. Trailers having a maximum mass of more than 750 kg and not more than 3.5 t
- c) category O₃. Trailers having a maximum mass of more than 3.5 t and not more than 10 t
- d) category O₄. Trailers having a maximum mass exceeding 10 t

In category O, the maximum mass of a semi-trailer, which must be taken into consideration when the vehicle is classified, is that portion of the mass of the semi-trailer supported directly by the ground when the semi-trailer is coupled to a tractor and laden with a maximum load.

3 General requirements for braking devices

3.1 Design and construction

A braking device shall be so designed, constructed, and fitted as to

- a) enable the vehicle to comply in normal use, and despite any vibration to which it may be subjected, with the applicable requirements of this specification; and
- b) enable the device to resist the corroding and aging phenomena to which it is exposed.

3.2 Performance

3.2.1 General

In no road test shall braking cause any of the following to occur:

- a) the wheels to lock;
- b) the vehicle to deviate from a lane of width 3,5 m;
- c) the vehicle to vibrate abnormally.

3.2.2 Service braking devices

a) General

A service braking device shall be such that when it is tested in accordance with the appropriate test(s) given in 5.3, 5.4, and 5.5,

- 1) the movement of the vehicle can be safely controlled;
- 2) in the test given in 5.3, the vehicle is halted within the relevant stopping distance given in column 5 of Table 1, and in the test given in 5.5, the equivalent braking force attained by the brake(s) of a trailer is at least equal to the value given in column 3 of Table 2;
- 3) the braking action can be graduated smoothly; and
- 4) the driver can achieve compliance with the above requirements from his driving seat without removing his hands from the steering control.

Table 1 — Required stopping distances in type O test (engine disconnected)

1	2	3	4	5	6	7		8
						Hand control	Foot control	
Category of vehicle	How laden	Initial speed, V, km/h	Brakes applied	Stopping distance, S, m, max.*	Mean deceleration, m/s ²	Force applied, N, max.		
L ₁	Driver only	40	Rear only	V ² /55	2.1	200	400	
L ₁	Driver and passenger	40	Rear only	V ² /75	2.9	200	400	
L ₁	Driver only	40	Both brakes	V ² /110	4.2	200	400	
L ₂ (symmetrical wheel arrangement)	First laden, then unladen	40	Both brakes	V ² /110	4.2	200	400	
L ₂ (asymmetrical)	First laden, then unladen	40	Both brakes	V ² /100	3.9	200	400	
L ₂ (symmetrical or asymmetrical)	First laden, then unladen	40	Either brake alone	V ² /45	1.7	200	400	
L ₃	Driver only	40	Front brake only	V ² /100	3.9	200	500	
L ₃	Driver only	40	Rear brake only	V ² /80	3.1	200	500	
L ₃	Driver only	60	Both brakes	V ² /130	5.0	200	500	
L ₃	Driver and passenger	40	Rear brake only	V ² /95	3.7	200	500	
L ₄	First driver only, then with passenger	60	Both brakes	V ² /120	4.6	200	500	
L ₅	First laden, then unladen	60	Both brakes	V ² /120	4.6	200	500	
L ₅	First laden, then unladen	40	Either brake alone	V ² /50	1.9	200	500	
M ₁	First laden, then unladen	80	Service brake	0.1 V + V ² /150	5.8	400	500	
M ₁	First laden, then unladen	80	Secondary brake (emergency)	0.1 V + 2(V ² /150)			500	
M ₂	First laden, then unladen	60	Service brake	0.15V + V ² /130	5.0	600	700	
M ₂	First laden, then unladen	60	Secondary brake (emergency)	0.15V + 2(V ² /130)			700	
M ₃	First laden, then unladen	60	Service brake	0.15V + V ² /130	5.0	600	700	
M ₃	First laden, then unladen	60	Secondary brake (emergency)	0.15V + 2(V ² /130)			700	
N ₁	First laden, then unladen	70	Service brake	0.15V + V ² /115	4.4	600	700	
N ₁	First laden, then unladen	70	Secondary brake (emergency)	0.15V + 2(V ² /115)			700	
N ₂	First laden, then unladen	50	Service brake	0.15V + V ² /115	4.4	600	700	
N ₂	First laden, then unladen	50	Secondary brake (emergency)	0.15V + 2(V ² /115)			700	
N ₃	First laden, then unladen	40	Service brake	0.15V + V ² /115	4.4	600	700	
N ₃	First laden, then unladen	40	Secondary brake (emergency)	0.15V + 2(V ² /115)			700	

* Based on the numerical value of V.

Table 2 — Performance of service braking devices of category Oi (when relevant), O₂, O₃, and O₄ vehicles

1	2	3
Type of braking	Force or pressure to be applied, max.	Equivalent braking force to be attained, min.
Continuous or semi-continuous	A pressure not exceeding 650 kPa in the brake cylinders	Not less than 45 % of the maximum weight* borne by the wheels of the trailer when stationary
Inertia	A thrust, on the trailer coupling, not exceeding a) 0,06 GA for multi-axle trailers, b) 0,09 GA for single axle trailers, where GA is the maximum weight* of the trailer as declared by the manufacturer	

* Weight, N = 9.8 x mass in kilograms.

b) Response time

In the case of a service braking device that is dependent, totally or partially, on a source of energy other than the muscular effort of the driver, the device shall be such that it complies with the relevant requirements of SANS 1051-2.

c) Residual performance (categories M and N)

- 1) The residual performance after a fade test on the service braking device of a category M or N vehicle, determined in accordance with 5.6, shall be at least 80 % of that required in terms of (a) (2) above, and at least 60 % of that actually obtained when it was subjected to the initial performance test given in 5.3, i.e. the stopping distances shall not exceed the specified and recorded values by more than 25 % and 66 % respectively.
- 2) In addition, after a category M₂, M₃, or N₃ vehicle has been subjected to the downhill test given in 5.8.1 (a) and (b), the residual performance of the service braking device, determined in accordance with 5.8.2, shall be at least 75 % of that required in terms of (a)(2) above, i.e. the stopping distance shall not exceed the specified value by more than 33 %. Alternatively, and if applicable, when a category M₂, M₃, or N₃ vehicle is tested in accordance with 5.8.1 (a) and (c), it shall be capable of a mean deceleration of at least 0.5 m/s².

d) Residual performance (category O)

- 1) The residual performance after a fade test on the service braking device of a category O₂, O₃, O₄, and (when relevant) d vehicle, determined in accordance with 5.7, shall be at least 80 % of that required in terms of (a) (2) above, and at least 60 % of that actually obtained when it was subjected to the performance test given in 5.5.
- 2) In addition, after a category O₄ vehicle has been subjected to the downhill test given in 5.8.1 (a) and (b), the residual performance of the service braking device, determined in accordance with 5.8.2, shall be at least 75 % of that required in terms of (a)(2) above, i.e. the equivalent braking force shall be at least 33 % of the maximum weight borne by the wheels of the trailer when stationary.

3.2.3 Secondary (emergency) braking devices

When a secondary (emergency) braking device is tested in accordance with 5.3,

- a) it shall be able to halt the vehicle within the relevant stopping distance given in column 5 of Table 1;
- b) it shall be possible to graduate the braking action; and
- c) the driver shall be able to achieve compliance with the above requirements from his driving seat while keeping at least one hand on the steering control.

It is assumed that not more than one failure of a service braking device can occur at any one time.

3.2.4 Parking braking devices

- a) When tested in accordance with 5.9.1, the parking braking device of a vehicle of a category given in column 1 of Table 3 shall, even in the absence of the driver, be able to hold the laden vehicle stationary (with the vehicle facing up or down) on the appropriate gradient given in column 2 without the applied force exceeding the appropriate maximum given in column 3 or 4, as relevant, and the working parts of the device shall then be capable of being locked in that position by purely mechanical means. The driver shall be able to achieve this braking action from his driving seat except that, in the case of a trailer, this braking action shall be achievable by a person standing on the ground (see 4.3.1).

Table 3 — Performance of parking braking devices

1 Vehicle category	2 Gradient %	3 Force applied N, max.		4
		Hand control	Foot control	
U	16	200	500	
M!	18	400	500	
M ₂ , M ₃ , N ₁ , N ₂ , N ₃	18	600	700	
O ₁ , O ₂ , O ₃ , O ₄	18	600	-	

- b) In addition, when a drawing vehicle of category M or N is tested in accordance with 5.9.2, the parking braking device of the drawing vehicle shall after, if necessary, several actuations of the control, be capable of holding the combination of vehicles stationary on a 12 % gradient with the combination facing up or down and with the device locked in the achieved position. The trailer air brake and the parking brake of the drawing vehicle may be designed to operate simultaneously, provided that the driver is enabled to check at any time that the parking braking performance of the drawing vehicle, obtained by the purely mechanical action of its parking brake device, is sufficient to hold the combination on a 12 % gradient.

4 Provision of and specific requirements for braking devices

4.1 Vehicles of category L

- a) Each category L₁, L₂, and L₃ vehicle shall be equipped with two independent service braking devices with independent controls, one device acting on the front wheel(s) and the other on the rear wheel(s). Provision of a parking braking device is not essential.
- b) Each category U vehicle shall be equipped with the braking devices which would be required if it had no side-car, i.e. as in (a) above. If these devices enable the required level of performance to be achieved in tests of the vehicle with the side-car, a brake on the side-car wheel is not required. Provision of a parking braking device is not essential.
- c) Each category L₅ vehicle shall be equipped with two independent service braking devices that, when actuated simultaneously, operate on all three wheels. In addition, there shall be parking-brake action on the wheel(s) of at least one axle, and the parking braking device, which may be one of the above two devices, shall be independent of the device that acts on the other wheel(s).
- d) At least one of the service braking devices shall act on braking surfaces that are attached to the wheels either rigidly or through components not liable to failure.
- e) Wear on the brakes shall be capable of being easily compensated for by means of a manual or an automatic system of adjustment. In addition, in the case of the brakes acting on the rear axle of a category L₅ vehicle, the control and the components of the transmission and of the brake shall possess a reserve of travel such that, when the brakes have become heated or the brake-linings have lost approximately 10 % of their original thickness, braking is ensured without immediate adjustment being necessary.

4.2 Vehicles of categories M and N

4.2.1 General

Each vehicle of category M or N shall be equipped with a service brake, a secondary (emergency) brake, and a parking brake.

4.2.2 Controls

The devices that provide service, secondary (emergency), and parking braking may have common components provided that

- a) there are at least two controls, independent of each other and readily accessible to the driver from the driving seat even when the driver is wearing a safety belt,
- b) the control of the service braking device is independent of that of the parking braking device,
- c) if the service braking device and the secondary (emergency) braking device have the same control,
 - 1) the effectiveness of the linkage between that control and the different components of the transmission is not liable to diminish after long usage, and
 - 2) actuation of the auxiliary service brake control, or, in the absence of such a control, the parking brake control, when tested in accordance with 5.9.3, produces a mean deceleration on halting the laden vehicle of at least 1.5 m/s,
- d) if the service braking device and the secondary (emergency) braking device have separate controls, simultaneous actuation of the two controls does not render both the braking devices inoperative, either when both braking devices are in good working order, or when one of them is faulty, and
- e) in the event of the breakage of any component, other than the brake as defined and the parts specified in 4.2.4, or if there is any other failure of the service braking device, the secondary braking device or that part of the service braking device which is not affected by such failure is able to bring the vehicle to a halt in the conditions specified for secondary braking.

4.2.3 Signalling of failure of hydraulic service braking devices

The failure of a component of a hydraulic service braking device shall be signalled to the driver by a warning device that operates a red tell-tale lamp not later than on actuation of the control. A device that operates a red tell-tale lamp when the level of the fluid in the reservoirs of the braking device falls below the value specified by the manufacturer, is permissible (see also 4.2.12(b)). The failure of a component of the warning device shall not allow total loss of effectiveness of the braking device in question to occur. Failure switches for both circuits of a dual line system may be integrated into a single assembly provided that failure of any one component cannot lead to leakage from both circuits. The tell-tale lamp shall, when operated, be visible even by daylight, and the satisfactory functioning of the warning device shall be easily verifiable by the driver.

4.2.4 Parts considered not liable to failure

The following parts shall be regarded as not liable to failure provided that they are readily accessible for maintenance:

- a) a pedal and its bearing;
- b) in a hydraulic system, a master cylinder and its piston(s);
- c) in a pneumatic system, a control valve;
- d) a linkage between pedal and master cylinder or control valve;
- e) a brake cylinder and its piston(s), hydraulic or pneumatic or both;

- f) a lever-and-cam brake assembly; and
- g) a component attaching a braking surface to its wheel(s).

Any of the above parts, failure of which would make it impossible to brake the vehicle with a degree of effectiveness at least equal to that prescribed for secondary (emergency) braking, shall be of metal, or a material with equivalent characteristics, and shall not be subject to significant distortion in the normal operation of the braking device.

4.2.5 Service brakes: Split and dual circuits

- a) Unless (b) below applies, a service braking device shall, whether or not it is combined with the secondary (emergency) braking device, be such that, in the event of failure of a component of its transmission, a sufficient number of wheels are still braked by actuation of the service braking control. These wheels shall be so selected that the remaining performance of the service braking device is at least equal to the following percentages of the performances required in terms of 3.2.2(a)(2) except that the maximum force applied to the control shall not exceed 700 N in all cases:
 - 1) laden vehicles of all categories: 30 %
 - 2) unladen vehicles of categories M₁, M₂, N¹, N₂: 25 %
 - 3) unladen vehicles of categories M₃ and N₃: 30 %
- b) The requirements given in (a) shall not apply to a tractor drawing a semi-trailer in which the transmission of the service braking device of the semi-trailer is independent of that of the service braking device of the drawing vehicle.

4.2.6 Energy sources

Where use is made of energy other than the muscular energy of the driver, there need be not more than one source, e.g. hydraulic pump, air compressor, of such other energy. In all cases such source(s) of energy shall be such that, in the event of failure of any component of the transmission, if the functioning of the component(s) not affected by the failure is required for halting the vehicle with the degree of effectiveness specified for secondary (emergency) braking (see table 1), the energy feed to the unaffected component(s) is maintained. This condition shall be met by means of devices that can be easily actuated when the vehicle is stationary, or by automatic means. In addition, storage devices located down-circuit of this device must be such that after four actuations of the service brake control it is still possible to halt the vehicle with the degree of effectiveness prescribed for secondary braking.

4.2.7 Energy reserves

- a) Where the secondary braking device and the service braking device have a common control and common transmission,
 - 1) if the service braking is actuated by the muscular energy of the driver assisted by one or more energy reserves, the secondary braking shall, in the event of failure of that assistance, be capable of being ensured by the muscular energy of the driver assisted by the energy reserves, if any, which are unaffected by the failure, the force applied to the control not exceeding the relevant maximum given in table 1; and
 - 2) if the service braking force and transmission depend exclusively on the use, controlled by the driver, of an energy reserve,
 - i) there shall be at least two completely independent energy reserves, each provided with its own independent transmission;

- ii) each of these systems may act on the brakes of at least two wheels, the wheels being so selected as to be capable of ensuring by themselves the prescribed degree of secondary (emergency) braking without endangering the stability of the vehicle during braking; and
 - iii) each energy reserve shall be equipped with an alarm device (see 4.2.13).
- b) Where an auxiliary source of energy is essential to the functioning of a braking device, the reserve of energy shall be such as to ensure that, if the engine stops, the braking performance remains adequate to bring the vehicle to a halt under the specified test conditions (see 5.1). In addition, if the muscular effort applied by the driver to the parking braking device is reinforced by a servo device, the actuation, whether application or release, of parking braking shall be ensured in the event of a failure of that servo. This shall, if necessary, be achieved by the use of a source of energy independent of that normally actuating the servo device. This independent source of energy may be that provided for the service braking system.

4.2.8 Automatic devices

The requirements of 4.2.5, 4.2.6, and 4.2.7 shall be met without the use of any automatic device of a kind such that its ineffectiveness might pass unnoticed owing to the fact that parts normally in a position of rest come into action only in the event of failure of the braking device.

4.2.9 Action of service braking devices

The action of a service braking device shall be

- a) on all the wheels of the vehicle,
- b) appropriately distributed among the axles, and
- c) divided between the wheels of an axle symmetrically in relation to the longitudinal median plane of the vehicle.

4.2.10 Braking surfaces

Service braking devices and parking braking devices shall act on braking surfaces permanently connected to the wheels by components of adequate strength.

No braking surface shall be capable of being disconnected from its wheel(s) unless such disconnection

- a) in the cases of the service braking device and the emergency braking device, is only momentary (e.g. during a change of gear), and that service braking or emergency braking with the prescribed degree of effectiveness continues to be possible;
- b) in the case of the parking braking device, is controlled exclusively by the driver from his driving seat by a system incapable of being brought into action by a leak.

4.2.11 Adjustment for brake wear

Wear on the brakes shall be capable of being easily compensated for by means of a manual or automatic system of adjustment. If slack-adjusters are used for this purpose, they shall be capable of providing adjustment in steps not greater than 5°, measured at the cam. In addition, the control and the components of the transmission and of the brakes shall possess a reserve of travel such that, when the brakes become heated or the brake-linings have lost approximately 10 % of their original thickness, effective braking is still ensured without immediate adjustment being necessary.

4.2.12 Hydraulic fluid reservoirs

In hydraulic braking devices, the fluid reservoirs shall be so designed and constructed that

- a) the filling ports are readily accessible, and

- b) the level of the fluid can be easily checked without the reservoir having to be opened, or a warning signal (whose effective functioning is easily verifiable by the driver) draws the driver's attention to any fall in the level of reserve fluid that is liable to cause a failure of the braking device.

4.2.13 Alarm

Every vehicle equipped with a brake actuated by an energy storage device (energy accumulator) shall, if braking with the prescribed performance for secondary braking is impossible without the use of the stored energy, be equipped, in addition to the pressure gauge, with an alarm device that gives a signal, optical or audible, when the energy in any part of the installation preceding the control valve falls to a value which, without re-feeding the storage devices, allows at least four brake applications to be made with the performance prescribed for secondary braking. This alarm device shall be directly and permanently connected to the circuit.

4.2.14 Failure of trailer's brake device or air supply

In the case of a drawing vehicle equipped with a brake controlled by the driver, the service braking device of the drawing vehicle shall be equipped with a device that is situated in the vehicle, and so designed that in the event of failure of the trailer's braking device, or in the event of an interruption of the air supply from the drawing vehicle to the trailer, it is still possible to brake the drawing vehicle by using the service brake, with the effectiveness prescribed for secondary (emergency) braking. (See table 1.)

4.2.15 Auxiliary equipment

Auxiliary equipment shall be supplied with energy in such a way that, even in the event of damage to the source of energy, operation of the auxiliary equipment cannot cause the reserves of energy that feed the braking devices to fall to below 65 % of their normal level.

4.2.16 Braking devices on drawing vehicles for trailers

In the braking devices of a drawing vehicle for a trailer the air supply connections shall be of the dual line or the multiple line type, and shall be of the automatic shut-off type and such that they cannot be reversed, i.e. wrongly connected. The braking devices on a drawing vehicle for a trailer of category O₃ or O₄ shall be such that

- a) when the secondary (emergency) braking device of the vehicle is actuated, there is a graduated braking action in the trailer also;
- b) if the service braking device consists of at least two independent circuits and there is a failure of one circuit, the circuit or circuits not affected by the failure are capable of at least partially actuating the brakes of the trailer, and it is possible to graduate this braking action;
- c) if there is a breakage of or leak in one of the air supply pipes or a breakage of or leak in such other type of connection as may be fitted,
 - 1) unless the breakage or leak automatically causes the trailer to be braked, it is still possible for the driver to actuate the brakes of the trailer, fully or partially, by means of the service brake control or of the secondary (emergency) brake control or of a separate control;
 - 2) if the breakage or leak automatically causes the trailer to be braked, the pressure in the feed line shall fall to not more than 150 kPa within 2 s when the service brake control of the drawing vehicle is fully actuated.

4.3 Vehicles of category O

4.3.1 General

- a) All category O vehicles shall be equipped with a parking braking device that is capable of being applied and released by a person standing on the ground, and such application and release shall be possible both when the trailer and drawing vehicle are connected and when the trailer is separate from the drawing vehicle. In the case of a category d trailer only, such a brake may be a device, attached to the vehicle, that

is designed merely to keep the vehicle stationary on an 18 % gradient with the vehicle facing up or down (see table 3).

- b) If a trailer is fitted with a device that enables compressed-air actuation of the braking device to be cut out, the device shall be so designed and constructed that it is positively restored to the position of rest as soon as the supply of compressed air to the trailer is resumed.

4.3.2 Category O₁

A trailer of category O₁ need not be equipped with a service braking device unless it is intended for coupling to a drawing vehicle having an unladen mass less than twice the maximum permissible vehicle mass of the trailer, in which case the trailer shall comply with the requirements of 4.3.3.

4.3.3 Category O₂

A trailer of category O₂ shall be equipped with a service braking device of the continuous, or the semi-continuous, or the inertia (overrun) type. The last type shall be provided only for trailers, other than semi-trailers, which are intended for coupling to a drawing vehicle having a maximum permissible vehicle mass not less than 1.33 times the maximum permissible vehicle mass of the trailer.

4.3.4 Categories O₃ and O₄

A trailer of category O₃ or O₄ shall be equipped with a service braking device of the continuous or the semi-continuous type. If such a trailer is fitted with a two-line air supply it shall comply with the requirements of 4.2.16(c).

4.3.5 Service brakes on category O vehicles

The action of the service braking device shall

- a) be on all the wheels of the trailer,
- b) be appropriately distributed among the axles of the trailer,
- c) be distributed between the wheels of an axle symmetrically in relation to the longitudinal median plane of the vehicle, and
- d) not be initiated by the slight decelerations that occur in normal driving.

4.3.6 Braking surfaces

The braking surfaces required to comply with the relevant performance requirements shall be in constant connection with the wheels, either rigidly or through components not liable to failure.

4.3.7 Adjustment for brake wear

Wear on the brakes shall be capable of being easily compensated for by means of a manual or automatic system of adjustment. If slack-adjusters are used for this purpose they shall be capable of providing adjustment in steps not greater than 5°, measured at the cam. In addition, the control and the components of the transmission and of the brake shall possess a reserve of travel such that, when the brakes become heated or the brake linings have lost approximately 10 % of their original thickness, effective braking is still ensured without immediate adjustment being necessary.

4.3.8 Couplings

- a) Except as allowed in terms of (b) below, the braking devices on a trailer shall be such that the trailer is stopped automatically if the coupling breaks while the trailer is in motion and, in the case of trailers with air brakes, when the feed line is exhausted at the rate of at least 100 kPa/s, this emergency application shall occur before the pressure in the feed line falls to 200 kPa;

- b) the requirements of (a) above shall not apply to a single-axled trailer having a maximum permissible vehicle mass not exceeding 1.5 t and that is equipped with, in addition to the coupling device, a secondary coupling, e.g. chain, wire, or rope, that, in the event of breakage of the main coupling, is capable of preventing the drawbar from touching the ground and of providing means for some residual guidance of the trailer.

5 Methods of test

5.1 Test conditions (general)

- a) Each test shall be carried out at the speed(s) specified in the test, except that, if the appropriate speed cannot be attained, the test shall be performed at the vehicle's maximum speed.
- b) In the case of a vehicle with compressed air brakes, the pressure in the brake cylinders at the start of any test shall be not greater than the maximum pressure and not less than the cut-in pressure of the vehicle, as specified in both cases, by the manufacturer of the vehicle.
- c) Roads on which tests are carried out shall be level and shall have a surface that affords good adhesion.
- d) No test shall be carried out when there is a wind of speed exceeding 25 km/h.
- e) At the start of a series of tests the tyres shall be cold and at the pressure prescribed by the vehicle manufacturer for the load actually borne by the wheels when the vehicle is stationary.
- f) In tests on motor cycles, the driver shall be seated in the saddle as for normal driving.

5.2 General performance report

The general behaviour of the vehicle during braking shall be recorded, and compliance with 3.2.1 shall be checked.

5.3 Type O test: Performance with engine disconnected (categories L, M, and N)

This is an ordinary performance test for stopping distance from a prescribed speed (see Table 1).

- a) If necessary, prepare the brakes for testing by burnishing to the manufacturer's specification.
- b) Check that the brakes are cold (below 100 °C measured on the disc or on the outside of the drum).
- c) Carry out the tests on a vehicle, laden and unladen.
- d) Carry out each braking test from the appropriate initial speed given in column 3 of table 1, using a force on the brake control not exceeding the appropriate maximum given in column 7 or column 8, as relevant.
- e) Measure the stopping distance or calculate it from measurements of the reaction time of the device and the mean deceleration.
- f) Check for compliance with the appropriate requirements of 3.2.2(a), 3.2.3 and, when relevant, 4.2.5.

5.4 Type O test: Performance with engine connected (categories L, M, and N)

Test the brakes of the vehicle, laden and unladen, at various speeds, the lowest being equal to 30 % of the maximum speed of the vehicle, and the highest being equal to 80 % of that maximum speed. Check the behaviour of the vehicle for compliance with 3.2.2(a)(1), (3), and (4). Record the speeds and the stopping distances in the test report.

5.5 Performance of service braking devices of vehicles of category O (trailers)

5.5.1 Category O₁ trailers

In the case of a category d trailer in which a service braking device is fitted (see 4.3.2), test the service braking device of the trailer as in 5.5.2.

5.5.2 Trailers of categories O₂, O₃, and O₄

Test the service brakes by means of a road test from an initial speed of 40 km/h and, if necessary, also by using a dynamometer. Check that by using a force or pressure, as relevant, not greater than the appropriate maximum given in column 2 of table 2, the equivalent braking force attained is at least equal to the appropriate value given in column 3 (see also 3.2.2(a)(2)).

5.6 Type I test: Fade test followed by residual performance test (Categories M and N)

5.6.1 Fade test

With the vehicle laden, test the service brakes by subjecting them to the appropriate number of braking cycles given in column 5 of table 4, during each of which the brakes are applied and released successively, under the following conditions:

- The speed at the end of each cycle shall be 50 % V_1 (see column 3 of Table 4);
- the duration of each cycle shall preferably be as given in column 4 of Table 4, but if the characteristics of the vehicle make it impossible to conform to this value, the duration of t shall be increased. In all cases, f shall include, in each cycle, a period of 10 s for stabilizing the speed V_T for the next cycle;
- the force applied to the brake control shall be so adjusted as to produce a mean deceleration of 3 m/s² during the first cycle, and the same force shall be used throughout the test;
- the highest gear ratio, other than that of overdrive etc., shall be continuously engaged during each braking cycle;
- after braking, the speed shall be regained by using the gears in such a way as to attain the speed V_i in the shortest possible time, i.e. by using the maximum acceleration allowed by the engine and gearbox.

Table 4 — Test conditions for fade test on category M and category N vehicles

1 Category of vehicle	2 3 4 5 Test conditions*			
	V_i , km/h	V_2 , km/h	t , seconds	n , cycles
M _i	+80% $V_{max.}$ or 120	50 % V_i	45	15
M ₂	+80% $V_{max.}$ or 100	50 % V_i	55	15
N _i	+80% $V_{max.}$ or 120	50 % V_i	55	15
M _s , N ₂ , N ₃	+80 % $V_{max.}$ or 60	50 % V_i	60	20
* The symbols have the following meaning: + whichever is the lesser V_i initial speed at beginning of braking cycle V_2 speed when brake is released $V_{max.}$ maximum speed of vehicle n number of braking cycles t preferred duration in seconds of each braking cycle, i.e. the period between successive applications of the brake				

5.6.2 Residual performance

Immediately after completing the procedure given in 5.6.1, determine the residual performance by repeating the procedures given in 5.3(d) and (e). Then check for compliance with 3.2.2(c)(1).

5.7 Type I test: Fade test followed by residual performance test (category O)

5.7.1 Fade test

With the use of a dynamometer type of brake testing machine or by conducting a road test, test the service brakes of the laden trailer in such a manner that the energy input to the brakes is equivalent to that which would be recorded, in the same period of time, by the laden trailer on a 7 % down-gradient at a steady speed of 40 km/h for a distance of 1.7 km or, if the power available is insufficient, at one of the lower speed and greater distance combinations shown in Table 5. During the test so adjust the force applied to the control as to keep the resistance of the trailer constant at a value

- a) in the case of a semi-trailer, equivalent to 7 % of the weight of the axle(s) of the semi-trailer when carrying its maximum load; and
- b) in other cases, equivalent to 7 % of the weight of the trailer.

Table 5 — Type I test for trailers

1	2
Speed km/h	Distance m
40	1 700
30	1 950
20	2500
15	3100

5.7.2 Residual performance

Immediately after completing the procedure given in 5.7.1, determine the residual performance by repeating the test given in 5.5.2. Then check for compliance with 3.2.2(d)(1).

5.8 Type II test: Downhill and residual performances

5.8.1 Downhill test (categories M₂, M₃, N₃, and O₄)

- a) Test the laden vehicle in such a manner that the energy input to the brakes is equivalent to that which would be recorded, in the same period of time, by the laden vehicle driven, on a 6 % down-gradient, at an average speed of 30 km/h for a distance of 6 km and, when relevant, with the appropriate gear engaged and the retarder in use.
- b) Select the lowest gear which enables the vehicle to attain a speed of 30 km/h without exceeding the maximum engine speed specified by the manufacturer. Engage the retarder, if fitted, and, with the engine running, apply the equivalent braking energy either by towing the vehicle and monitoring the towing force or by using a dynamometer type testing machine and monitoring the brake force.
- c) Alternatively, in the case of a vehicle in which all the energy is absorbed by the braking action of the engine or retarder alone, and where such braking action can be sustained under the conditions in (a) above, select the lowest gear ratio which enables the vehicle to attain a speed of 25 km/h without exceeding the maximum engine speed specified by the manufacturer. Engage the retarder, if fitted, and measure the time taken by the fully-laden vehicle travelling on a level road to reduce its speed by 5 km/h from the highest speed obtainable in that gear. Repeat the test in the opposite direction and check the average of the mean decelerations so obtained for compliance with the relevant requirement given in 3.2.2(c)(2).

5.8.2 Residual performance (categories M₂, M₃, N₃ and O₄)

Immediately after completing the test given in 5.8.1 (b), determine the residual performance by repeating the procedures given in 5.3(d) and (e) or 5.5.2, as relevant. Then check for compliance with the relevant requirement given in 3.2.2(c)(2) or the requirements of 3.2.2(d)(2), as appropriate.

5.9 Tests for parking braking devices (categories L₅, M, N, and O)

5.9.1 Categories L₅, M, N, and O

Position the laden vehicle, facing first in the upwards and then in the downwards position, on the appropriate gradient (see column 2 of table 3), apply the parking brake, and check the brake for compliance with the requirements of 3.2.4(a). Alternatively, conduct the test, in each direction, on a dynamometer and predict the results by calculation, but ensure that suspect or borderline results are verified by testing, as above, on suitable gradients. In the case of a trailer, check that the applied force can be applied by a person standing on the ground.

5.9.2 Drawing vehicles of categories M and N

In the case of a drawing vehicle of category M or N, after testing the parking brakes of the individual vehicles as in 5.9.1, couple the vehicle and trailer and, on a 12 % gradient, test the parking brake of the drawing vehicle for compliance with 3.2.4(b). Alternatively, conduct the test, in each direction, on a dynamometer and predict the result by calculation, but ensure that suspect or borderline results are verified by testing, as above, on suitable gradients.

5.9.3 Categories M and N

In the case of a vehicle of category M or N that has the same control for the service braking device and the secondary braking device, conduct a single laden test in accordance with 5.3(a), (b), (c), and (d) by applying the auxiliary service brake control or, in its absence, the parking brake control and determine the mean deceleration on halting the vehicle. Check for compliance with 4.2.2(c)(2).

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