CD/K/050-2:2008
ICS 43.040.40; 65.060.10

EAST AFRICAN STANDARD

Braking (motor and towed vehicles, designed for public roads) — Part 2: Low speed trailers

EAST AFRICAN COMMUNITY

First Edition 2010

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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Braking (motor and towed vehicles, designed for public roads) — Part 2: Low speed trailers

1 Scope

This part of CD/K/050 applies to the braking systems of low speed trailers, including trailers purely for agricultural and forestry purposes, with a maximum design speed of between 6 km/h and 40 km/h.

2 Normative references

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

CD/K/050-1:2008, *Braking (motor and towed vehicles, designed for public roads) — Part 1: Low speed vehicles*

CD/K/051-1:2008, *Pneumatic braking system connections between drawing and drawn vehicles — Part 1: Contact type couplings*

CD/K/051-2:2008, *Pneumatic braking system connections between drawing and drawn vehicles — Part 2: Palm type couplings*

CD/K/051-3:2008, *Pneumatic braking system connections between drawing and drawn vehicles — Part 3: The arrangement of connections on vehicles, using contact type or palm type couplings*

3 Definitions

For the purposes of this part of this East African Standard, the following definitions apply:

3.1
actuation of a braking system
brake application and brake release

3.2
automatic braking
braking of trailers, which will occur automatically in the event of the separation of the components of the combination of coupled vehicles, including such separation caused by coupling breakage, without the braking effectiveness of the remainder of the combination being substantially reduced

3.3
brake
part in which the forces opposing the movement of the vehicle develop

NOTE It may be a friction brake (when the forces are generated by the friction between the two parts of the trailer moving relatively to each other), an electrical brake (when the forces are generated by the electromagnetic action between two parts of the trailer moving relatively to but not in contact with each other), a fluid brake (when the forces are generated by the action of a fluid situated between two parts of the trailer moving relatively to each other) or, an engine/exhaust brake (when the forces are derived from a controlled increase in the braking action of the engine transmitted to the wheels). A device which mechanically locks the motor vehicle's transmission but which cannot be used when the vehicle is in motion is regarded as a parking brake.

3.4
braking ratio
the value of the deceleration of a vehicle other than a semi-trailer, divided by gravity acceleration 9; in the case of a semi-trailer, the value of the braking force divided by the static load on the semi-trailer axle(s)

3.5
braking system
combination of parts whose function is to reduce the speed of a moving trailer progressively, or to bring it to a halt, or to keep it stationary if already halted. A braking system consists of the energy supply device, the control, the transmission and the brakes themselves and, where applicable, a supplementary device on the towing vehicle for energy supply to, and control of, the braking system of the trailer

3.6
braking system component
one of the individual parts which, when assembled, constitutes the braking system

3.7
continuous braking
braking of a combination of vehicles through an installation with the following characteristics:

a) a single control which the driver actuates progressively, by a single movement, from the driver's seat of the towing vehicle;

b) a single energy source supplying the energy required for braking all the vehicles constituting the combination of vehicles;

NOTE The energy source may be the muscular energy of the driver.

c) simultaneous or suitably phased braking of each vehicle of the combination, whatever its relative position

3.8
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 controlling it

NOTE This energy 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.

3.9
energy supply device
part of a braking system which supplies and regulates the energy required for braking

3.10
failure
malfunction of the braking system which is not directly overcome by the driver

NOTE When not otherwise specified, it is assumed for this part of this East African Standard that not more than one failure can occur simultaneously in the braking system, including accessories.

3.11
independent muscular power braking system
braking system of a combination of vehicles with the following characteristics:

a) the control of the braking system of the trailers is independent of the control of the braking system of the towing vehicles; the control of the braking system of the trailers, is in any case so mounted on the towing vehicle that it is easily actuated by the driver from the driver's seat; and

b) the energy used for braking the trailers is the muscular energy of the driver.

3.12
inertia braking system
braking system in which the energy necessary to produce the braking force arises from the relative movement of the trailer towards the towing vehicle

3.13
laden vehicle
vehicle loaded to its maximum mass

3.14
low speed trailer
trailer
any vehicle for transporting goods or passengers and, which according to its design, is suited and intended for being coupled to a low speed towing vehicle having a maximum design speed of between 6 km/h and 40 km/h

3.15
maximum mass
maximum design mass of a low speed trailer stated by the vehicle manufacturer (this mass may be higher than the maximum legally permissible mass)

3.16
semi-continuous braking
braking of a combination of vehicles through an installation with the following characteristics:

a) a single control which the driver can actuate progressively, by a single movement, from the driver's seat of the towing vehicle;

b) different energy sources supplying the energy required for braking all the vehicles constituting the combination of vehicles;

NOTE One of the energy sources may be the muscular energy of the driver.

c) simultaneous or suitably phased braking of each vehicle of the combination, whatever its relative position

3.17
transmission
combination of components situated between the control and the brake and connecting the two operationally. The transmission is mechanical, hydraulic, pneumatic, electrical, or a combination of these. Where the braking power is derived from or assisted by a source of energy independent of the driver but controlled by him, the reserve of energy in the device is regarded as part of the transmission

3.18
unladen vehicle
vehicle in running order with its tanks and radiators full, carrying a driver with a mass of 75 kg, but no passenger, optional accessories or load

4 Classification of low speed trailers

Trailers are classified in the categories given in table 1.

Table 1 — Categories of trailers

Category	Maximum design mass of a trailer *t*
R1	≤1.5
R2	> 1.5 and ≤ 6
R3	>6

5 Requirements

5.1 Construction

5.1.1 General

5.1.1.1 The braking system shall, depending on the requirements for different trailer categories, contain the service braking system, parking braking system and automatic braking system. The service, parking and automatic braking systems may have common components.

5.1.1.2 Wear on the brakes shall be capable of being compensated for by a manual or automatic adjusting device. In addition, the control devices, the transmission devices and the brakes shall have a reserve of travel such that, when the brakes become heated and the brake linings have sustained a certain degree of wear, braking is ensured without immediate adjustment being necessary.

5.1.1.3 The efficiency of the braking system shall be distributed between the wheels of the same axle symmetrically to the median longitudinal plane of the trailer. Braking shall act on those wheels bearing at least half of that part of the trailer's maximum mass supported by the axles of the trailer and, when several axles are braked, be appropriately distributed among them.

5.1.1.4 The brakes required to attain the prescribed performance shall be permanently connected with the wheels, either rigidly or through components not liable to failure.

5.1.2 Resistance against vibration

The braking system shall be so designed and installed as to enable the trailer in normal use, despite the vibration to which it may be subjected, to comply with the requirements of this part of CD/K/050.

5.1.3 Resistance against corrosion

The braking system shall be so designed and installed as to be able to resist the corrosion and aging phenomena to which it is exposed and which might lead to a sudden loss of braking efficiency.

5.1.4 Service braking system

The service braking system shall make it possible to control the movement of the trailer and to stop it safely, speedily and effectively, whatever its permissible design speed and load, on any up or down gradient. These conditions shall be deemed to be fulfilled if the requirements of 5.3 are satisfied.

The driver shall be able to reach the control from his driver's seat without taking both hands off the steering wheel.

5.1.5 Parking braking system

5.1.5.1 The parking braking system shall permit the trailer to be held stationary on up or down gradients, the vehicle being held locked in the braking position by purely mechanical means.

5.1.5.2 When a trailer is detached from the towing vehicle, the parking braking system shall be capable of being actuated by a person standing on the ground. When the trailer is attached to the towing vehicle, the parking braking system shall be capable of being actuated as above or by the driver of the towing vehicle (or both). This last requirement is not mandatory if the parking braking system is activated automatically when the trailer is separated for the towing vehicle.

5.1.5.3 Obtaining the prescribed braking efficiency by successive applications of the control shall be allowed.

5.1.5.4 In the case of parking braking by mechanical locking of the brake cylinders (lock actuators),

a) when the pressure in the locking chamber closely approaches the level at which mechanical locking occurs, an optical or acoustic alarm device shall come into action,

b) where cylinders are equipped with a mechanical locking device, movement of the brake piston shall be effected by energy from two energy storage devices,

c) it shall not be possible to release the locked brake cylinder unless it is certain that after such release the brake can be applied again, and

d) in case of failure of the energy source feeding the locking chamber, an auxiliary releasing device (e.g. mechanical or pneumatic) shall be available, using, for example, the air in one of the trailer's tyres.

5.1.6 Automatic braking system

The automatic braking system of a trailer shall automatically effect braking of the trailer when it is separated accidentally from the towing vehicle.

5.2 Special requirements

5.2.1 Spring braking system

5.2.1.1 A spring braking system shall not be used as a service braking system.

5.2.1.2 A small variation in any of the pressure limits which might occur in the spring compression chamber feed circuit, shall not cause a significant variation in the braking force.

5.2.1.3 The spring braking system shall be so designed that it is possible to apply and release the brakes at least three times, starting with an initial pressure in the spring compression chamber equal to the maximum design pressure. This requirement shall be met when the brakes are closely adjusted.

5.2.1.4 The pressure in the compression chamber below which the springs begin to actuate the brakes, the latter being adjusted as closely as possible, shall not be greater than 80 % of the minimum level of the normal operation pressure available.

5.2.1.5 If the pressure in the spring compression chamber falls to the level at which the brake components are set in motion, an optical or acoustic alarm device shall be activated. Provided that this requirement is met, the alarm device may be the same as that prescribed in CD/K/050-1:2008.

5.2.1.6 The spring braking system shall be so designed that, in the event of failure, it is possible to release it without using its normal control. This requirement shall be met by means of an auxiliary device (pneumatic, mechanical, etc.).

5.2.1.7 If the operation of the auxiliary device referred to in 5.2.1.6 requires the use of a tool or spanner, such tool or spanner shall be kept in the trailer.

5.2.2 Trailers of category R1, R2 and R3

5.2.2.1 General

The parking braking system may be part of the automatic braking system of a category R1, R2 and R3 trailer. On trailers having a device which switches off the automatic braking system in a pneumatic or hydraulic way, this device shall be so designed that it automatically returns to its normal operating position when the trailer is re-supplied with energy.

5.2.2.2 Trailers of category R1

5.2.2.2.1 A trailer of category R1 need not be equipped with a service braking system or an automatic braking system, provided that, in addition to the coupling for the towing vehicle, a secondary connection device, e.g. chain or cable, be supplied, which, in case of breakage of the coupling device,

prevents the trailer drawbar from hitting the ground and ensures that the trailer has a certain amount of guidance.

5.2.2.2.2 If, however, a trailer of category R1 is equipped with a braking system, it shall satisfy the same requirements as for trailers of category R2.

5.2.2.3 Trailers of category R2

A trailer of category R2 shall be equipped with an automatic braking system and a service braking system which comprise at least an independent muscular power braking system or an inertia braking system. The driver shall be able to actuate any braking system controls which are mounted on the towing vehicle, without turning and without making any movement incompatible with the driving of the vehicle. However, where a trailer is equipped with a continuous or semi-continuous braking system, it shall satisfy the same requirements as for trailers of category R3.

5.2.2.4 Trailers of category R3

5.2.2.4.1 A trailer of category R3 shall be equipped with an automatic braking system and a service braking system which comprise a continuous or semi-continuous braking system. The energy supply, the energy storage and the control of this braking system may be installed on the towing vehicles.

5.2.2.4.2 Any pressure drop in the automatic braking circuit shall be indicated by an audible or visual alarm device as soon as the pressure in the energy reserve falls below 90 bar in the case of trailers with hydraulic braking systems; 5 bar in the case of trailers with air braking systems; or 30 kPa in the case of trailers with vacuum braking systems.

5.2.2.4.3 A hydraulic brake line connection between the towing vehicle and the trailer shall be of a single-line system with pressure rise. The pressure at the coupling head shall not exceed 15 MPa (150 bar).

5.2.2.4.4 A pneumatic or vacuum brake line connection between the towing vehicle and the trailer shall be of a multiple-line type. The maximum pressure at the coupling head shall not exceed 850 kPa (8,5 bar) in the case of air braking systems, or 80 kPa in the case of vacuum braking systems.

5.2.2.4.5 In a multiple-line system, the service control line shall be yellow and the emergency feed line shall be red, for identification purposes. The connections shall be contact type couplings that comply with the requirements of the relevant parts of CD/K/051.

5.3 Braking performances

5.3.1 Service braking system

5.3.1.1 General

If a trailer is equipped with a semi-continuous or a continuous braking system, the minimum braking performance given in 5.3.1.2 shall be achieved with the vehicle laden and having a pressure, at the coupling head, of

a) 12 MPa (120 bar) for hydraulic braking systems;

b) 650 kPa (6.5 bar) for air braking systems; and

c) 60 kPa (0.6 bar) for vacuum braking systems.

5.3.1.2 Cold performance (type O)

When tested in accordance with 6.3.1, the service braking system of a trailer of categories R2 or R3 shall achieve a braking ratio of 0.24.

5.3.1.3 Residual performance (type I)

When tested in accordance with 6.3.2, the braking efficiency of the service braking system of a trailer of categories R2 or R3 shall not be less than 75 % of the prescribed performance in 5.3.1.2, and not less than 60 % of the value obtained in a type O test.

5.3.2 Parking braking system

When tested in accordance with 6.4, the parking braking system of a trailer shall be able to keep the laden trailer stationary on an up or down gradient of 18 %.

5.3.3 Automatic braking systems

When tested in accordance with 6.5, the automatic braking system of the trailer, at a pressure that corresponds to the value releasing the alarm device, shall be able to:

a) achieve a braking ratio of 0.13; and

b) keep the laden trailer stationary on an up or down gradient of 18 %.

5.3.4 Inertia braking systems

Inertia braking systems shall comply with the requirements in Annex A.

6 Braking tests

6.1 General testing conditions

6.1.1 The efficiency prescribed for the service braking system is based on the stopping distance. It is determined either by measuring the stopping distance in relation to the initial speed or by measuring the mean fully developed deceleration. The efficiency prescribed for the parking braking system is based on the ability to hold the vehicle stationary on an up or down gradient.

6.1.2 The stopping distance is the distance covered by the vehicle from the beginning of the actuation of the braking system until the moment when the vehicle stops; the initial speed is the speed at the moment of the beginning of the actuation of the braking system.

6.1.3 The mean fully developed deceleration is the average value of the deceleration, obtained after the end of the effective build-up time. Instead of the mean fully developed deceleration it is possible to indicate the braking ratio (z).

6.1.4 When not otherwise specified, the braking performance is measured by road tests. Other test procedures are permissible when their equivalence is proved. Carry out road tests under the following conditions:

a) the trailer has the load condition prescribed for each test type; the load condition is indicated in the test report;

b) the force applied to the brake control in order to obtain the prescribed performance during the tests does not exceed 600 N on the pedal controls and 400 N on the hand-operated controls;

c) the road has a surface affording good adhesion;

d) the test is performed only when there is no wind liable to affect the results;

e) at the beginning of the tests the tyres are cold and at the pressure prescribed for the load actually borne by the wheels when the vehicles are stationary;

f) at the beginning of the tests the brakes are adjusted as closely as possible in accordance with the indications of the trailer manufacturer; and

g) the prescribed braking performance is obtained without the wheels locking, without deviation of the trailer from its course and without abnormal vibration.

6.2 Inspection

Carry out inspection. Check for compliance with 5.1 and 5.2.

6.3 Tests for service braking systems

6.3.1 Type O test

6.3.1.1 Start the test with cold brakes. A brake is deemed to be cold if one of the following conditions is fulfilled:

a) the temperature measured on the brake disc or on the outside of the drum is below 100 °C; or

b) in the case of completely enclosed brakes including brakes immersed in oil, the temperature measured on the outside of the brake housing is below 50 °C; or

c) the brakes have not been used for 1 h before the test.

6.3.1.2 Ensure that the road used for the braking test is level.

6.3.1.3 Ensure that the initial speed of the trailer is the maximum design speed.

6.3.1.4 Conduct the test with the trailer laden to its maximum mass. In the case of a trailer with part of its load transferred to the head to which the towing vehicle is coupled, distribute the load in such a way that the maximum design load at the coupling head is attained. In other cases, load the trailer in such a way that the front axle supports the maximum design load. Fit the wheels of the braked axles with tyres of the maximum diameter allowed by the manufacturer.

6.3.1.5 Apply brakes under the conditions given in 6.3.1.3 and 6.3.1.4.

6.3.1.6 Determine the braking performance at the relevant pressure given in 5.3.1.1. Repeat the test with the vehicle unladen.

6.3.1.7 Check for compliance with the requirement in paragraph 5.3.1.2.

6.3.2 Type I test

6.3.2.1 Apply the brakes so that the input energy is equivalent to that occurring over the same period with a laden vehicle driven at a steady speed equal to 80 % ± 5 % of the speed prescribed for the type O test, for a distance of 1 km on a 10 % down gradient.

6.3.2.2 At the end of the heating procedure in 6.3.2.1, carry out a type O test with the temperature achieved.

6.3.2.3 Check for compliance with the requirement in paragraph 5.3.1.3.

6.4 Parking braking test

Apply parking brakes with the laden trailer on 18 % up and down gradients. Check for compliance with 5.3.2.

6.5 Automatic braking tests

6.5.1 Under the conditions given in 6.3.1.1 to 6.3.1.4 (inclusive), drop the pressure in the supply line of the automatic braking system to the value that releases the alarm device.

6.5.2 Check for compliance with 5.3.3(a).

6.5.3 Apply the automatic brake of the laden trailer, by dropping the pressure in the supply line of the automatic braking system to the value that releases the alarm device, on 18 % up and down gradients.

6.5.4 Check for compliance with 5.3.3(b).

Annex A
(normative)

Conditions governing the testing of vehicles equipped with inertia (overrun) brakes

A.1 General provisions

A.1.1 The inertia (overrun) braking system of a trailer consists of the control device, the transmission and the wheel brakes, hereinafter called "brakes".

A.1.2 The control device is the aggregate of components integral with the drawing device.

A.1.3 The transmission is the aggregate of components between the last part of the control device and the first part of the brake.

A.1.4 The brake is the mechanism in which the forces opposing the movement of the vehicle develop. The first part of the brake is either the lever actuating the brake cam, similar components (mechanic-transmission inertia brakes), or the brake cylinder (hydraulic-transmission inertia brakes).

A.1.5 Braking systems in which stored energy (e.g. electric, pneumatic/vacuum or hydraulic energy) is transmitted to the trailer by the drawing vehicle and is merely controlled by the thrust on the coupling, do not constitute inertia (overrun) braking systems within the meaning of this part of the specification.

A.1.6 For the purposes of this annex, two axles with a wheel base of less than 1 m (tandem axle) are deemed to be one axle.

A.2 Symbols and definitions

A.2.1 Units

Mass:	kg
Forces:	N
Torques and moments:	Nm
Areas:	cm^2
Pressure:	kPa
Lengths:	SI unit specified in each case.

A.2.2 Symbols for all types of brakes (see Figure A.1)

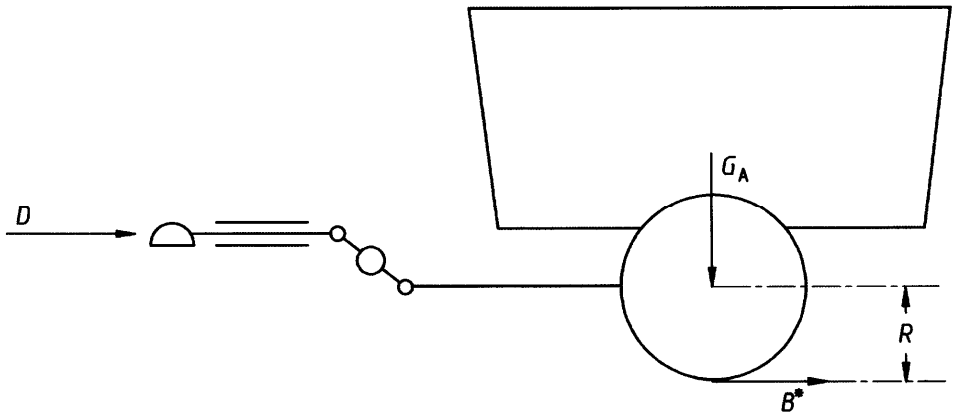


Figure A.1 — Symbols valid for all types of brake

G_A maximum design mass of the trailer declared by the manufacturer;

G'_A total mass of the trailer capable of being braked by the control device, as declared by the manufacturer;

G_B total mass of the trailer capable of being braked by the combined operation of all the brakes of the vehicle;

$G_B = n \bullet G_{Bo}$

G_{Bo} fraction of the permissible total mass of a trailer capable of being braked by one brake, as declared by the manufacturer;

B^* required braking force;

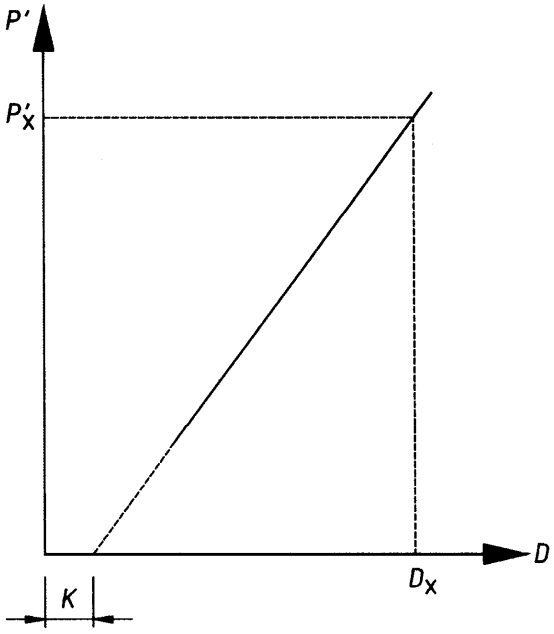
B required braking force taking account of rolling resistance;

D^* permissible thrust on the coupling;

D thrust on the coupling;

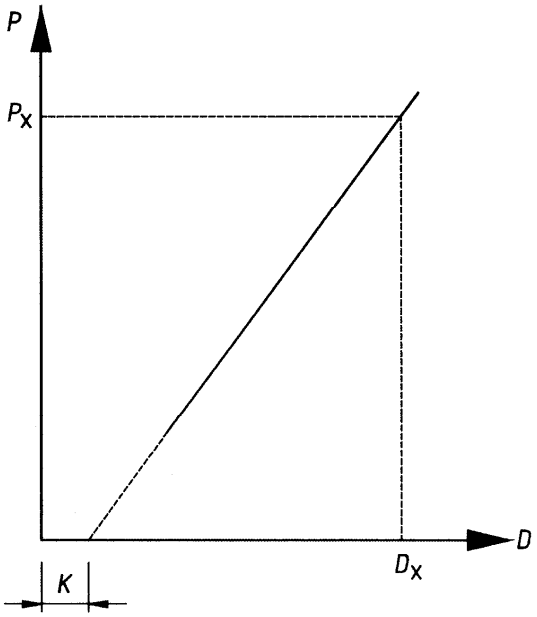
P' control-device output force;

K supplementary force of the control device, conventionally designated by the force D corresponding to the point of the intersection with the axis of the abscissa of the extrapolated curve expressing P' as function of D, measured with the device in the mid-travel position (see Figure A.2 and Figure A.3);



$$\eta_{HO} = \frac{P'_X}{D_X - K} \cdot \frac{1}{i_{HO}}$$

Figure A.2 — Mechanical transmission



$$\eta_{H0} = \frac{P_X}{D_X - K} \cdot \frac{F_{HZ}}{i_H}$$

Figure A.3 — Hydraulic transmission

K_A threshold force of the control device — this is the maximum force on the coupling head that can be applied for a short period of time without producing any output force (i.e. with the control device uncoupled from the transmission). By convention, K_A is defined as the force required to move the coupling head at a speed of 10 mm/s — 15 mm/s;

D_1 maximum force applied to the coupling head when it is being pushed home at a speed of s mm/s ±10 %, the transmission being uncoupled;

D_2 maximum force applied to the coupling head when it is being pulled at a speed of s mm/s ±10 % out of the position of maximum compression, the transmission being uncoupled;

η_{H0} efficiency of the inertia (overrun) control device;

η_{H1} efficiency of the transmission system;

η_H overall efficiency of the control device and transmission.

For a mechanical transmission system $\eta_H = \eta_{H0} \bullet \eta_{H1}$

For a hydraulic transmission system $\eta_H = \eta_{H0}$

s travel of the control device in millimetres;

s' effective (useful) travel of the control device in millimetres, determined as required by A.9.4.2;

s'' spare travel of the master cylinder, measured in millimetres at the coupling head;

s_0 loss of travel, i.e. the horizontal travel in millimetres of the coupling head when moved from 300 mm above to 300 mm below the horizontal, the transmission remaining stationary,

$2s_B$ available brake-shoe lift (brake-shoe application travel) in millimetres, measured on the diameter parallel to the brake-shoe lifting device, the brakes not being adjusted during the test;

$2s_B$* minimum required brake-shoe lift (minimum brake-shoe application travel) in millimetres:
$2s_B^* = 2.4 + 4 \times 2r/1000$

where $2r$ is the diameter of the brake drum in millimetres (see Figure A.4);

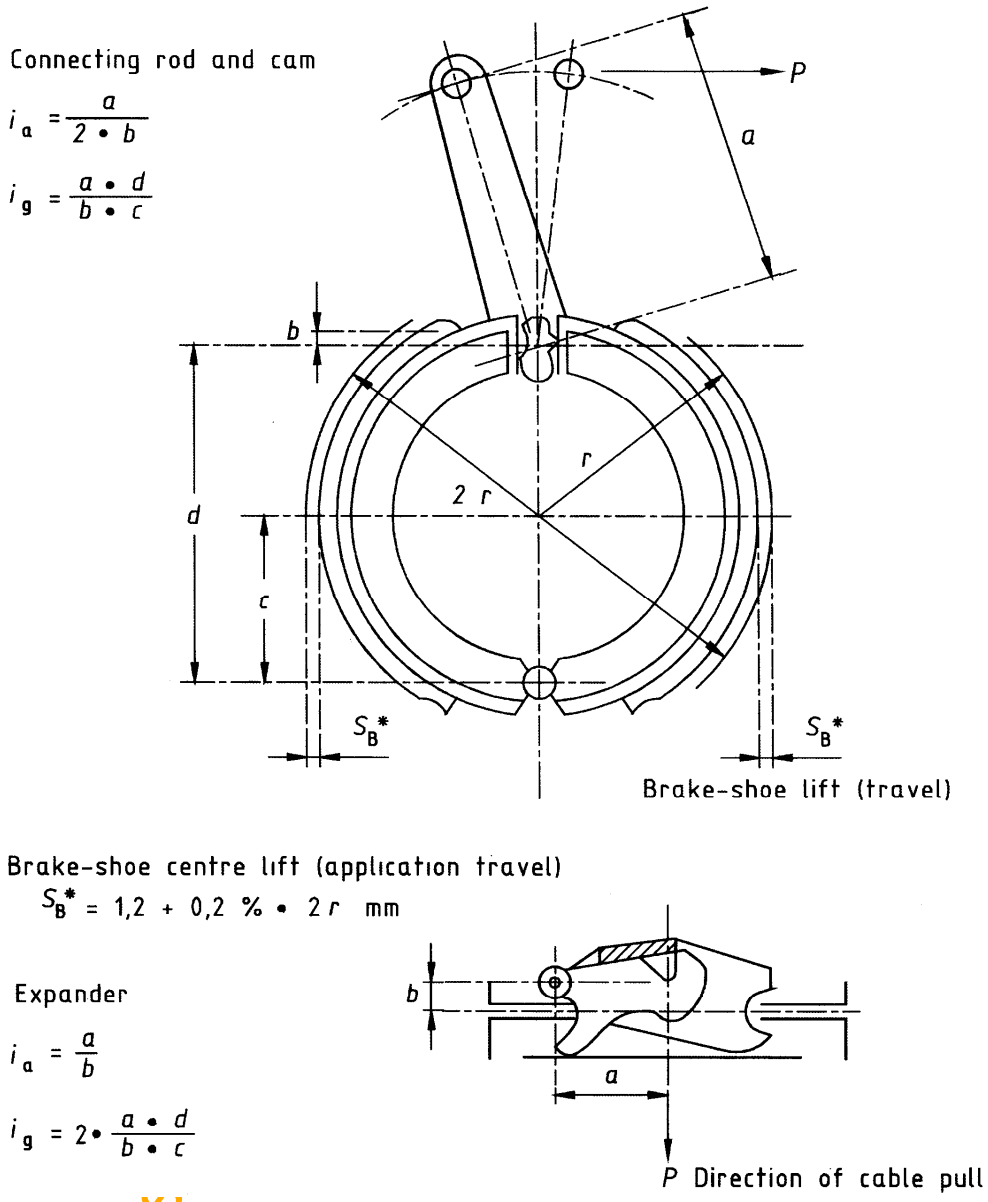


Figure A.4 — Brake checks

M braking torque;

R radius in metres of the pneumatic tyres under load, measured on the test vehicle and rounded to the nearest centimetre;

n number of brakes.

A.2.3 Symbols for mechanical-transmission brakes (see Figure A.5)

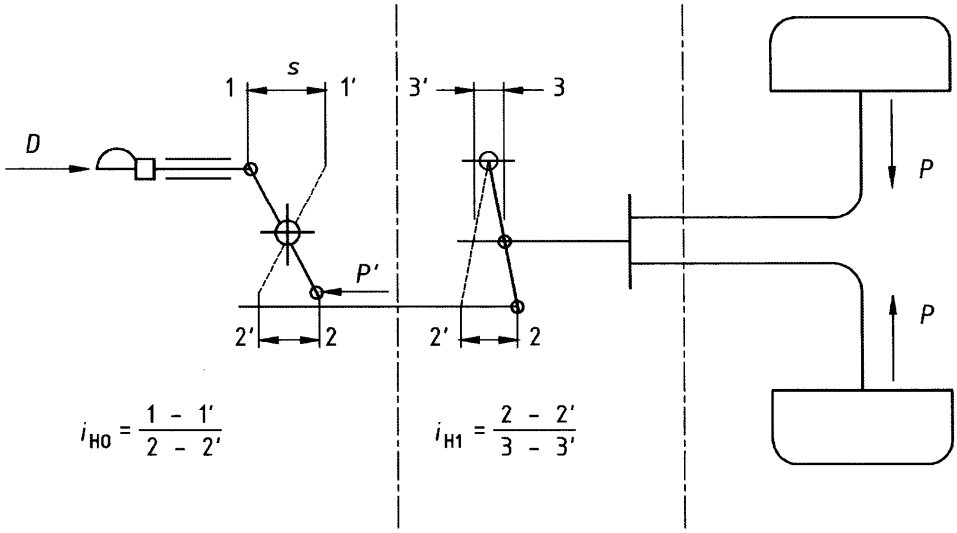


Figure A.5 — Mechanical-transmission braking system

i_{H0} reduction ratio between travel of coupling head and travel of lever at output side of control device;

i_{H1} reduction ratio between travel of lever at output side of control device and travel of brake lever (gearing down of transmission);

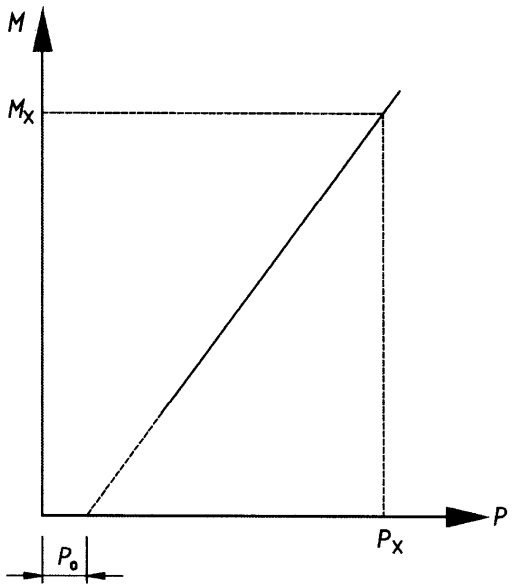
i_H reduction ratio between travel of coupling head and travel of brake lever

$$i_H = i_{H0} \times i_{H1}$$

i_g reduction ratio between the travel of the brake lever and the lift (application travel) at the brake-shoe centre (see Figure A.4);

P force applied to the brake lever of each braked wheel;

P_0 brake retraction force: i.e. in graph of $M = f(P)$, the value of the force at the point of intersection of the extrapolation of this function with the abscissa (see Figure A.6);



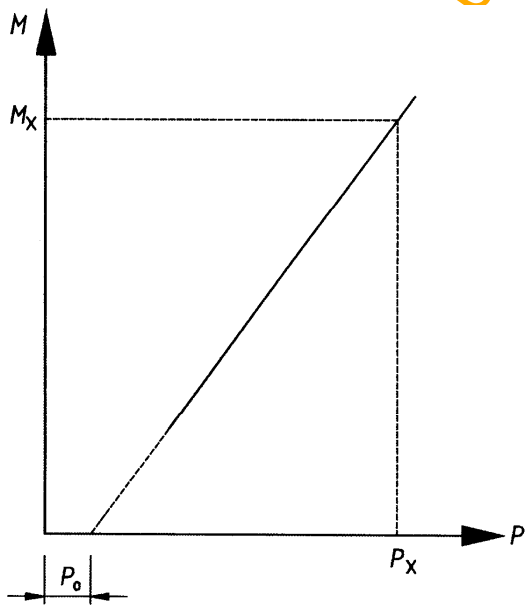
$$\rho = \frac{M_x}{P_x - P_0}$$

Figure A.6 — Mechanical brake

ρ characteristic of brake as defined by:

$$M = \rho(P - P_0)$$

A.2.4 Symbols for hydraulic-transmission brakes (see Figures A.7 and A.8)



$$\rho' = \frac{M_x}{P_x - P_0}$$

Figure A.7 — Hydraulic brake

i_h reduction ratio between travel of coupling head and travel of piston in master cylinder;

i'_g reduction ratio between travel of cylinder thrust point and lift (application travel) of brake-shoe centre;

F_{RZ} surface area of piston in a brake cylinder;

F_{HZ} surface area of piston in the master cylinder;

p hydraulic pressure in the brake cylinder.

p_0 retraction pressure in the brake cylinder; i.e. in graph of M = $f(p)$, the value of the pressure p at the point of intersection of the extrapolation of this function with the abscissa (see Figure A.7)

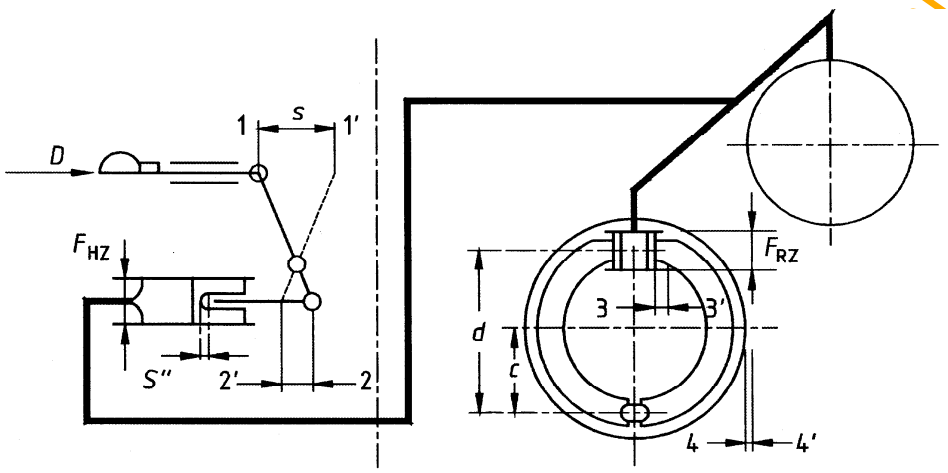


Figure A.8 — Hydraulic-transmission braking system

ρ' characteristic of the brake as defined by

$$M=\rho'(p - p_0)$$

A.3 General requirements

A.3.1 The transmission of force from the coupling head to the brakes of the trailer shall be effected either by rod linkage or by one or more fluids. However, a sheathed cable (Bowden cable), chains or a metal cable may form part of the transmission.

A.3.2 All bolts at joints shall be adequately protected. In addition, these joints shall be either self-lubricating or easily accessible for lubrication.

A.3.3 Inertia (overrun) braking systems shall be so arranged that, when maximum travel of the coupling head is used, no part of the transmission seizes, undergoes permanent deformation, or breaks. In checking this, the end of the transmission shall be disconnected from the brake control levers.

A.3.4 The inertia braking system shall allow the trailer to be reversed with the towing vehicle. Devices used for this purpose shall act automatically and disengage automatically when the vehicle moves forward.

A.4 Requirements for control devices

A.4.1 The sliding members of the control device shall be long enough to enable the full travel to be used even when the trailer is coupled.

A.4.2 The sliding members shall be either lubricated or made of self-lubricating materials. The surfaces in frictional contact shall be made of a material such that there is neither an electrochemical couple nor any mechanical incompatibility liable to cause jamming or seizing of the sliding members.

A.4.3 The stress threshold (K_A) of the control device shall not be below 0.01 gG'_A and not above 0.03 gG'_A.

A.4.4 The maximum insertion force D_1 shall not exceed 0.05 gG_A. This requirement shall be met within a temperature range of-20 °C to 20 °C.

A.4.5 The maximum tractive force D_2 shall not exceed 0.3 gG'_A.

A.5 Checks and measurements to be carried out on the control devices

A.5.1 Control devices for conformity with the requirements of A.3 and A.4 above.

A.5.2 For all types of brakes, measure the following:

a) travel *s* and effective (useful) travel *s*';

b) supplementary force *K*;

c) stress threshold K_A;

d) insertion force D_1, and

e) tractive force D_2.

A.5.3 In the case of mechanical-transmission inertia (overrun) brakes, determine the following:

a) the reduction ratio i_{H0} measured at the mid-travel position of the control;

b) the control-device output force *P*' as function of the thrust *D* on the coupling.

The supplementary force *K* and efficiency shall be derived from the curve obtained from these measurements:

$$\eta_{H0} = (1/i_{H0}) \bullet (P'/(D\text{-}K))$$

A.5.4 In the case of hydraulic-transmission inertia (overrun) brakes, determine the following:

a) the reduction ratio i_h measured at the mid-travel position of the control;

b) the master-cylinder output pressure p as a function of the thrust *D* on the drawbar of the surface area F_{HZ} of the master-cylinder piston to be specified by the manufacturer. The supplementary force *K* and the efficiency are derived form the representative curve obtained from these measurements:

$$\eta_{H0} = (1/i_{H0}) \bullet (p \bullet F_{HZ}/(D\text{-}K))$$

c) the spare travel of master cylinder *s*".

A.5.5 In the case of inertia (overrun) brakes on multi-axled trailers, measure the loss of travel s_0.

A.6 Checks and measurements to be carried out on the transmission (mechanical transmission system)

A.6.1 Check the transmission for conformity with the requirements of A.3.

A.6.2 Measure the force *P* applied to each brake lever for various values of the control device output force *P*' applied to the main rod.

A.7 Requirements for brakes

A.7.1 In addition to the brakes to be tested, the manufacturer shall submit to the technical service responsible for conducting the tests, drawings for the brakes showing the type, dimensions and material of the main components and the make and type of the linings. In the case of hydraulic brakes, these drawings shall show the surface area F_{RZ} of the brake cylinders. The manufacturer shall also specify the maximum braking torque M_{max} he allows, and the mass G_{Bo}.

A.7.2 The force *P*, or the pressure p, required to produce a braking torque of M_{max} shall not be less than the force or pressure required to produce a braking force of 0.24 G_{Bo}.

A.8 Checks and measurements to be carried out on the brakes

A.8.1 Carry out tests on the brakes and components. Check for compliance with A.7.

A.8.2 Determine the following:

a) lift (application travel $2s_B$*);

b) lift (application travel) $2s_B$ (which shall be greater than $2s_B$*);

c) the braking torque *M* as a function of the force *P* applied to the control lever in mechanical-transmission devices or of the pressure *p* in the brake cylinder in hydraulic-transmission devices.

The rotational speed of the braking surfaces shall correspond to an initial vehicle speed of 25 km/h. The following shall be derived from the curve obtained from these measurements:

1) in the case of mechanically actuated brakes, the retraction force P_0 and the characteristic ρ, and

2) in the case of hydraulically actuated brakes, the retraction pressure P_0 and the characteristic ρ'.

A.9 Compatibility between the control device and the inertia (overrun) brakes of a vehicle

A.9.1 A check shall be made on the vehicle in order to verify, taking into account the characteristics of the control device, the characteristics of the brakes and the trailer characteristics, whether the vehicle's inertia (overrun) braking system meets the prescribed requirements.

A.9.2 General checks for all types of brake

A.9.2.1 Any parts of the transmission not checked at the same time as the control device or the brakes shall be checked on the vehicle.

A.9.2.2 The total mass G_A of the trailer shall not exceed the total mass of G_A' for which the control device is authorized.

A.9.2.3 The total mass G_A of the trailer shall not exceed the total mass G_B which can be braked by the combined effect of all the brakes of the trailer.

A.9.2.4 The stress threshold K_A shall be not below 0.01 gG_A and not above 0.03 gG_A.

The insertion force D_1 shall not exceed 0.05 gG_A The maximum tractive force D_2 shall not exceed 0.3 gG_A.

A.9.3 Check for braking performance

A.9.3.1 The sum of the braking forces exerted on the circumference of the trailer wheels shall be not less than $B^* = 0.24\ gG_A$, including a rolling resistance of 0.01 G_A. This corresponds to a braking force B of 0.23 gG_A.

In this case the maximum permissible thrust on the coupling is:

$D^* = 0.03\ gG_A$ for multi-axled trailers; and

$D^* = 0.04\ gG_A$ for single-axled trailers.

A.9.3.2 To check whether the conditions in A.9.3.1 are satisfied, the following relationships shall be applied:

a) for mechanical-transmission inertia (overrun) brakes:

$$[(B \bullet R)/\rho + nP_0][1/((D^*-K)\eta_H)] \leq i_H$$

b) for hydraulic-transmission inertia (overrun) brakes:

$$[(B \bullet R)/(n \bullet \rho') + p_0][1/((D^*-K)\eta_H)] \leq i_H/F_{HZ}$$

A.9.4 Check for travel of the control device

A.9.4.1 In the case of control devices of multi-axled trailers where the total travel of the transmission device depends on the angular position of the drawbar, the travel s of the control device shall be longer than the effective (useful) travel s' of the control device, the difference being at least equal to the loss of travel s_0. The loss of travel s_0 shall not exceed 10 % of the effective travel s'.

A.9.4.2 The effective (useful) travel s' of the control device shall be determined as follows:

a) if the brake linkage is affected by the angular position of the drawbar, then

$$s' = s - s_0$$

b) if there is no loss of travel, then

$$s' = s$$

c) in hydraulic braking systems:

$$s' = s - s''$$

A.9.4.3 To check whether the travel of the control device is sufficient, the following relationships shall be applied:

a) for mechanical-transmission inertia (overrun) brakes:

$$i_H \leq s'/(s_B^* \bullet i_g)$$

b) for hydraulic-transmission inertia (overrun) brakes:

$$(i_h/F_{HZ}) \leq (s'/2s_B^* \bullet nF_{RZ} \bullet i_g)$$

A.9.5 Additional checks

A.9.5.1 In the case of mechanical-transmission inertia (overrun) brakes, a check shall be made to verify that the linkage by which the forces are transmitted from the control device to the brakes is of a good standard of design and construction.

A.9.5.2 In the case of hydraulic-transmission inertia (overrun) brakes a check shall be made to verify that the travel of the master cylinder is at least equal to s/i_h.