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COUNCIL DIRECTIVE

of 26 July 1971

on the approximation of the laws of the Member States relating to the braking devices of certain categories of motor vehicles and of their trailers

(71/320/EEC)

(OJ L 202, 6.9.1971, p. 37)

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► <u>M1</u> Commission Directive 74/132/EEC of 11 February 1974	L 74	7	19.3.1974
► <u>M2</u> Commission Directive 75/524/EEC of 25 July 1975	L 236	3	8.9.1975

Amended by:

► <u>A1</u> Act of Accession of Denmark, Ireland and the United Kingdom of Great Britain and Northern Ireland	L 73	14	27.3.1972
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Corrected by:

- **C1** Consolidated text of corrigenda to instruments published in Special Editions 1952-72, p. 96 (71/320/EEC)
- **C2** Corrigendum, OJ L 247, 23.9.1975, p. 36 (75/524/EEC)

▼B**COUNCIL DIRECTIVE****of 26 July 1971****on the approximation of the laws of the Member States relating to the braking devices of certain categories of motor vehicles and of their trailers**

(71/320/EEC)

THE COUNCIL OF THE EUROPEAN COMMUNITIES,

Having regard to the Treaty establishing the European Economic Community, and in particular Article 100 thereof;

Having regard to the proposal from the Commission;

Having regard to the Opinion of the European Parliament⁽¹⁾;Having regard to the Opinion of the Economic and Social Committee⁽²⁾;Whereas the technical requirements which motor vehicles must satisfy pursuant to national laws relate, *inter alia*, to the braking devices of certain categories of motor vehicles and of their trailers;Whereas those requirements differ from one Member State to another; whereas it is therefore necessary that all Member States adopt the same requirements either in addition to or instead of their existing rules, in order, in particular, to allow the EEC type approval procedure which was the subject of the Council Directive of 6 February 1970 on the approximation of the laws of the Member States relating to the type approval of motor vehicles and their trailers to be applied in respect of each type of vehicle⁽³⁾;

Whereas the harmonised requirements must ensure road safety throughout the whole Community;

HAS ADOPTED THIS DIRECTIVE:

Article 1

1. For the purposes of this Directive, 'vehicle' means any motor vehicle falling within one of the international categories listed below and intended for use on the road, such vehicle being with or without bodywork, having at least four wheels and a maximum design speed exceeding 25 km/h, and its trailers, with the exception of vehicles which run on rails, agricultural tractors and machinery and public works vehicles:

(a) Category M: Motor vehicles having at least four wheels or having three wheels when the maximum weight exceeds 1 metric ton, and used for the carriage of passengers:

- Category M₁: Vehicles used for the carriage of passengers, and comprising not more than eight seats in addition to the driver's seat;
- Category M₂: Vehicles used for the carriage of passengers, comprising more than eight seats in addition to the driver's seat, and having a maximum weight not exceeding 5 metric tons;
- Category M₃: Vehicles used for the carriage of passengers, comprising more than eight seats in addition to the driver's seat, and having a maximum weight exceeding 5 metric tons.

⁽¹⁾ OJ No C 160, 18.12.1969, p. 7.

⁽²⁾ OJ No C 100, 1.8.1969, p. 13.

⁽³⁾ OJ No L 42, 23.2.1970, p. 1.

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(b) Category N: Motor vehicles having at least four wheels or having three wheels when the maximum weight exceeds 1 metric ton, and used for the carriage of goods:

- Category N₁: Vehicles used for the carriage of goods and having a maximum weight not exceeding 3·5 metric tons;
- Category N₂: Vehicles used for the carriage of goods and having a maximum weight exceeding 3·5 but not exceeding 12 metric tons;
- Category N₃: Vehicles used for the carriage of goods and having a maximum weight exceeding 12 metric tons.

(c) Category O: Trailers (including semi-trailers):

- Category O₁: Trailers with a maximum weight not exceeding 0·75 metric tons;
- Category O₂: Trailers with a maximum weight exceeding 0·75 but not exceeding 3·5 metric tons;
- Category O₃: Trailers with a maximum weight exceeding 3·5 but not exceeding 10 metric tons;
- Category O₄: Trailers with a maximum weight exceeding 10 metric tons.

2. Articulated category M vehicles made up of two non-separable but articulated units shall be considered to be single vehicles.

3. In the case of a category M or N drawing vehicle designed to be coupled to a semi-trailer, the maximum weight to be taken into consideration when classifying that vehicle shall be the weight of the drawing vehicle in running order plus the maximum weight transferred to the drawing vehicle by the semi-trailer and, where appropriate, the maximum weight of the drawing vehicle's own load.

4. In the case of category N vehicles, the equipment and fittings of certain special vehicles not intended for the carriage of passengers (such as crane vehicles, workshop vehicles, publicity vehicles) shall be considered to be goods.

5. The maximum weight to be taken into consideration when classifying a category O semi-trailer shall be the weight transmitted to the ground by the axle or axles of the semi-trailer when coupled to the drawing vehicle and laden with a maximum load.

Article 2

No Member State may refuse to grant EEC type approval or national type approval of a vehicle on grounds relating to its braking devices if that vehicle is fitted with the devices specified in Annexes I to VIII and if these devices satisfy the requirements set out therein.

▼A1*Article 2a*

No Member State may refuse or prohibit the sale, registration, entry into service or use of a vehicle on grounds relating to its braking devices if that vehicle is equipped with the braking devices specified in Annexes I to VIII and if such braking devices satisfy the requirements set out therein.

▼B*Article 3*

The Member State which has granted type approval shall take the necessary measures to ensure that it is informed of any modification

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to a component or characteristic mentioned in item 1.1 of Annex I. The competent authorities of that State shall decide whether the modified prototype should be submitted to fresh tests and whether a fresh report should be drawn up thereon. If such tests reveal failure to comply with the requirements of this Directive, the modification shall not be authorised.

Article 4

Pending the entry into force of a separate Directive on the definition of an 'urban bus', such vehicles shall continue to be submitted to the Type II A test described in Annex II where their maximum weight exceeds 10 metric tons.

Article 5

The amendments necessary for adjusting the requirements of the Annexes so as to take account of technical progress shall be adopted in accordance with the procedure laid down in Article 13 of the Council Directive of 6 February 1970 on the type approval of motor vehicles and their trailers.

Article 6

1. Member States shall put into force the provisions containing the requirements needed in order to comply with this Directive within eighteen months of its notification and shall forthwith inform the Commission thereof.
2. With effect from 1 October 1974, the provisions of item 2.2.1.4 of Annex I shall also apply to vehicles other than those in category M₃ or category N₃.
3. Member States shall ensure that the texts of the main provisions of national law which they adopt in the field covered by this Directive are communicated to the Commission.

Article 7

This Directive is addressed to the Member States.



ANNEX I

DEFINITIONS, REQUIREMENTS, CONSTRUCTION AND FITTING

1. DEFINITIONS

1.1. 'Type of vehicle with respect to the braking devices'

'Type of vehicle with respect to the braking devices' means vehicles which do not differ in such essential respects as:

1.1.1. *In the case of motor vehicles*

- 1.1.1.1. the vehicle category, as defined in Article 1 of this Directive
- 1.1.1.2. the maximum weight, as defined in item 1.14
- 1.1.1.3. the distribution of weight among the axles
- 1.1.1.4. the maximum design speed
- 1.1.1.5. a different type of braking device with particular reference to the presence or otherwise of devices for braking a trailer
- 1.1.1.6. the number and arrangement of the axles
- 1.1.1.7. the engine type
- 1.1.1.8. the number and ratios of gears
- 1.1.1.9. ratio(s) of rear drive axle(s)
- 1.1.1.10. the tyre dimensions

1.1.2. *In the case of trailers*

- 1.1.2.1. the vehicle category, as defined in Article 1 of this Directive
- 1.1.2.2. the maximum weight, as defined in item 1.14
- 1.1.2.3. the distribution of weight among the axles
- 1.1.2.4. a different type of braking device
- 1.1.2.5. the number and arrangement of the axles
- 1.1.2.6. the tyre dimensions

1.2. 'Braking device'

'Braking device' means the combination of parts whose function is progressively to reduce the speed of a moving vehicle or to bring it to a halt, or to keep it stationary if it is already halted. These functions are specified in item 2.1.2. The device shall consist of the brake control, the transmission and the brake proper.

1.3. 'Graduated braking'

'Graduated braking' means braking during which, within the normal range of operation of the device, during either the application or the releasing of the brakes,

- the driver can, at any time, increase or reduce the braking force through action on the control,
- the braking force acts in the same direction as the action on the control (monotonic function),
- it is easily possible to make a sufficiently fine adjustment to the braking force.

1.4. 'Control'

'Control' means the part actuated directly by the driver (or, where appropriate, in the case of a trailer, the driver's mate) to supply to the transmission the energy required for braking or controlling it. 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.

▼B**1.5. 'Transmission'**

'Transmission' means the combination of components situated between the control and the brake and connecting the two operationally. The transmission may be mechanical, hydraulic, pneumatic, electrical, or mixed. 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 shall likewise be regarded as part of the transmission.

1.6. 'Brake'

'Brake' means the part in which the forces opposing the movement of the vehicle develop. It may be a friction brake (when the forces are generated by the friction between two parts of the vehicle moving relatively to one another); an electrical brake (when the forces are generated by electromagnetic action between two parts of the vehicle moving relatively to but not in contact with one another); a fluid brake (when the forces are generated by the action of a fluid situated between two parts of the vehicle moving relatively to one another); or an engine brake (when the forces are derived from a controlled increase in the braking action of the engine transmitted to the wheels).

1.7. 'Different types of braking devices'

'Different types of braking devices' means equipment which differs in such essential respects as:

- 1.7.1. components having different characteristics,
- 1.7.2. a component made of materials having different characteristics or a component different in shape or size,
- 1.7.3. a different assembly of the components.

1.8. 'Braking system component'

'Braking system component' means one of the individual parts which, when assembled, constitute the braking device.

1.9. 'Continuous braking'

'Continuous braking' means the braking of combinations of vehicles through an installation having the following characteristics:

- 1.9.1. a single control which the driver actuates progressively, by a single movement, from his driving seat,
- 1.9.2. the energy used for braking the vehicles constituting the combination of vehicles is supplied from the same source (which may be the muscular energy of the driver),
- 1.9.3. the braking installation ensures simultaneous or suitably phased braking of each of the constituent vehicles of the combination, whatever their relative positions.

1.10. 'Semi-continuous braking'

'Semi-continuous braking' means the braking of combinations of vehicles through an installation having the following characteristics:

- 1.10.1. a single control which the driver can actuate progressively, by a single movement, from his driving seat,
- 1.10.2. the energy used for braking the vehicles constituting the combination of vehicles is supplied from two different sources (one of which may be the muscular energy of the driver),
- 1.10.3. the braking installation ensures simultaneous or suitably phased braking of each of the constituent vehicles of the combination, whatever their relative positions.

1.11. 'Automatic braking'

'Automatic braking' means braking of the trailer or trailers occurring automatically in the event of separation of components of the combination of coupled vehicles, including such separation through coupling breakage, without the effectiveness of the remainder of the combination being affected.

▼B**1.12. ‘Inertia or “overrun” braking’**

‘Inertia braking’ means braking by utilising the forces generated by the trailer’s moving up on the drawing vehicle.

1.13. ‘Laden vehicle’

‘Laden vehicle’ means, except where otherwise stated, a vehicle laden to its ‘maximum weight’.

1.14. ‘Maximum weight’

‘Maximum weight’ means the maximum weight stated by the vehicle manufacturer to be technically permissible (this weight may be higher than the ‘permissible maximum weight’).

2. CONSTRUCTION AND FITTING REQUIREMENTS**2.1. General***2.1.1. Braking device*

2.1.1.1. The braking device must be so designed, constructed and fitted as to enable the vehicle in normal use, despite the vibration to which it may be subjected, to comply with the undermentioned requirements.

2.1.1.2. In particular, the braking device must be so designed, constructed and fitted as to be able to resist the corrosion and ageing phenomena to which it is exposed.

2.1.2. Functions of the braking device

The braking device defined in item 1.2 must fulfil the following conditions:

2.1.2.1. Service braking

The service braking must enable the driver to control the movement of the vehicle and to halt it safely, speedily and effectively, whatever its speed and load, on any up or down gradient. It must be possible to graduate this braking action. The driver must be able to achieve this braking action from his driving seat without removing his hands from the steering control.

2.1.2.2. Secondary braking

The secondary braking must make it possible to halt the vehicle within a reasonable distance in the event of the failure of the service braking. It must be possible to graduate this braking action. The driver must be able to obtain this braking action from his driving seat while keeping at least one hand on the steering control. For the purposes of these requirements, it is assumed that not more than one failure of the service braking can occur at one time.

2.1.2.3. Parking braking

The parking braking must enable the vehicle to be held stationary on an up or down gradient even in the absence of the driver, the working parts being then held in the locked position by a purely mechanical device. The driver must be able to achieve this braking action from his driving seat, subject, in the case of a trailer, to the requirements of item 2.2.2.10.

2.2. Characteristics of braking devices*2.2.1. Vehicles of categories M and N*

2.2.1.1. The set of braking devices with which a vehicle is equipped must satisfy the requirements laid down for the service, secondary and parking brake

2.2.1.2. The devices providing service, secondary and parking braking may have common components, provided that they fulfil the following conditions:

2.2.1.2.1. there must be at least two controls, independent of each other and readily accessible to

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- the driver from the driving seat; this requirement must be met even when the driver is wearing a safety belt;
- 2.2.1.2.2. the control of the service braking device must be independent of the control of the parking braking device;
- 2.2.1.2.3. where the service and secondary braking devices have the same control, the effectiveness of the linkage between that control and the various components of the transmission systems must not be liable to diminish after a certain period of use;
- 2.2.1.2.4. where the service and secondary braking devices have the same control, the parking braking device must be so designed that it can be actuated when the vehicle is in motion;
- 2.2.1.2.5. in the event of a breakage of any component other than the brakes (as defined in item 1.6) or the components specified in item 2.2.1.2.7, or of any other failure of the service braking device (malfunction, partial or total exhaustion of an energy reserve), the secondary braking device or that part of the service braking device which is not affected by the failure must be able to bring the vehicle to a halt in the conditions prescribed for secondary braking;
- 2.2.1.2.6. in particular, where the secondary braking device and the service braking device have a common control and common transmission;
- 2.2.1.2.6.1. where the service braking is actuated by the muscular energy of the driver assisted by one or more energy reserves, the secondary braking must, 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 prescribed maxima;
- 2.2.1.2.6.2. where the force for the service braking and transmission depend exclusively on the use of an energy reserve controlled by the driver, there must be at least two completely independent energy reserves, each provided with its own independent transmission; each of them may act on the brakes of only two or more wheels so selected as to be capable of ensuring by themselves the prescribed degree of secondary braking without endangering the stability of the vehicle during braking; in addition, each of these energy reserves must be fitted with a warning device as defined in item 2.2.1.13;
- 2.2.1.2.7. for the purposes of item 2.2.1.2.5, certain parts, such as the pedal and its bearing, the master cylinder and its piston or pistons (hydraulic systems), the control valve (pneumatic systems), the linkage between the pedal and the master cylinder or the control valve, the brake cylinders and their pistons (hydraulic and/or pneumatic systems), and

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the lever-and-cam assemblies of brakes, shall not be regarded as liable to breakage if they are amply dimensioned, are readily accessible for maintenance, and exhibit safety features at least equal to those prescribed for other essential components (such as the steering linkage) of the vehicle. Where the failure of any such part would make it impossible to brake the vehicle with a performance at least equal to that prescribed for the secondary braking, that part must be made of metal or of a material with equivalent characteristics and must not be subject to significant distortion in the normal operation of the braking devices.

- 2.2.1.3. Where there are separate controls for the service and secondary braking devices, simultaneous actuation of the two controls must not render both the service and secondary braking devices inoperative, either when both braking devices are in good working order or when one of them is faulty.
- 2.2.1.4. In the event of failure in a part of the transmission of the service brake, the following conditions must be met:
- 2.2.1.4.1. a sufficient number of wheels must still be braked by actuation of the service braking device control, whatever the vehicle load;
- 2.2.1.4.2. these wheels must be so selected that the residual performance of the service braking device is equal to not less than x% of the performance prescribed for the category to which the vehicle belongs, the force applied to the control not exceeding 70 kg:
- | | |
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| vehicles at maximum weight (all categories) | x = 30 |
| unladen vehicles: categories M ₁ , M ₂ , N ₁ , N ₂ | x = 25 |
| categories M ₃ and N ₃ | x = 30 |
- 2.2.1.4.3. however, the above requirements shall not apply to drawing vehicles for semi-trailers when the transmission of the service braking device of the semi-trailer is independent of that of the drawing vehicle.
- 2.2.1.5. Where use is made of energy other than the muscular energy of the driver, there need not be more than one source of such other energy (hydraulic pump, air compressor, etc.), but the means by which the device constituting that source is driven must be completely reliable. In the event of failure in any part of the transmission of a vehicle's braking devices, the supply to the part not affected by the failure must continue to be ensured where this is required for the purpose of halting the vehicle with the degree of effectiveness prescribed for secondary braking. This condition must be met by means of devices which can be easily actuated when the vehicle is stationary, or by automatic means.
- 2.2.1.6. The requirements of items 2.2.1.2, 2.2.1.4 and 2.2.1.5 must be met without the use of any automatic device of a kind such that its ineffectiveness might pass unnoticed because the parts which are normally in an 'at rest' position are actuated only in the event of failure of the braking device.
- 2.2.1.7. The service braking device must act on all the wheels on the vehicle.
- 2.2.1.8. The action of the service braking device must be appropriately distributed among the axles.
- 2.2.1.9. The action of the service braking device must be distributed between the wheels of the same axle symmetrically in relation to the longitudinal median plane of the vehicle.

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- 2.2.1.10. The service braking device and the parking braking device must act on braking surfaces permanently connected to the wheels through components of adequate strength. It must not be possible to disconnect a braking surface from the wheels; however, in the case of the servicing device and secondary braking device, such disconnection of the braking surfaces shall be permitted provided that it is only momentary, for instance during a change of gear, and that both the service braking and the secondary braking continue to operate with the prescribed degree of effectiveness. In addition, any such disconnection shall be permitted in the case of the parking braking device, provided that it is controlled exclusively by the driver from his driving seat by a system which cannot be actuated by a leak ⁽¹⁾.
- 2.2.1.11. Wear on the brakes must be easily compensated by means of a system of manual or automatic adjustment. In addition, the control and the components of the transmission and of the brakes must possess a reserve of travel such that, when the brakes become heated or when the brake linings have reached a certain degree of wear, effective braking is ensured without an immediate adjustment being necessary.
- 2.2.1.12. In hydraulic braking devices:
- 2.2.1.12.1. the filling ports of the fluid reservoirs must be readily accessible; in addition, the containers of reserve fluid must be so made that the level of the reserve fluid can be easily checked without the containers having to be opened. Where this last condition is not fulfilled, a warning light must indicate to the driver when the reserve fluid falls to a level liable to cause a failure of the braking device. The driver must be able to check easily whether the light is functioning properly;
- 2.2.1.12.2. ►M2 the failure of a part of a hydraulic transmission system shall be signalled to the driver by a device comprising a red tell-tale lamp lighting up not later than on actuation of the control. However a device comprising a red tell-tale lamp lighting up when the level of the fluid in its reservoirs falls below the value specified by the manufacturer is admissible. The tell-tale lamp shall be visible even by daylight; the satisfactory condition of the lamp must be easily verifiable by the driver. The failure of a component of the device shall not entail total loss of effectiveness of the braking device in question. ◀
- 2.2.1.13. Every vehicle fitted with a brake actuated from an energy reservoir must, ►C1 where braking with the performance prescribed for secondary braking is impossible ◀ without the use of stored energy, be fitted with a warning device, in addition to a pressure gauge where fitted, giving an optical or acoustical signal when the energy, in any part of the installation preceding the control valve, falls to 65% or less of its normal value. This device must be directly and permanently connected to the circuit.
- 2.2.1.14. Without prejudice to the requirements of item 2.1.2.3, where the use of an auxiliary energy source is essential for the operation of a braking device, the energy reserve must be such as to ensure that, should the engine stop, the braking performance remains sufficient to bring the vehicle to a halt in the prescribed conditions. In addition, if the muscular energy applied by the driver to

(1) This item must be interpreted in the following way: The performance of the service and secondary braking devices must remain within the limits prescribed in the Directive, even during momentary disconnection.

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the parking braking device is reinforced by some aid, the actuation of the parking braking must be ensured in the event of failure of that aid, if necessary by using a reserve of energy independent of that normally supplying such aid. This reserve of energy may be that intended for the service braking. The expression 'actuation' also covers the action of releasing.

- 2.2.1.15. In the case of a motor vehicle to which the coupling of a trailer equipped with a brake controlled by the driver of the drawing vehicle is authorised, the service braking device of the drawing vehicle must be fitted with a device so designed that if the trailer braking device should fail, or the air supply pipe (or such other type of connection as may be adopted) between the drawing vehicle and trailer should break, it will still be possible to brake the drawing vehicle with the effectiveness prescribed for the secondary braking; it is accordingly prescribed, in particular, that this device be fitted to the drawing vehicle⁽¹⁾.
- 2.2.1.16. The auxiliary equipment must draw its energy only in such a way that its operation, even in the event of damage to the energy source, cannot cause the reserves of energy feeding the braking devices to fall below the level indicated in item 2.2.1.13.
- 2.2.1.17. In the case of a braking device operated by compressed air, the pneumatic link with the trailer must be of the type with two or more pipes.
- 2.2.1.18. Where the trailer belongs to category O₃ or O₄, the service braking device must be of a continuous or semi-continuous type.
- 2.2.1.19. In the case of a vehicle authorised to draw a category O₃ or O₄ trailer, the braking devices must satisfy the following conditions:
- 2.2.1.19.1. when the secondary braking device of the drawing vehicle is actuated, there must also be a graduated braking action on the trailer;
- 2.2.1.19.2. should the main braking device of the drawing vehicle fail, and if this device is made up of at least two independent sections, the section or sections not affected by this failure must be able partially or fully to actuate the trailer brakes. It must be possible to graduate this braking action;
- 2.2.1.19.3. in the case of a break or leak in one of the air supply pipes (or in such other type of connection as may be adopted), it must nevertheless be possible for the driver to fully or partially actuate the trailer brakes, by means either of the service braking control or of the secondary braking control or of a separate control, unless the break or leak automatically causes the trailer to be braked.
- 2.2.1.20. Except in the case of 'urban buses', vehicles used for the carriage of passengers comprising more than eight seats in addition to the driver's seat, and having a maximum weight exceeding 10 metric tons, must satisfy the Type II A test described in item 1.5 of Annex II and not the Type II test described in item 1.4 of that Annex.

2.2.2. *Vehicles of category O*

- 2.2.2.1. Trailers of category O₁ need not be fitted with a service braking device; however, if trailers of this category are equipped with a service braking device this must

⁽¹⁾ This point is to be interpreted in the following way: It is essential, in all cases, that the service braking device should be fitted with a device (for instance a limiting valve) ensuring that the vehicle can still be braked by the service brake, but with a performance equal to that of the secondary brake.

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- comply with the same requirements as those of category O₂.
- 2.2.2.2. Every trailer of category O₂ must be fitted with a service braking device either of the continuous or semi-continuous type or of the inertia (overrun) type. The latter type shall be authorised only for trailers other than semi-trailers.
- 2.2.2.3. Every trailer of category O₃ or O₄ must be fitted with a service braking device of the continuous or semi-continuous type.
- 2.2.2.4. The service braking device must act on all the wheels of the trailer.
- 2.2.2.5. The action of the service braking device must be suitably distributed among the axles.
- 2.2.2.6. The action of every braking device must be distributed between the wheels of each axle symmetrically in relation to the longitudinal median plane of the vehicle.
- 2.2.2.7. The braking surfaces required to attain the prescribed degree of effectiveness must be in constant contact with the wheels, either rigidly or through components not liable to failure.
- 2.2.2.8. Wear on the brakes must be easily compensated by a system of manual or automatic adjustment. In addition, the control and the components of the transmission and of the brakes must possess a reserve of travel such that, when the brakes become heated or when the brake linings have reached a certain degree of wear, braking is ensured without immediate adjustment being necessary.
- 2.2.2.9. The braking devices must be such that the trailer is stopped automatically if the coupling breaks while the trailer is in motion. However, this requirement shall not apply to single-axled trailers with a maximum weight not exceeding 1.5 metric tons provided that the trailers are fitted, in addition to the main coupling, with a secondary coupling (chain, cable, etc.) which, in the event of breakage of the main coupling, can stop the drawbar from touching the ground and provide some residual steering action on the trailer.
- 2.2.2.10. On every trailer which is required to be fitted with a service braking device, parking braking must be ensured even when the trailer is separated from the drawing vehicle. It must be possible for a person standing on the ground to actuate the parking braking device; however, in the case of a trailer used for the carriage of passengers, it must be possible to actuate this brake from inside the trailer. The expression 'actuate' also covers the action of releasing.
- 2.2.2.11. Where a trailer is fitted with a device enabling compressed-air actuation of the braking device to be cut out, the first-mentioned device must be so designed and constructed that it is positively restored to the 'at rest' position not later than on the resumption of the supply of compressed air to the trailer.

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ANNEX II

BRAKING TESTS AND PERFORMANCE OF BRAKING DEVICES

1. BRAKING TESTS

1.1. General

1.1.1. The performance prescribed for braking devices shall be based on the stopping distance. The performance of a braking device shall be determined either by measuring the stopping distance in relation to the initial speed or by measuring the reaction time of the device and the mean deceleration in normal operation as prescribed in Annex III.

1.1.2. The stopping distance shall be the distance covered by the vehicle from the moment when the driver begins to actuate the control of the device until the moment when the vehicle stops; the initial speed shall be the speed at the moment when the driver begins to actuate the control of the device. In the formulae given below, for the measurement of braking performance,

v = initial speed in km/h

s = stopping distance in metres.

1.1.3. For the type approval of any vehicle, the braking performance shall be measured during road tests conducted in the following conditions:

1.1.3.1. the vehicle's condition as regards weight must be as prescribed for each type of test and be specified in the test report;

1.1.3.2. the test must be carried out at the speeds prescribed for each type of test. Where a vehicle is so constructed that its maximum speed is lower than that prescribed for a test, the test must be performed at the maximum speed of the vehicle;

1.1.3.3. during the tests the force applied to the brake control in order to obtain the prescribed performance must not exceed the maximum laid down for the test vehicle's category;

1.1.3.4. ► **M2** without prejudice to the requirements contained in item 1.1.4.2 below, the road shall possess a surface having good adhesion; ◀

1.1.3.5. the tests must be performed when there is no wind liable to affect the results;

1.1.3.6. at the start of the tests the tyres must be cold and at the pressure prescribed for the load actually borne by the wheels when the vehicle is stationary;

1.1.3.7. the prescribed performance must be obtained without locking of the wheels, without deviation of the vehicle from its course, and without abnormal vibration.

1.1.4. *Behaviour of the vehicle during braking*

1.1.4.1. In braking tests, and in particular in those at high speed, the general behaviour of the vehicle during braking must be checked.

▼ **M2**

1.1.4.2. The behaviour of vehicles in categories M_1 , M_2 , M_3 , N_1 , N_2 , N_3 , O_3 and O_4 on a road surface having reduced adhesion shall fulfil the conditions laid down in the Appendix.

▼ **B**1.2. **Type O test**

(ordinary performance test with brakes cold)

▼**B**1.2.1. *General*

1.2.1.1. The brakes must be cold. A brake is deemed to be cold when the temperature measured on the disc or on the outside of the drum is below 100°C.

1.2.1.2. The test must be conducted in the following conditions:

1.2.1.2.1. the vehicle must be laden, the distribution of its weight among the axles being that stated by the maker. Where provision is made for several arrangements of the load on the axles the distribution of the maximum weight among the axles must be such that the load on each axle is proportional to the maximum permissible load for each axle;

1.2.1.2.2. in the case of a motor vehicle, every test must be repeated on the unladen vehicle carrying only the driver and possibly one person—preferably sitting on the front seat—responsible for noting the results of the test;

1.2.1.2.3. the limits prescribed for minimum performance, both for tests with the vehicle unladen and for tests with the vehicle laden, shall be those laid down hereunder for each category of vehicle;

1.2.1.2.4. the road must be level.

1.2.2. *Type O test with engine disconnected*

1.2.2.1. The test must be carried out at the speed prescribed for the category to which the vehicle belongs, the figures prescribed in this connection being subject to a certain margin of tolerance. The minimum performance prescribed for each category must be attained.

1.2.3. *Type O test with engine connected*

1.2.3.1. Apart from the tests prescribed in item 1.2.2, additional tests shall be carried out at various speeds with the engine connected, the lowest being equal to 30% of the maximum speed of the vehicle and the highest being equal to 80% of that speed. The performance figures measured and the behaviour of the vehicle shall be recorded in the test report.

1.3. **Type I test**

(fade test)

1.3.1. *With repeated braking*

1.3.1.1. The service brakes of vehicles in categories M₁, M₂, M₃, N₁, N₂ and N₃ shall be tested by successively applying and releasing the brakes a number of times, the vehicle being laden, in accordance with the conditions shown in the following table:

Category of vehicle \ Conditions	v ₁ km/h	v ₂ km/h	Δ t secs	n
M ₁	80% v _{max} ≤ 120	½ v ₁	45	15
M ₂	80% v _{max} ≤ 100	½ v ₁	55	15
M ₃	80% v _{max} ≤ 60	½ v ₁	60	20
N ₁	80% v _{max} ≤ 120	½ v ₁	55	15
N ₂	80% v _{max} ≤ 60	½ v ₁	60	20

▼B

Category of vehicle \ Conditions	v_1 km/h	v_2 km/h	Δt secs	n
N_3	$80\% v_{\max}$ ≤ 60	$\frac{1}{2} v_1$	60	20

where:

v_1 = initial speed, when braking starts,

v_2 = speed at end of braking,

v_{\max} = maximum speed of the vehicle,

n = number of times brakes applied,

Δt = duration of a braking cycle (time elapsing between the initiation of one brake application and the initiation of the next).

1.3.1.2. If the characteristics of the vehicle do not allow for the period of time prescribed for Δt , the duration may be increased; in any event, in addition to the time necessary for braking and accelerating the vehicle, a period of 10 seconds must be allowed in each cycle for stabilising the speed v_1 .

1.3.1.3. In these tests, the force applied to the control must be so adjusted as to attain a mean deceleration of 3 m/sec^2 at the first application of the brakes. This force must remain constant throughout the succeeding brake applications.

1.3.1.4. During brake applications the highest gear ratio (excluding overdrive, etc.) must be continuously engaged.

1.3.1.5. For regaining speed after braking, the gearbox must be used in such a way as to attain the speed v_1 in the shortest possible time (maximum acceleration allowed by the engine and gearbox).

1.3.2. With continuous braking

1.3.2.1. The service brakes of trailers of categories O_3 and O_4 shall be tested in such a manner that, the vehicle being laden, the energy input to the brakes is equivalent to that recorded in the same period of time with a laden vehicle driven at a steady speed of 40 km/h on a 7% down gradient for a distance of 1.7 km.

1.3.2.2. The test may be carried out on a level road, the trailer being drawn by a motor vehicle; during the test, the force applied to the control must be adjusted so as to keep the resistance of the trailer constant (7% of the weight of the trailer). If the power available for hauling is insufficient, the test can be conducted at a lower speed but over a greater distance, as shown in the following table:

Speed (km/h)	Distance (metres)
40	1 700
30	1 950
20	2 500
15	3 100

1.3.3. Residual performance

1.3.3.1. At the end of the Type I test (test described in item 1.3.1. or test described in item 1.3.2 of this Annex) the residual performance of the service braking device shall be measured under the same conditions as for the Type O test with the engine disconnected (the temperature conditions may be different); this residual performance must not be less than 80% of that prescribed for the cate-

▼B

gory in question nor less than 60% of the figure recorded in the Type O test with the engine disconnected.

1.4. **Type II test**

(downhill behaviour test)

- 1.4.1. Laden vehicles shall be tested in such a manner that the energy input is equivalent to that recorded in the same period of time with a laden vehicle driven at an average speed of 30 km/h on a 6% down gradient for a distance of 6 km, with the appropriate gear engaged (if the vehicle is a motor vehicle) and the retarder, if the vehicle is fitted with one, being used. The gear engaged must be such that the rpm of the engine does not exceed the maximum value prescribed by the manufacturer.
- 1.4.2. For vehicles in which the energy is absorbed by the braking action of the engine alone, a tolerance of ± 5 km/h on the average speed shall be permitted, and the gear enabling the speed to be stabilised at the value closest to 30 km/h on the 6% down gradient shall be engaged. If the performance of the braking action of the engine alone is determined by a measurement of deceleration, it shall be sufficient if the mean deceleration measured is at least 0.5 m/sec^2 .
- 1.4.3. At the end of the test, the residual performance of the service braking device shall be measured in the same conditions as for the Type O test with the engine disconnected (the temperature conditions, of course, are different); this residual performance must not be less than 75% of that prescribed for the Type O test with the engine disconnected.

1.5. **Type IIA test**

(test for vehicles, other than 'urban buses', used for the carriage of passengers comprising more than eight seats in addition to the driver's seat and having a maximum weight exceeding 10 metric tons)

- 1.5.1. Laden vehicles shall be tested in such a manner that the energy input is equivalent to that recorded in the same period of time with a laden vehicle driven at an average speed of 30 km/h on a 7% down gradient for a distance of 6 km. During the test, the service, secondary and parking braking devices must not be engaged. The gear engaged must be such that the rpm of the engine does not exceed the maximum value prescribed by the manufacturer.
- 1.5.2. For vehicles in which the energy is absorbed by the braking action of the engine alone, a tolerance of ± 5 km/h on the average speed shall be permitted and the gear enabling the speed to be stabilised at the value closest to 30 km/h on a 7% down gradient shall be engaged. If the performance of the braking action of the engine alone is determined by a measurement of deceleration, it shall be sufficient if the mean deceleration measured is at least 0.6 m/sec^2 .

2. PERFORMANCE OF BRAKING DEVICES

2.1. **Vehicles of categories M and N**2.1.1. *Service braking devices*

2.1.1.1. Provisions relating to tests

2.1.1.1.1. The service brakes of vehicles of categories M_1 , M_2 , M_3 , N_1 , N_2 and N_3 shall be tested under the conditions shown in the following table:

	M_1	M_2	M_3	N_1	N_2	N_3
Type of test	0—I	0—I	0—I—II	0—I	0—I	0—I—II
v	80 km/h	60 km/h	60 km/h	70 km/h	50 km/h	40 km/h
s \leq	$0.1 v + \frac{v_2}{150}$	$0.15 v + \frac{v_2}{130}$		$0.15 v + \frac{v_2}{115}$		
dm \geq	5.8 m/s^2	5 m/s^2		4.4 m/s^2		

▼**B**

	M ₁	M ₂	M ₃	N ₁	N ₂	N ₃
f ≤	50 kgf	70 kgf	70 kgf	70 kgf	70 kgf	70 kgf

where:

v = test speed

s = stopping distance

dm = mean braking deceleration at normal engine speed

f = force applied to foot control

2.1.2. Secondary braking devices

2.1.2.1. The secondary braking, even if the device which actuates it is also used for other braking functions, must give a stopping distance not exceeding the first term plus twice the second term of the binomial expression giving the service-braking stopping distance for the category in question.

2.1.2.2. If the secondary braking control is a manual control, the prescribed performance must be obtained by applying to the control a force not exceeding 40 kgf in the case of category M₁ vehicles and 60 kgf in the case of other vehicles, and the control must be so placed that it can be easily and quickly grasped by the driver.

2.1.2.3. If the secondary braking control is a foot control, the prescribed performance must be obtained by applying to the control a force not exceeding 50 kgf in the case of category M₁ vehicles and 70 kgf in the case of other vehicles, and the control must be so placed that it can be easily and quickly actuated by the driver.

2.1.2.4. The performance of the secondary braking device shall be checked by the Type O test.

2.1.3. Parking braking devices

2.1.3.1. The parking braking device must, even if it is combined with one of the other braking devices, be capable of holding a laden vehicle stationary on an 18% up or down gradient.

2.1.3.2. On vehicles to which the coupling of a trailer is authorised, the parking braking device of the drawing vehicle must be capable of holding the combination of vehicles stationary on a 12% gradient.

2.1.3.3. If the control is a manual control, the force applied to it must not exceed 40 kgf in the case of category M₁ vehicles and 60 kgf in the case of all other vehicles.

2.1.3.4. If it is a foot control, the force exerted on the control must not exceed 50 kgf in the case of category M₁ vehicles and 70 kgf in the case of all other vehicles.

2.1.3.5. A parking braking device which has to be actuated several times before attaining the prescribed performance is admissible.

2.2. Vehicles of category O

2.2.1. Service braking devices

2.2.1.1. Requirement relating to tests of category O₁ vehicles.

2.2.1.1.1. Where the provision of a service braking device is mandatory, the performance of the device must meet the requirements laid down for category O₂.

2.2.1.2. Requirements relating to tests of category O₂ vehicles.

2.2.1.2.1. Where the service braking device of the trailer is of the continuous or semi-continuous type, the sum of the forces exerted at the periphery of the braked wheels must be equal to not less

▼B

than 45% of the maximum weight borne by the wheels when the vehicle is stationary. Where the trailer is fitted with a compressed air brake, the check must be made with a pressure not exceeding 6.5 bars in the brake cylinders⁽¹⁾.

2.2.1.2.2. Where the braking device is of the inertia type, it must comply with the conditions laid down in Annex VIII.

2.2.1.2.3. In addition, these vehicles must be subjected to the Type I test.

2.2.1.2.4. In the Type I test of a semi-trailer, the weight braked by its axles must be that corresponding to the load on the axle or axles of the semi-trailer when the latter is carrying its maximum load.

2.2.1.3. Requirements relating to tests of category O₃ vehicles.

The same requirements apply as apply to category O₂; in addition, these vehicles must undergo the Type I test.

2.2.1.4. Requirements relating to tests of category O₄ vehicles.

2.2.1.4.1. The same requirements apply as apply to category O₂; in addition, these vehicles must be subjected to the Type I and Type II tests.

2.2.1.4.2. In the Type I and Type II tests of a semi-trailer, the weight braked by its axles must be that corresponding to the load on the axle or axles of the semi-trailer when the latter is carrying its maximum load.

2.2.2. *Parking braking devices*

2.2.2.1. The parking brake with which the trailer or semi-trailer is fitted must be capable of holding the laden trailer or semi-trailer stationary, when separated from the drawing vehicle, on an 18% up or down gradient. The force applied to the control must not exceed 60 kgf.

2.3. **Reaction time**

Where a vehicle is fitted with a service braking device which is totally or partially dependent on a source of energy other than the muscular effort of the driver, the following requirements must be satisfied:

2.3.1. in an emergency manoeuvre, the time lapsing between the moment when the control begins to be actuated and the moment when the braking force on the least favourably placed axle reaches the level corresponding to the prescribed performance must not exceed 0.6 seconds;

2.3.2. the requirements of Annex III shall apply to compressed air devices with double pipes.

⁽¹⁾ The pressures specified here and in the following Annexes are relative pressures measured in bars.

▼ **M1**

Appendix (See 1.1.4.2)

DISTRIBUTION OF BRAKING EFFORT AMONG VEHICLE AXLES▼ **M2**

1. GENERAL REQUIREMENTS

Vehicles of categories M_1 , M_2 , M_3 , N_1 , N_2 , N_3 , O_3 and O_4 shall fulfil the conditions of the present Appendix. If a special device is used, this must operate automatically.

2. SYMBOLS

i	= axle index ($i = 1$, front axle; $i = 2$, second axle; etc.)
P_i	= normal reaction of road surface on axle i under static conditions
N_i	= normal reaction of road surface on axle i under braking
T_i	= force exerted by the brakes on axle i under normal braking conditions on the road
f_i	= T_i/N_i , adhesion used by axle i ⁽¹⁾
J	= deceleration of vehicle
g	= acceleration due to gravity $g = 10 \text{ m/s}^2$
z	= braking rate of vehicle = J/g ⁽²⁾
P	= weight of vehicle
h	= height of centre of gravity
E	= wheelbase
k	= theoretical coefficient of adhesion between tyre and road
K_c	= correction factor — semi-trailer laden
K_v	= correction factor — semi-trailer unladen
TM	= sum of braking forces at the periphery of wheels of drawing vehicles for trailers or semi-trailers
PM	= total normal static reaction between road surface and wheels of drawing vehicles for trailer or semi-trailer as referred to in items 3.1.4 and 3.1.5 respectively
p_m	= pressure at coupling head of service line
TR	= sum of braking forces at periphery of all wheels of trailer or semi-trailer
PR	= total normal static reaction of road surface on wheels of trailer or semi-trailer
PR_{\max}	= value of PR at maximum weight of semi-trailer
E_r	= distance between king-pin and centre of axle or axles of semi-trailer
h_r	= height above ground of centre of gravity of semi-trailer

3. REQUIREMENTS FOR MOTOR VEHICLES

3.1. **Two axle vehicles.**

3.1.1. ⁽³⁾ For all categories of vehicle for k values between 0.2 and 0.8:

$$z \geq 0.1 + 0.85(k - 0.2)$$

⁽¹⁾ Adhesion curves used by each axle means curves showing the adhesion used by axle i plotted against the vehicle braking rate under the specified load conditions.

⁽²⁾ For semi-trailers, z is the braking force divided by the static weight on the semi-trailer axle(s).

⁽³⁾ The provisions of item 3.1.1 do not affect the requirements of Annex II relating to the braking efficiency. However, if, when verifying the provisions of item 3.1.1 braking efficiencies are obtained which are higher than those prescribed in Annex II, the provisions relating to the adhesion utilization curve shall be applied within the areas of diagrams IA and IB defined by the straight lines $k = 0.8$ and $z = 0.8$.

▼ **M2**

For all states of load of the vehicle, the adhesion utilization curve of the front axle shall be situated above that for the rear axle:

- for all braking rates of between 0.15 and 0.8 in the case of vehicles of category M_1 .

However, for vehicles of this category over the range of z values, between 0.3 and 0.45, an inversion of the adhesion utilization curves is permitted provided that the adhesion utilization curve of the rear axle does not exceed by more than 0.05 the line defined by the formula $k = z$ (line of ideal adhesion utilization — see diagram 1A);

- for all braking rates of between 0.15 and 0.30, in the case of vehicles of other categories. This condition is also considered satisfied if the adhesion utilization curves for each axle of between 0.15 and 0.30 are situated between two parallels to the line of ideal adhesion utilization given by the equation $k = z \pm 0.08$ as shown in diagram 1 B and the adhesion utilization curve for the rear axle for braking rates $z \geq 0.3$ complies with the relationship

$$z \geq 0.3 + 0.74 (k - 0.38)$$

- 3.1.2. The pressure at the service-line coupling head of a motor vehicle authorized to draw a trailer fitted with air brakes shall not be affected by the operation of the pressure-regulating devices on the axles of the drawing vehicle.
- 3.1.3. In order to verify the requirement of item 3.1.1, the manufacturer shall provide the adhesion utilization curves for the front and rear axles calculated by the formulas:

$$f_1 = \frac{T_1}{N_1} = \frac{T_1}{P_1 + z \frac{h}{E} P} \qquad f_2 = \frac{T_2}{N_2} = \frac{T_2}{P_2 - z \frac{h}{E} P}$$

- 3.1.4. Vehicles other than tractive units for semi-trailers.
- 3.1.4.1. The graphs shall be plotted for both the following load conditions:
- unladen, in running order with the driver on board,
 - laden. Where provision is made for several possibilities of load distribution, the one whereby the front axle is the most heavily laden shall be the one to be taken into consideration.

The height of the centre of gravity is specified by the manufacturer.

In the case of a vehicle fitted with air brakes, whether it is a trailer or a motor vehicle authorized to draw a trailer, the permissible relationship between the braking rate TR/PR or TM/PM and the pressure p_m shall be within the areas shown in diagram 2.

- 3.1.5. Tractive units for semi-trailers.
- 3.1.5.1. Tractive units with unladen semi-trailer

An unladen articulated combination is considered to be a tractive unit in running order, with the driver on board, coupled to an unladen semi-trailer. The dynamic load of the semi-trailer on the tractive unit shall be represented by a static weight applied at the coupling king-pin equal to 15 % of the maximum weight on the coupling. For the solo tractive unit the height of the centre of gravity shall be that specified by the manufacturer. The braking forces must continue to be regulated between the state of the tractive unit with semi-trailer (unladen) and that of the solo tractive unit; the braking forces relating to the solo tractive unit shall be verified.

- 3.1.5.2. Tractive units with laden semi-trailer

A laden articulated combination is considered to be a tractive unit in running order with the driver on board coupled to a laden semi-trailer. The dynamic load of the semi-trailer on the tractive unit shall be represented by a static weight P_s applied at the coupling king-pin equal to:

$$P_s = P_{so} (1 + 0.45 z)$$

▼ M2

where P_{so} represents the difference between the maximum laden weight of the tractive unit and its unladen weight.

For h the following value shall be taken: $h = \frac{h_o P_o + h_s P_s}{P}$

where:

h_o is the height of the centre of gravity of the tractive unit

h_s is the height of the coupling on which the semi-trailer rests

P_o is the unladen weight of the solo tractive unit

$$P = P_o + P_s = P_1 + P_2.$$

- 3.1.5.3. In the case of a vehicle fitted with a compressed air braking system, the permissible relationship between the braking rate TM/PM and the pressure p_m shall be within the areas shown in diagram 3.

3.2. Vehicles with more than two axles

The requirements of item 3.1 shall apply to vehicles with more than two axles. The requirements of item 3.1.1 with respect to wheel lock sequence shall be considered to be met, if, in the case of braking rates of between 0.15 and 0.30, the adhesion used by at least one of the front axles is greater than that used by at least one of the rear axles.

4. REQUIREMENT FOR SEMI-TRAILERS

For semi-trailers fitted with compressed-air braking systems:

The permissible relationship between the braking rate TR/PR and the pressure p_m shall lie within two areas derived from diagrams 4A and 4B for the laden and unladen states of load. This requirement shall be met for all permissible load conditions of the semi-trailer axles.

5. REQUIREMENTS FOR TRAILERS

- 5.1. The following requirements shall only apply to trailers fitted with air brakes. They shall not apply to single-axle trailers nor to twin-axle trailers where the axle spread is less than two metres.
- 5.2. The requirements set out in item 3.1 shall apply to twin-axle trailers not excluded by the requirements contained in 5.1.
- 5.3. Trailers with more than two axles shall be subject to the requirements contained in item 3.2.

▼ C2

6. CONDITIONS TO BE FULFILLED IN THE CASE OF FAILURE OF THE BRAKING DISTRIBUTION SYSTEM

When the requirements of this Appendix are met by means of a special device (e.g., controlled mechanically by the suspension of the vehicle), it shall be possible in the event of failure of this device or its control to stop the vehicle under the conditions prescribed for secondary braking in the case of motor vehicles; in the case of trailers and semi-trailers in the event of failure of the control a braking rate of at least 30 % of the service brake performance prescribed for the vehicle in question shall be attained.

▼ M2

7. MARKINGS

- 7.1. Vehicles, other than those of category M_1 , which meet the requirements of this Appendix by means of a device mechanically controlled by the suspension of the vehicle, shall be marked to show the useful travel of the device between the positions corresponding to vehicle unladen and laden states respectively.
- 7.2. When the requirements of this Appendix are met by means of a device actuated by compressed air, the vehicle shall be marked to show the pressure values at the outlet side of the device during full braking of the vehicle under both unladen and laden conditions.
- 7.3. The markings referred to under items 7.1 and 7.2 above shall be affixed in a visible position in indelible form.

▼ M2

8. VEHICLE INSPECTION

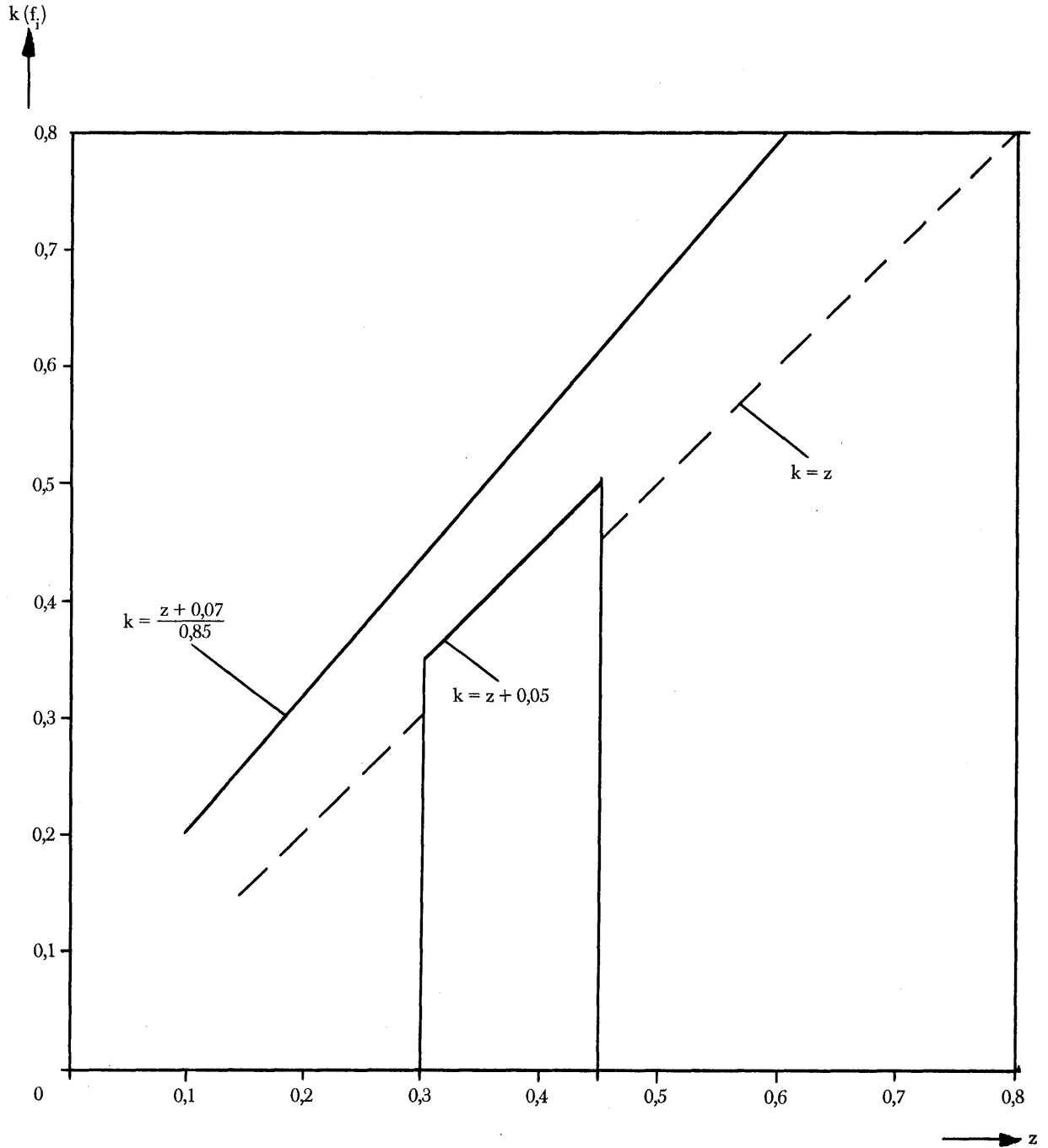
During the EEC type-approval testing of a vehicle the technical inspection authority shall verify conformity with the requirements contained in the present Appendix and carry out any further tests considered necessary to this end. The report on the additional tests shall be appended to the EEC type-approval certificate.

▼ M2

DIAGRAM 1 A

VEHICLES OF CATEGORY M₁

(see item 3.1.1)

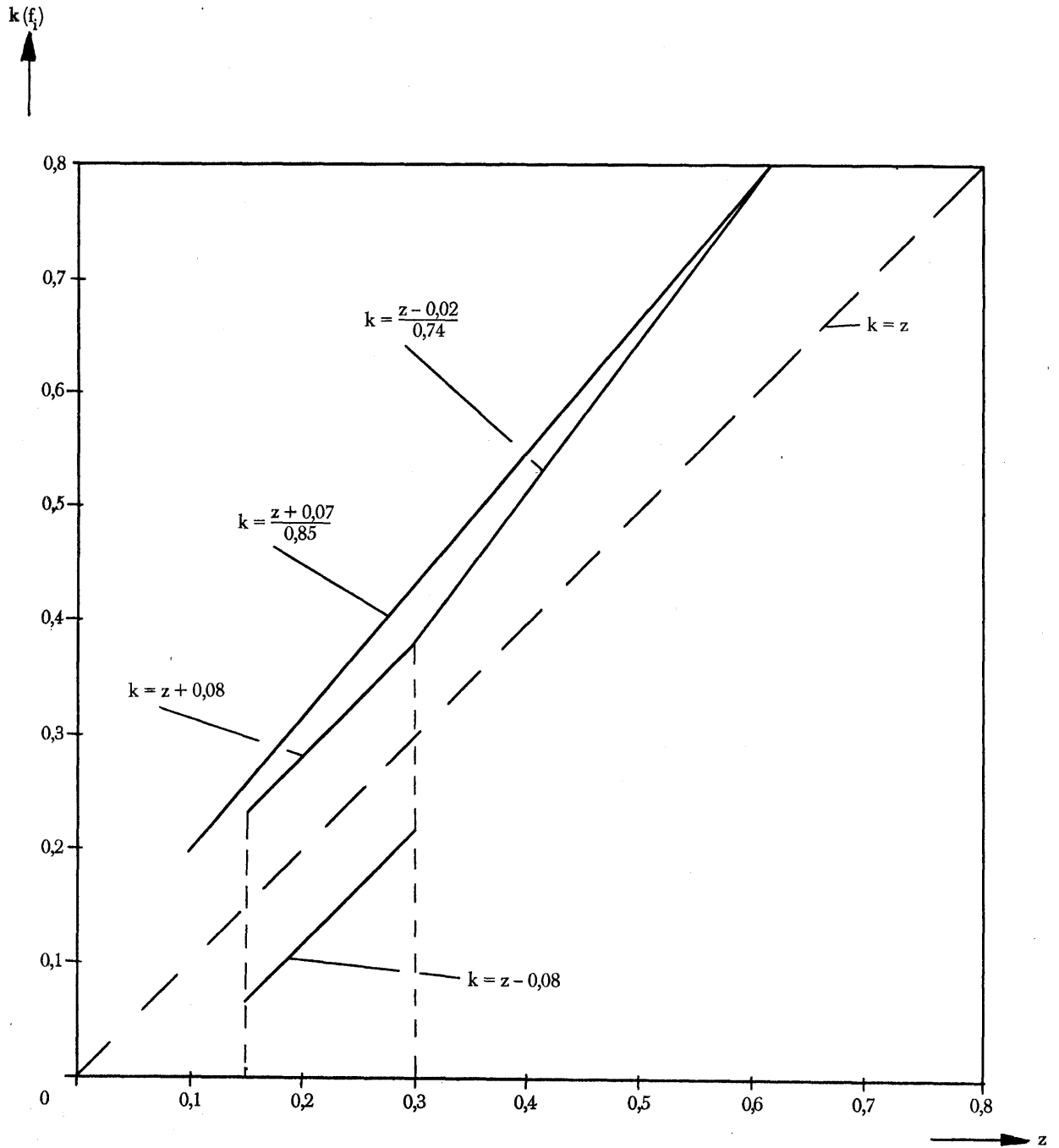


▼ M2

DIAGRAM 1 B

VEHICLES OTHER THAN VEHICLES OF CATEGORY M₁

(see item 3.1.1)

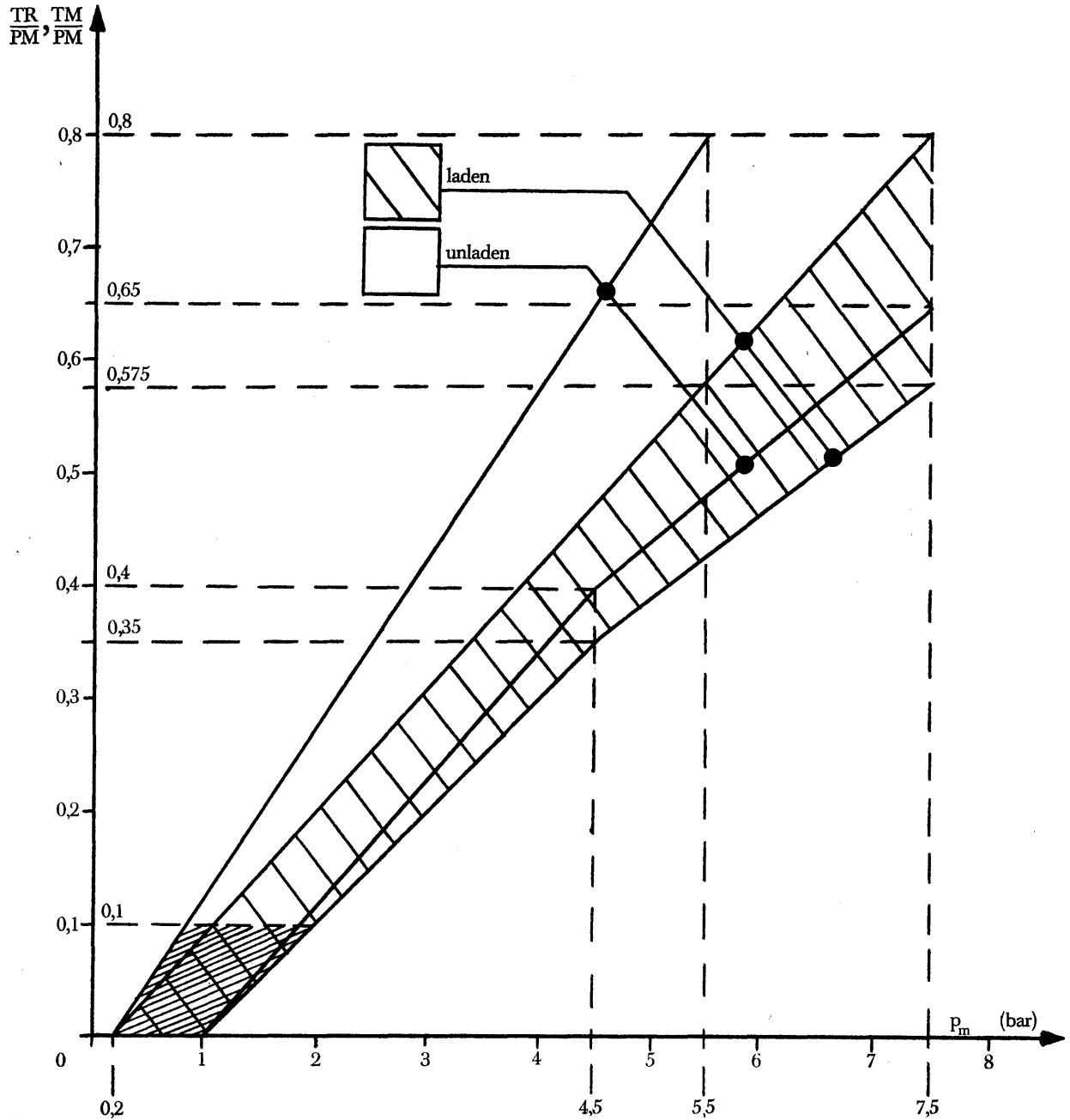


▼ M2

DIAGRAM 2

DRAWING VEHICLES AND TRAILERS

(see item 3.1.4.1)

*Note:*

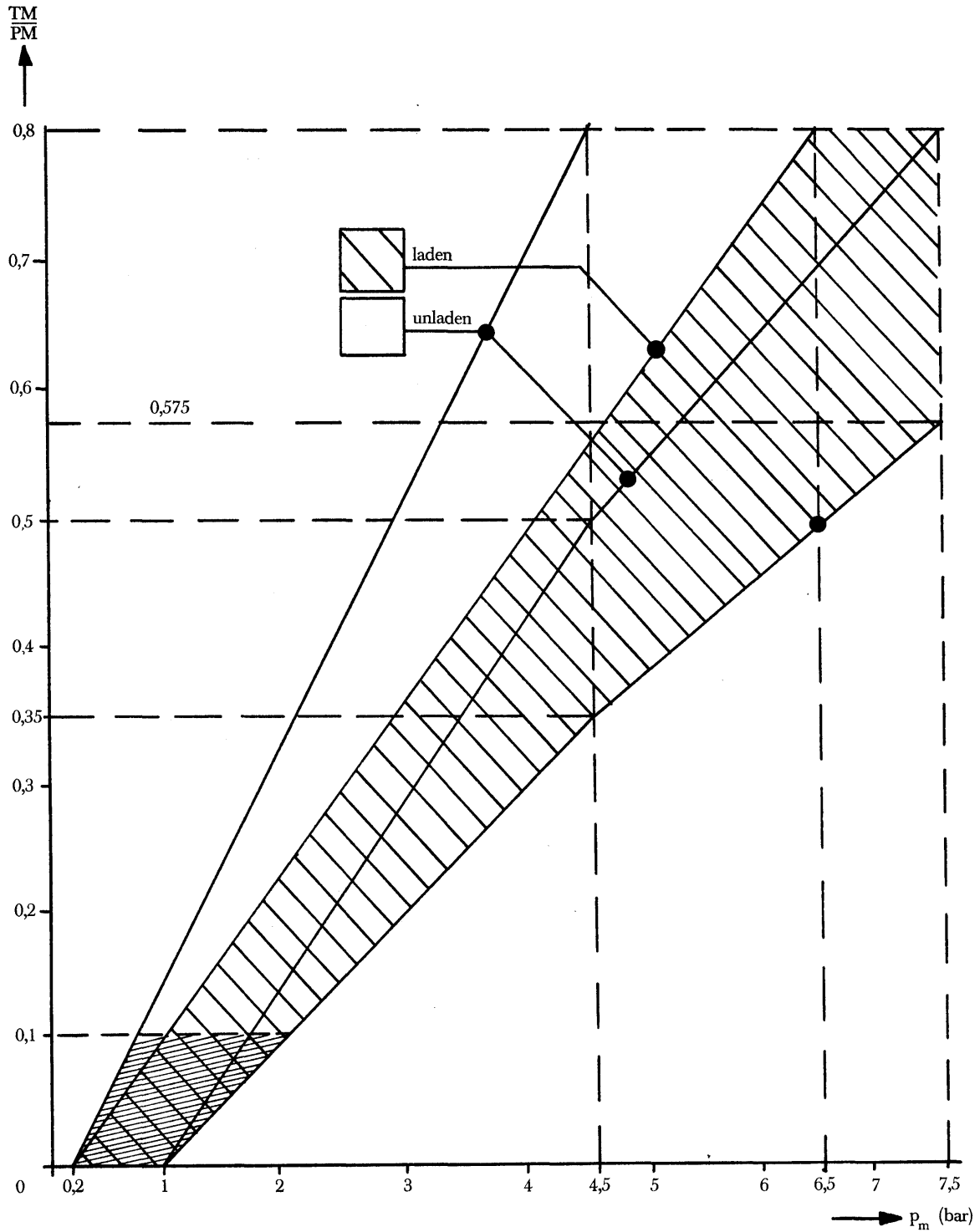
It is understood that between the values $\frac{TM}{PM} = 0$ and $\frac{TM}{PM} = 0.1$ or $\frac{TR}{PR} = 0$ and $\frac{TR}{PR} = 0.1$ it is not necessary that there should be proportionality between the braking rate $\frac{TM}{PM}$ or $\frac{TR}{PR}$ and the control pressure as measured at the coupling head.

▼ M2

DIAGRAM 3

TRACTIVE UNITS FOR SEMI-TRAILERS

(see item 3.1.5)



Note:

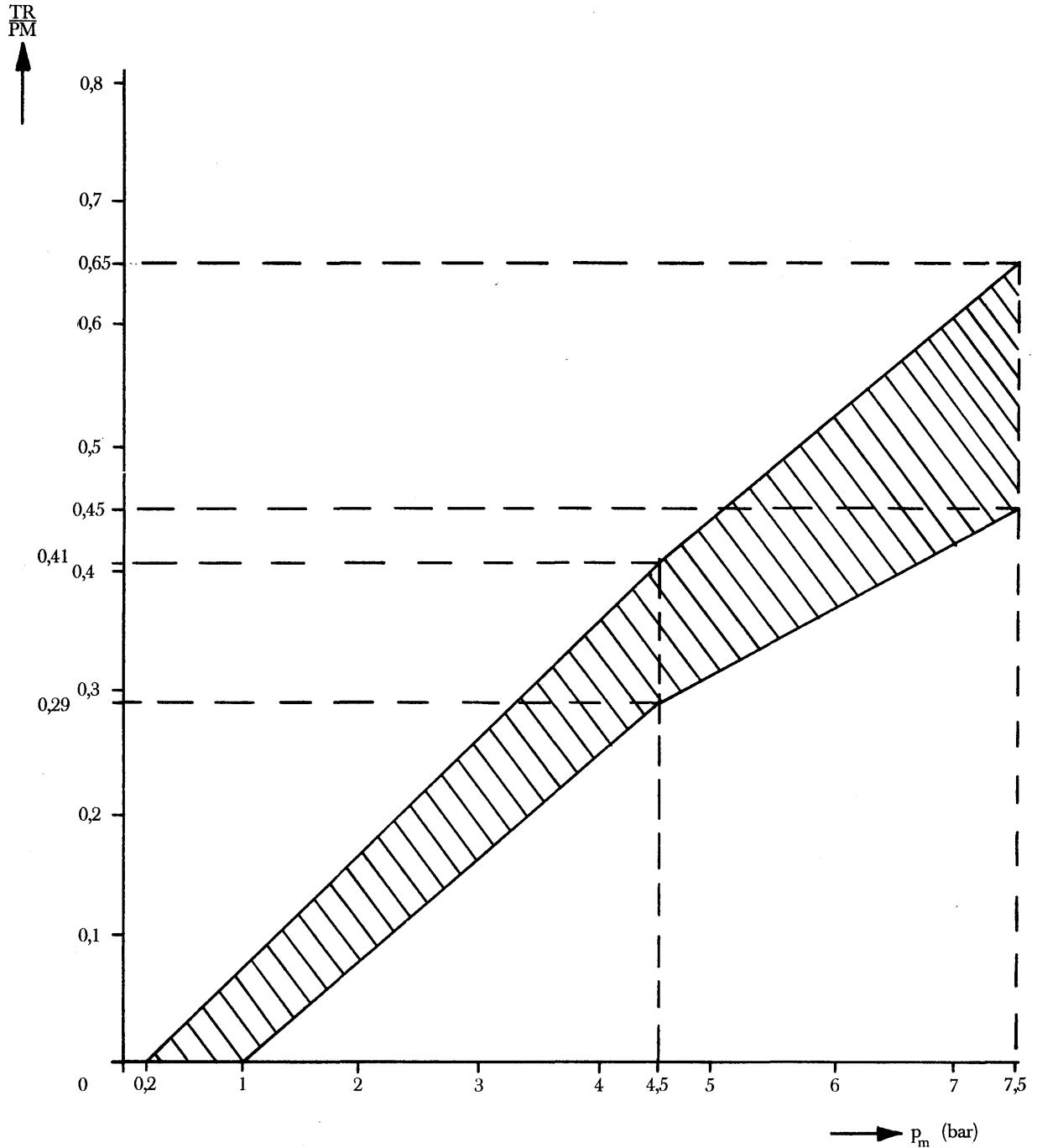
- (1) Between the values $\frac{TM}{PM} = 0$ and $\frac{TM}{PM} = 0 \cdot 1$, it is not necessary that there should be proportionality between the braking rate $\frac{TM}{PM}$ and the service line pressure as measured at the coupling head.
- (2) The relationships required by the diagram shall apply progressively for intermediate states of loading between the laden and the unladen states and shall be achieved by automatic means.

▼ M2

DIAGRAM 4 A

SEMI-TRAILERS

(see item 4)



The relationship between the braking rate $\frac{TR}{PR}$ and control line pressure for the laden and unladen condition is determined as follows:

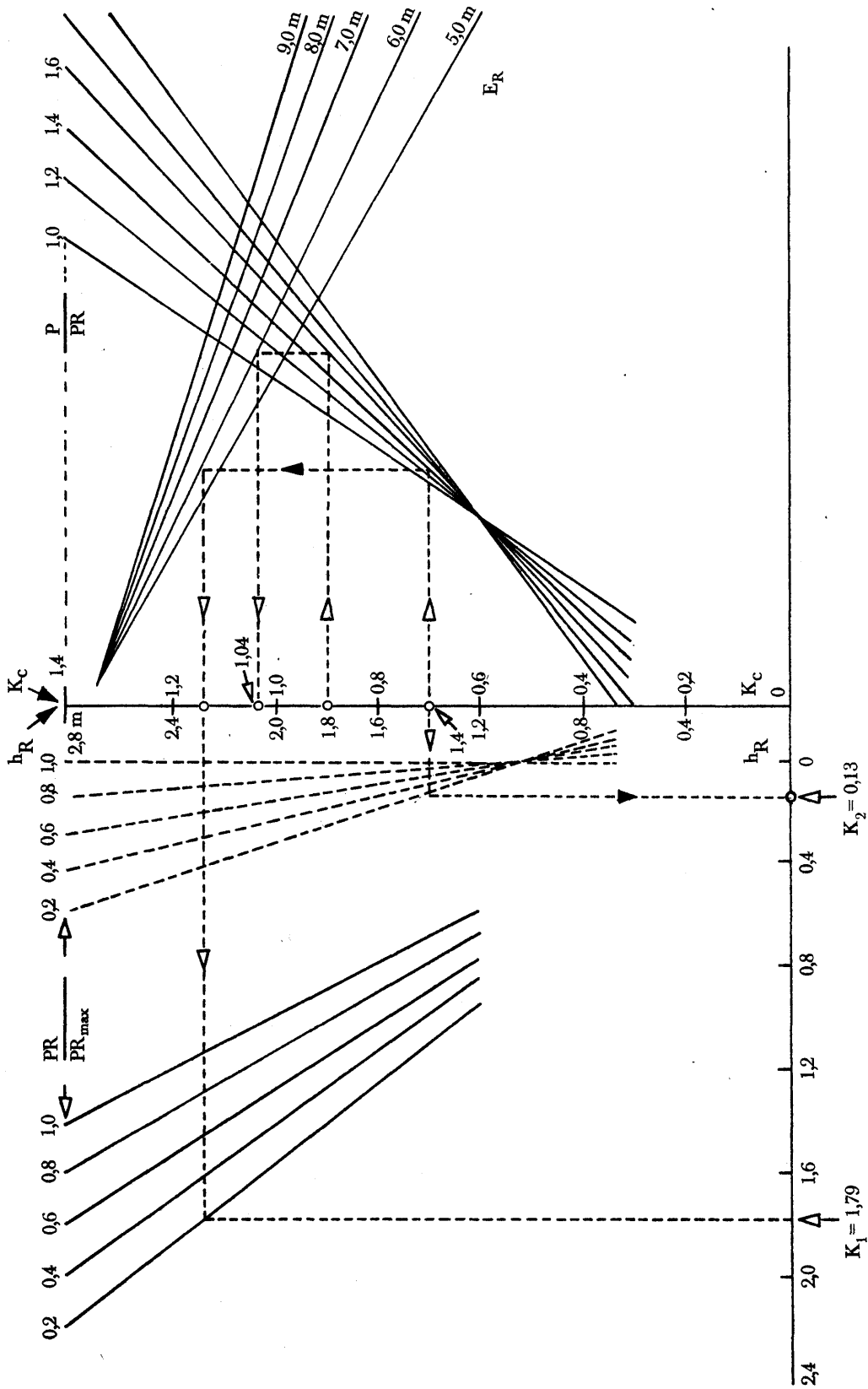
The factors K_c (laden), K_v (unladen) are obtained by reference to diagram 4 B.

Construct the laden and unladen bands by multiplying the upper and lower boundaries of the band in diagram 4 A shown below by the two factors obtained, K_c and K_v respectively.

▼ M2

DIAGRAM 4 B

(see item 4)



▼ **M2****Explanatory note on the use of diagram 4B**

1. Formula from which Diagram 4 B is derived is:

$$K = \left[1 \cdot 7 - \frac{0 \cdot 7 \text{ PR}}{\text{PR}_{\max}} \right] \left[1 \cdot 35 - \frac{0 \cdot 96}{E_R} \left(1 \cdot 0 + (h_R - 1 \cdot 2) \frac{P}{\text{PR}} \right) \right] - \left[1 \cdot 0 - \frac{\text{PR}}{\text{PR}_{\max}} \right] \left[\frac{h_R - 1 \cdot 0}{2 \cdot 5} \right]$$

2. Description of the method of use by means of a worked example.
- 2.1. The dashed lines shown on Diagram 4B refer to the determination of the factors K_c and K_v for the following vehicle where:

	Laden	Unladen
P	24 t	4.2 t
PR	15 t	3 t
PR_{\max}	15 t	15 t
h_R	1.8 m	1.4 m
E_R	6.0 m	6.0 m

In the following items the figures in parenthesis relate only to the vehicle being used for the purpose of illustrating the method of use of Diagram 4B.

- 2.2. Calculate the ratios

- (a) $\left[\frac{P}{\text{PR}} \right]$ laden (= 1.6)
- (b) $\left[\frac{P}{\text{PR}} \right]$ unladen (= 1.4)
- (c) $\left[\frac{\text{PR}}{\text{PR}_{\max}} \right]$ unladen (= 0.2)

- 2.3. Determination of the laden factor, K_c

- (a) Start at appropriate h_R ($h_R = 1.8$ m)
- (b) Move horizontally to the appropriate P/PR line ($P/\text{PR} = 1.6$)
- (c) Move vertically to appropriate E_R line ($E_R = 6.0$ m)
- (d) Move horizontally to K_c scale, K_c is the laden factor required ($K_c = 1.04$).

- 2.4. Determination of the unladen factor, K_v .

- 2.4.1. Determination of the factor K_2

- (a) Start at appropriate h_R ($h_R = 1.4$ m)
- (b) Move horizontally to appropriate PR/PR_{max} line in group of curves nearest to vertical axis ($\text{PR}/\text{PR}_{\max} = 0.2$)
- (c) Move vertically to horizontal axis and read off the value of K_2 ($K_2 = 0.13$ m).

- 2.4.2. Determination of factor K_1

- (a) Start at appropriate h_R ($h_R = 1.4$ m)
- (b) Move horizontally to the appropriate P/PR line ($P/\text{PR} = 1.4$)
- (c) Move vertically to the appropriate E_R line ($E_R = 6.0$ m)
- (d) Move horizontally to the appropriate PR/PR_{max} line in group of curves furthest from the vertical axis.
($\text{PR}/\text{PR}_{\max} = 0.2$)
- (e) Move vertically to horizontal axis and read off the value of K_1 ($K_1 = 1.79$).

- 2.4.3. Determination of factor K_v

The unladen factor K_v is obtained from the following expression:
 $K_v = K_1 - K_2$ ($K_v = 1.66$).



ANNEX III

**METHOD OF MEASURING THE REACTION TIME FOR VEHICLES
FITTED WITH COMPRESSED AIR BRAKING DEVICES WITH
DOUBLE PIPES**

1. GENERAL REQUIREMENTS

- 1.1. The reaction time for the braking device shall be determined with the vehicle stationary, the pressure being measured at the opening of the least efficient brake cylinder.
- 1.2. During the tests, the stroke of the brake cylinders of the individual axles must be that corresponding to the most closely adjusted brakes.
- 1.3. The following tests shall apply to standard road trains for which the maximum pressure in the feed pipe varies between 6.5 and 8.0 bars and the maximum pressure in the control pipe is between 6.0 and 7.5 bars.
- 1.4. Pressures differing from those specified in item 1.3 may be used for components designed for other pressure maxima levels at the coupling heads. In such cases, this must be noted in the test report; a plate indicating clearly the operating pressure maxima and minima must be fixed to the vehicle.

2. MOTOR VEHICLES

- 2.1. At the start of each test, the pressure in the reservoirs must be equal to the minimum pressure at which the governor starts feeding the installation again. In installations not fitted with a governor (e.g. pressure limited compressor) the pressure in the reservoir at the start of each test must be equal to 90% of the pressure stated by the manufacturer, as defined in item 1.2.2.1 of Annex IV, to be used for tests prescribed in this Annex.
- 2.2. Reaction times in terms of actuation time (tf) shall be obtained by a series of actuations to the fullest extent, starting from the shortest possible up to a time of about 0.4 seconds. The values measured must be given on a diagram.
- 2.3. Reaction times corresponding to an actuation time of 0.2 seconds shall be determinant for the test. This reaction time can be obtained from the diagram by interpolation.
- 2.4. In the case of the actuation time of 0.2 seconds, the time elapsing between the beginning of actuation of the control pedal and the moment when the pressure in the brake cylinder reaches 75% of its asymptotic value must not exceed 0.6 seconds.

The value thus noted may be rounded to the nearest tenth of a second.
- 2.5. In the case of motor vehicles having a brake coupling for trailers, it is advisable, as an exception to the requirements of item 1.1, not to measure the reaction time at the braking cylinder, but at the extremity of a pipe with a length of about 2.5 metres and an internal diameter of 13 mm which shall be joined to the brake coupling (coupling head) of the motor vehicle.
- 2.6. The time which elapses between the start of the activation of the control pedal and the moment when the pressure measured at the coupling head of the control pipe reaches x% of its asymptotic value must not exceed the values listed in the table below:

x (%)	t (seconds)
10	0.2
75	0.4

3. TRAILERS (including semi-trailers)

- 3.1. The reaction times for trailers shall be measured without a drawing vehicle. To simulate the drawing vehicle it is necessary to provide a simulator to which the coupling heads of the control pipe and of the feed pipe of the trailer are to be connected.

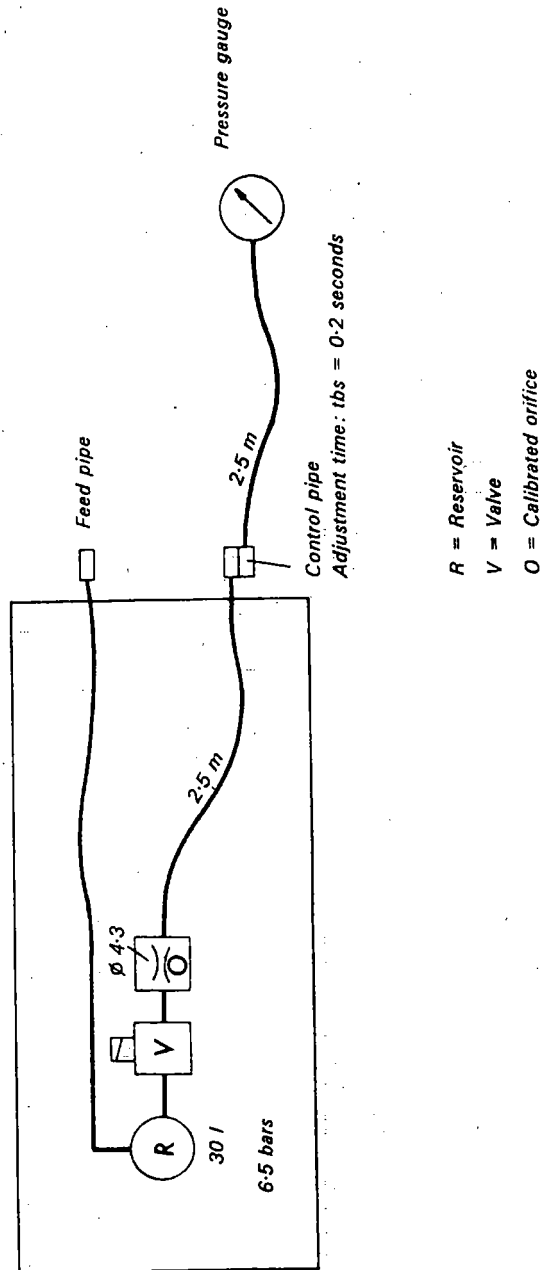
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- 3.2. The pressure in the feed pipe must be 6·5 bars. The pressure in the reservoir or reservoirs of the trailer must be that corresponding to a pressure of 6·5 bars in the feed pipe.
- 3.3. The simulator must have the following features:
 - 3.3.1. it must have a thirty litre reservoir filled to a pressure of 6·5 bars;
 - 3.3.2. it must be adjusted in such a way that if a tube with a length of 2·5 metres and an internal diameter of 13 mm is joined to it, the time taken for the pressure to increase from 10% to 75%, i.e. from 0·65 bars to 4·9 bars, would be 0·2 seconds. Between these two values, the pressure must increase in an approximately linear way. The sketch in the Appendix to this Annex gives an example of the correct use of the simulator.
- 3.4. The time elapsing between the moment when the pressure produced in the control pipe by the simulator reached 10% of the asymptotic pressure and the moment when the pressure in the brake cylinder of the trailer reaches 75% of its asymptotic value must not exceed 0·4 seconds.

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APPENDIX

Simulator (see 3.3.2)





ANNEX IV

ENERGY RESERVOIRS AND SOURCES OF ENERGY FOR COMPRESSED AIR BRAKES

1. CAPACITY OF RESERVOIRS

1.1. **General requirements**

- 1.1.1. Vehicles on which the operation of the braking devices depends on the use of compressed air must be fitted with reservoirs of a capacity meeting the requirements of items 1.2 and 1.3 below.
- 1.1.2. Nevertheless, the capacity of reservoirs shall not be laid down where the braking system is such that in the absence of any energy reserve it is possible to achieve a braking performance at least equal to that prescribed for the secondary braking.
- 1.1.3. When verifying compliance with the requirements of items 1.2 and 1.3 the brakes must be adjusted as closely as possible.

1.2. **Motor vehicles**

- 1.2.1. The reservoirs of brakes of motor vehicles must be such that after eight full-stroke actuations of the service braking control it is still possible to achieve the performance prescribed for secondary braking.
- 1.2.2. During the test, the following requirements are to be satisfied:
 - 1.2.2.1. The initial pressure in the reservoirs must be that indicated by the manufacturer. This pressure must be such as to enable the prescribed performance for the service braking to be achieved;
 - 1.2.2.2. The reservoir or reservoirs must not be replenished; in addition, the reservoir or reservoirs of auxiliary equipment must be isolated;
 - 1.2.2.3. In the case of motor vehicles to which the coupling of a trailer or semi-trailer is authorised, the feed line must be blocked off and a reservoir of 0.5 litre capacity must be connected to the control line. The pressure in this reservoir must be exhausted before each actuation of the brakes. After the test referred to in item 1.2.1 the pressure in the control line must not be less than one half of the pressure obtained at the first brake application.

1.3. **Trailers (including semi-trailers)**

- 1.3.1. Reservoirs fitted to trailers must be such that after eight full-stroke actuations of the drawing vehicle's service braking device, the pressure supplied to the operating parts using it is not less than one half of the pressure obtained at the first brake application.
- 1.3.2. During the test, the following requirements are to be satisfied:
 - 1.3.2.1. The pressure in the reservoirs at the beginning of the test must be equal to the maximum specified by the manufacturers;
 - 1.3.2.2. The feed line must be blocked off; in addition, the auxiliary equipment reservoirs must be isolated;
 - 1.3.2.3. There must be no significant replenishment of the reservoir during the test;
 - 1.3.2.4. For each application of the brakes, the pressure in the control pipe must correspond to the maximum specified by the manufacturer.

2. CAPACITY OF ENERGY SOURCES

2.1. **General provisions**

Compressors must satisfy the requirements laid down in the following items:

▼B**2.2. Definitions**

- 2.2.1. p_1 is the pressure corresponding to 65% of the pressure p_2 defined in item 2.2.2
- 2.2.2. p_2 is the value specified by the manufacturer and referred to in item 1.2.2.1
- 2.2.3. T_1 is the time required for the relative pressure to rise from 0 to p_1 ; T_2 is the time required for the relative pressure to rise from 0 to p_2 .

2.3. Conditions of measurement

- 2.3.1. In all cases the rpm speed of the compressor shall be that obtained when the engine is running at the speed corresponding to its maximum power or at the speed allowed by the control valve.
- 2.3.2. The auxiliary equipment reservoirs shall be isolated during the tests for determining the periods T_1 and T_2 .
- 2.3.3. On motor vehicles constructed to draw trailers, the trailer shall be represented by a reservoir whose maximum relative pressure p (expressed in bars) is that which can be supplied through the feed circuit of the drawing vehicle and whose volume V (expressed in litres) is given by the formula $p \cdot V = 20 R$ (R being the permissible maximum load, expressed in metric tons, on the axles of the trailer or semi-trailer).

2.4. Interpretation of results

- 2.4.1. The time T_1 for the least efficient reservoir must not exceed:
- three minutes in the case of vehicles to which the coupling of a trailer or semi-trailer is not authorised;
 - six minutes in the case of vehicles to which the coupling of a trailer or semi-trailer is authorised.
- 2.4.2. The time T_2 for the least efficient reservoir must not exceed:
- six minutes in the case of vehicles to which the coupling of a trailer or semi-trailer is not authorised;
 - nine minutes in the case of vehicles to which the coupling of a trailer or semi-trailer is authorised.

2.5. Additional test

- 2.5.1. When the vehicle is equipped with an auxiliary equipment reservoir or reservoirs with a total capacity exceeding 20% of the total capacity of the brake reservoirs, an additional test must be carried out during the course of which there must be no interference with the functioning of the valves controlling the filling of the auxiliary equipment reservoir(s). A check must be made during the course of this test that the period T_3 required to bring about a rise in the pressure in the brake reservoirs from 0 to p_2 is less than:
- eight minutes in the case of vehicles to which the coupling of a trailer or semi-trailer is not authorised;
 - eleven minutes in the case of vehicles to which the coupling of a trailer or semi-trailer is authorised.

*ANNEX V***SPRING BRAKES****1. DEFINITION**

'Spring brakes' are braking devices for which the energy required for braking is supplied by one or more springs acting as an energy accumulator.

2. GENERAL REQUIREMENTS

- 2.1. A spring brake shall not be used as a service brake.
- 2.2. A small variation in any of the pressure limits which may occur in the brake compression chamber feed circuit must not cause a significant variation in the braking force.
- 2.3. The feed circuit to the spring compression chamber must include an energy reserve which does not supply any other device or equipment. This provision shall not apply if the springs can be maintained in the compressed state by using two or more independent systems.
- 2.4. The device must 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 must be met when the brakes are adjusted as closely as possible.
- 2.5. The pressure in the compression chamber beyond which the springs begin to actuate the brakes, the latter being adjusted as closely as possible, must not be greater than 80% of the minimum level (pm) of the normal available pressure.
- 2.6. When the pressure in the compression chamber falls to the level at which the brake parts begin to move, an optical or audible warning device must be actuated. Provided this requirement is met, the warning device may be that specified in item 2.2.1.13 of Annex I.
- 2.7. On motor vehicles fitted with spring brakes and authorised to draw trailers with continuous or semi-continuous brakes, automatic application of the spring brakes must cause the trailer brakes to be applied.

3. RELEASE SYSTEM

- 3.1. Spring brakes must be so designed that, in the event of failure, it is possible to release them without using their normal control. This may be achieved by the use of an auxiliary device (pneumatic, mechanical, etc.).
- 3.2. If the operation of the auxiliary device referred to in item 3.1 requires the use of a tool or spanner, the tool or spanner must be kept on the vehicle.

*ANNEX VI***PARKING BRAKING BY MECHANICAL LOCKING OF THE BRAKE CYLINDERS****(lock actuators)**

1. DEFINITION

'Mechanical locking of the brake cylinders' means a device for ensuring parking braking by mechanical wedging of the brake piston rod.

Mechanical locking occurs when the locking chamber is emptied of compressed air; the mechanical locking device shall be designed in such a way that it can be released when the locking chamber is again subjected to pressure.

2. SPECIAL PROVISIONS

- 2.1. When the pressure in the locking chamber approaches the level corresponding to mechanical locking, an optical or audible warning system must be actuated.
- 2.2. In the case of brake actuators fitted with a mechanical locking device, the brake actuator must be capable of being actuated by either of two energy reserves.
- 2.3. The locked brake cylinder may only be released if it is certain that the brake can be operated again after such release.
- 2.4. In the event of a failure of the source of energy supplying the locking chamber, an auxiliary unlocking device (mechanical or pneumatic, for instance) using, for example, the air in one of the tyres of the vehicle, must be provided.



ANNEX VII

CASES IN WHICH TYPE I AND/OR II (OR II A) TESTS DO NOT HAVE TO BE CARRIED OUT ON A VEHICLE SUBMITTED FOR TYPE APPROVAL

1. Type I and/or II (or II A) tests do not have to be carried out on a vehicle submitted for type approval in the following three cases:
 - 1.1. where the vehicle in question is a motor vehicle, a trailer or a semi-trailer which, in respect of tyres, braking energy absorbed by each axle and method of fitting of tyres and brakes, is identical, as far as braking is concerned, to a motor vehicle, a trailer, or a semi-trailer which:
 - 1.1.1. has passed a Type I and/or II (or II A) test;
 - 1.1.2. has been type approved, with regard to braking energy absorbed, for axle weights greater than or equal to those of the vehicle submitted for type approval.
 - 1.2. where the vehicle in question is a motor vehicle, a trailer or a semi-trailer of which the axle or axles, in respect of tyres, braking energy absorbed by each axle and method of fitting of tyres and brakes, is or are identical, as far as braking is concerned, to an axle or axles which has or have individually passed a Type I and/or II test for axle weights greater than or equal to those of the vehicle submitted for type approval, provided that the braking energy absorbed by each axle does not exceed the energy absorbed by that axle during the reference test or tests carried out separately on that axle.
 - 1.3. where the vehicle submitted for type approval is fitted with a retarder, other than an engine brake, identical to a retarder which has already been tested under the following conditions:
 - 1.3.1. in a test carried out on a gradient of at least 6% (Type II test) or of at least 7% (Type II A test), this retarder has, on its own, stabilised the speed of a vehicle with a maximum weight at the time of testing at least equal to the maximum weight of the vehicle submitted for type approval;
 - 1.3.2. in the above test, a check must be made as to whether the speed of rotation of the revolving parts of the retarder is such that, when the vehicle submitted for type approval is travelling at a speed of 30 km/h, the retarding torque is at least equal to the retarding torque in the test mentioned in item 1.3.1.
2. The term 'identical' as used in items 1.1, 1.2 and 1.3 means identical as regards the geometrical and mechanical characteristics of the vehicle parts mentioned in those items, and also as regards the characteristics of the materials from which these parts are made.
3. When advantage is taken of the above provisions, the type approval communication in respect of braking (Annex IX) must contain the following particulars:
 - 3.1. where item 1.1 is applicable, the type of the approval number of the vehicle on which the Type I and/or II (or II A) test serving as a reference test has been carried out (item 14.7.1 of Annex IX);
 - 3.2. where item 1.2 is applicable, the table in item 14.7.2 of the model item of the communication in Annex IV must be completed;
 - 3.3. where item 1.3 is applicable, the table in item 14.7.3 of the model of the communication in Annex IX must be completed.
4. When a person applying for type approval in a Member State refers to a type approval granted in another Member State, that person must produce the documents relating to such approval.



ANNEX VIII

CONDITIONS GOVERNING THE TESTING OF VEHICLES EQUIPPED WITH INERTIA (OVERRUN) BRAKES

1. GENERAL PROVISIONS

- 1.1. The inertia (overrun) braking device of a trailer comprises the control device, the transmission and the brakes proper, hereinafter called 'brakes'.
- 1.2. The control device is the combination of components comprising the coupling head.
- 1.3. The transmission is the combination of components comprised between the coupling head and the first part of the brake.
- 1.4. The 'brake' is the part 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 or similar parts (mechanical-transmission inertia brake) or the brake cylinder (hydraulic-transmission inertia brake).
- 1.5. Braking devices in which accumulated energy (for instance, electric, pneumatic or hydraulic) is transmitted to the trailer by the drawing vehicle and is only controlled by the force at the coupling shall not be deemed to be inertia braking devices within the meaning of this Directive.
- 1.6. Two axles with a wheelbase of less than one metre (tandem axle) shall, for the purposes of this Annex, also be deemed to be one axle.

1.7. **Tests**

- 1.7.1. Determination of the main characteristics of the brake.
- 1.7.2. Determination of the main characteristics of the control device and testing as to whether that device conforms with the provisions of this Directive.
- 1.7.3. Testing on the vehicle
 - the compatibility of the control device and the brake
 - the transmission.

2. SYMBOLS AND DEFINITIONS

2.1. **Units used**

- 2.1.1. Weights and forces: kg
- 2.1.2. Torques and moments: m · kg
- 2.1.3. Areas: cm²
- 2.1.4. Pressures: kg/cm²
- 2.1.5. Lengths: units specified in each case.

2.2. **Symbols valid for all types of brakes** (see diagram in Appendix 1, p. 771)

- 2.2.1. G_A : 'total weight' of the trailer declared to be technically permissible by the manufacturer;
- 2.2.2. G'_A : 'total weight' of the trailer which, according to the manufacturer's declaration, can be braked by the control device;
- 2.2.3. G_B : 'total weight' of the trailer which can be braked by the joint operation of all the trailer brakes

$$G_B = n \cdot G_{B_0}$$
- 2.2.4. G_{B_0} : Fraction of the permissible 'total weight' which, according to the manufacturer's declaration, can be braked by one brake;
- 2.2.5. B^* : braking force required;
- 2.2.6. B : required braking force taking account of rolling resistance;

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- 2.2.7. D^* : permitted thrust on coupling;
- 2.2.8. D : load on the coupling;
- 2.2.9. P' : control device output force;
- 2.2.10. K : supplementary force of control device by convention; this is defined as the force D corresponding to the point of intersection of the x axes of the extrapolated curve expressing P' in terms of D , measured with the control system in the mid-travel position (see graph in Appendix 1, p. 772);
- 2.2.11. K_A : threshold force of control device—this is the maximum force on the coupling head which can be applied for a short period of time without producing any output force on the control device. By convention, K_A is defined as the force measured when force begins to be exerted on the coupling head at a speed of from 10 to 15 mm/s, the control device transmission being uncoupled;
- 2.2.12. D_1 : this is the maximum force applied to the coupling head when it is forced rearward at a speed of s mm/s $\pm 10\%$, the transmission being uncoupled;
- 2.2.13. D_2 : this is the maximum force applied to the coupling head when this is pulled forward at a speed of s mm/s $\pm 10\%$ from its rearmost position, the transmission being uncoupled;
- 2.2.14. η_{Ho} : efficiency of the inertia control device;
- 2.2.15. η_{H_1} : efficiency of the transmission system;
- 2.2.16. η_H : total efficiency of the control device and of the transmission
 $\eta_H = \eta_{Ho} \cdot \eta_{H_1}$;
- 2.2.17. s : travel of control (expressed in millimetres);
- 2.2.18. s' : effective travel of control (expressed in millimetres) fixed in accordance with the requirements of item 9.4.1;
- 2.2.19. s'_1 : safe travel of the master cylinder actuator, measured in millimetres at the coupling head;
- 2.2.20. s_o : loss of travel, that is to say the travel, measured in millimetres, of the coupling head when it is actuated in such a way as to travel from a point 300 mm above the horizontal plane to a point 300 mm below, the transmission remaining stationary;
- 2.2.21. $2s_B$: brake-shoe lift measured on the diameter parallel to the operating mechanism and without the brakes being adjusted during the test (expressed in millimetres);
- 2.2.22. $2s_{B^*}$: minimum brake-shoe lift (expressed in millimetres)

$$2s_{B^*} = 2 \cdot 4 + \frac{4}{1000} \cdot 2r;$$
 $2r$ being the diameter of the brake drum expressed in millimetres (see diagram in Appendix 1, p. 773);
- 2.2.23. M : braking moment;
- 2.2.24. R : radius of pneumatic tyres (in metres) measured under load from wheel centre to ground level on the vehicle being tested (rounded to the nearest centimetre);
- 2.2.24. n : number of brakes;
- 2.3. **Symbols for mechanical transmission brakes** (see diagram in Appendix 1, p. 774)
- 2.3.1. i_{Ho} : reduction ratio between travel of the coupling head and travel of the lever at the output side of the control device;
- 2.3.2. i_{H_1} : reduction ratio between travel of the lever at the output side of the control device and travel of the brake lever (gearing down of transmission);

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- 2.3.3. i_H : reduction ratio between travel of the coupling head and travel of the brake lever
 $i_H = i_{H_0} \cdot i_{H_1}$;
- 2.3.4. i_g : reduction ratio between travel of the brake lever and the brake-shoe centre lift (see diagram in Appendix 1, page 773);
- 2.3.5. P : force applied to the brake control lever;
- 2.3.6. P_o : brake retraction force; that is, in the graph $M = f(P)$, the value of the force P at the point of intersection of the extrapolation of this function with the abscissa (see graph in Appendix 1, p. 775);
- 2.3.7. ρ : characteristic of the brake defined by: $M = \rho (P - P_o)$
- 2.4. **Symbols for hydraulic-transmission brakes** (see diagram in Appendix 1, p. 776).
- 2.4.1. i_h : reduction ratio between travel of the coupling head and travel of the piston in master cylinder;
- 2.4.2. i'_g : reduction ratio between travel of the actuation point of the cylinders and the brake-shoe centre lift;
- 2.4.3. F_{RZ} : surface area of piston in brake cylinder;
- 2.4.4. F_{HZ} : surface area of piston in master cylinder;
- 2.4.5. p : hydraulic pressure in brake cylinder;
- 2.4.6. p_o : retraction pressure in brake cylinder; that is, in the graph $M = f(p)$, the value of the pressure p at the point of intersection of the extension of this function with the abscissa (see graph in Appendix 1, p. 775).
- 2.4.7. ρ' : characteristic of the brake defined by: $M = \rho' (p - p_o)$.

3. GENERAL REQUIREMENTS

- 3.1. The transmission of braking power from the coupling head to the trailer's brakes must be effected either by a rod linkage or by means of one or more fluids. However, a sheathed cable (Bowden cable) may be used to provide part of the transmission. This part must be as short as possible.
- 3.2. All pins at joints must be adequately protected. In addition, these joints must be either self-lubricating or easily accessible for lubrication.
- 3.3. Inertia braking devices with hydraulic transmission must be arranged in such a way that, even when the coupling head is forced rearward to its fullest extent, it is possible to avoid damage created by excessive forces in the transmission and the braking device. Any device which is used to enable this to be done (stress reducer) may only reduce the braking force to the extent that the prescribed braking force can still be achieved.
- 3.3.1. Item 3.3 shall apply *mutatis mutandis* if the inertia braking device with mechanical transmission is fitted with a stress reducer.
- 3.3.2. Inertia braking devices with mechanical transmission without a stress reducer must be arranged in such a way that, in the case where the coupling head travels to its fullest extent, no part of the transmission becomes jammed, or suffers any permanent distortion, or fails. This must be checked by uncoupling the first element of the transmission from the brake control levers.

4. REQUIREMENTS FOR CONTROL DEVICES

- 4.1. The sliding members of the control device must be long enough to enable the brake to be fully applied, even when the trailer is coupled.
- 4.2. The sliding members must be protected by a bellows or some equivalent device. They must either be lubricated or be constructed of self-lubricating materials. The surfaces in frictional contact must be made of a material such that there is neither electrochemical torque nor any mechanical incompatibility liable to cause the sliding members to seize.

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- 4.3. The stress reducer equipment mentioned in item 3.3 must only commence to function when the pressure on the coupling reaches $0.12 G'_A$ in the case of single-axle trailers and $0.08 G'_A$ in the case of multi-axle trailers. They must prevent the braking force on the wheels from exceeding that corresponding to a pressure on the coupling of $0.18 G_B$ in the case of single-axle trailers and of more than $0.12 G_B$ in the case of multi-axle trailers.
- 4.4. The threshold force of the control equipment (K_A) must be not less than $0.02 G'_A$ and not more than $0.04 G'_A$.
- 4.5. The maximum depression force of D_1 may not exceed $0.09 G'_A$ in the case of single-axle trailers and $0.06 G'_A$ in the case of multi-axle trailers.
- 4.6. The maximum towing force D_2 must be between $0.1 G'_A$ and $0.5 G'_A$.

5. TESTS AND MEASUREMENTS TO BE CARRIED OUT ON THE CONTROL SYSTEM

- 5.1. Compliance with the requirements of items 3 and 4 above must be verified on the control device submitted to the technical service conducting the tests.
- 5.2. The following shall be measured in respect of all types of brakes:
- 5.2.1. the travel s and the available travel s' ;
- 5.2.2. the supplementary force K ;
- 5.2.3. the threshold force K_A ;
- 5.2.4. the damping force D_1 ;
- 5.2.5. the towing force D_2 .
- 5.3. In the case of mechanical-transmission inertia brakes, the following shall be determined:

- 5.3.1. the reduction ratio i_{H_0} , measured at the mid-travel portion of the control;
- 5.3.2. the force P' at the output side of the control device as a function of the thrust D on the drawbar.

The supplementary force K and the efficiency are derived from the representative curve obtained from these measurements.

$$\eta H_0 = \frac{1}{i_{H_0}} \cdot \frac{P'}{D - K}$$

(see graph in Appendix 1, p. 772)

- 5.4. In the case of hydraulic-transmission inertia brakes, the following shall be determined:

- 5.4.1. the reduction ratio i_h measured at the mid-travel position of the control;
- 5.4.2. the pressure p at the output side of the master cylinder as a function of the thrust D on the drawbar and of the surface area F_{HZ} in the master cylinder piston, as specified by the manufacturer. The supplementary force K and the efficiency are derived from the representative curve obtained from these measurements

$$\eta H_0 = \frac{1}{i_h} \cdot \frac{p \cdot F_{HZ}}{D - K}$$

(see graph in Appendix 1, page 772);

- 5.4.3. the safe travel of the master cylinder actuator s'' mentioned in item 2.2.19.

- 5.5. In the case of inertia brakes fitted with the devices mentioned in item 3.3 (stress reducers), it is necessary to check whether the limits mentioned in item 4.3 are observed.
- 5.6. In the case of inertia brakes on multi-axle trailers, the loss of travel s_0 mentioned in item 9.4.1 shall be measured.

6. REQUIREMENTS FOR BRAKES

- 6.1. The manufacturer must make available to the technical service responsible for the tests, in addition to the brakes to be tested, drawings of the brakes showing the type, dimensions and material of the main

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parts, and the make and type of the linings. These drawings must indicate the surface area F_{RZ} of the brake cylinders in the case of hydraulic brakes. The manufacturer must also indicate the maximum braking torque M_{max} which is allowed, as well as the weight G_{Bo} mentioned in item 2.2.4.

- 6.2. The braking torque M_{max} indicated by the manufacturer must be at least twice the force P or at least twice the pressure p required to give a braking force of $0.45 G_{Bo}$.
- 6.3. The devices mentioned in item 3.3 must only commence to function when the force P or the pressure p has reached the value corresponding to a braking force of $0.6 G_{Bo}$. They must prevent twice the force P or twice the pressure p mentioned in item 6.2 being exceeded.

7. TESTS AND MEASUREMENTS TO BE CARRIED OUT ON THE BRAKES

- 7.1. The brakes and items of equipment made available to the technical service responsible for the tests must be tested to check whether they conform to the requirements of item 6.
- 7.2. The following shall be determined:
 - 7.2.1. the minimum shoe centre lift $2s_B^*$;
 - 7.2.2. the shoe centre lift $2s_B$ (which must be greater than $2s_B^*$);
 - 7.2.3. the braking moment M as a function of the force P applied to the control lever in the case of devices with mechanical transmission, and of the pressure p in the brake cylinder in the case of devices with hydraulic transmission.

The speed at which the braking surfaces rotate must correspond to an initial vehicle speed of 50 km/h. The following shall be deducted from the curve obtained from these measurements:

- 7.2.3.1. the retraction force P and the characteristic ρ in the case of mechanically actuated brakes (see graph in Appendix 1, p. 775).
- 7.2.3.2. the retraction pressure p_o and the characteristic ρ in the case of hydraulically actuated brakes (see graph in Appendix 1, p. 775).

8. TEST REPORTS

Where applications are made for type approval of trailers fitted with inertia brakes, such applications are to be accompanied by the test reports relating to the control system and the brakes, as well as the test report on the compatibility between the inertia control device, the transmission and the brakes on the trailer; these reports are to include at least the particulars shown in Appendices 2, 3 and 4 to this Annex.

9. COMPATIBILITY OF THE CONTROL DEVICE AND THE INERTIA BRAKES OF A VEHICLE

- 9.1. A check must be made on the vehicle, taking into account the characteristics of the control device (Appendix 2) and of the brakes (Appendix 3) as well as the trailer characteristics mentioned in item 4 of Appendix 4, as to whether the inertia braking device of the trailer complies with the requirements laid down.

9.2. General tests for all types of brakes

- 9.2.1. Those parts of the transmission which have not been tested at the same time as the brake control device or the brakes must be tested on the vehicle. The results of the test must be entered in Appendix 4 (for example i_{H1} and η_{H1}).

9.2.2. Weight

- 9.2.2.1. The total weight of the trailer G_A must not exceed the total weight G'_A for which the control device is authorised.
- 9.2.2.2. The total weight of the trailer G_A must not exceed the total weight G_B which can be braked by the joint operation of all the trailer brakes.

▼ **B**9.2.3. *Forces*

- 9.2.3.1. The threshold force K_A must not be less than $0.02 G_A$ nor greater than $0.04 G_A$.
- 9.2.3.2. The maximum damping force D_1 must not exceed $0.09 G_A$ in the case of single-axle trailers, nor $0.06 G_A$ in the case of multi-axle trailers.
- 9.2.3.3. The maximum pulling force D_2 must be between $0.1 G_A$ and $0.5 G_A$.

9.2.4. *Device mentioned in item 3.3 (stress reducer)*

- 9.2.4.1. A check must be made as to whether the control device or the brakes are fitted with such a device.
- 9.2.4.2. Where this device forms part of the control device, the minimum value of G_B fixed in item 4.3 for the control device must not be less than the total permissible weight G_B for the brakes used on the trailer which is being tested.

9.3. **Test of braking efficiency**

- 9.3.1. The sum of the braking forces exerted on the circumference of the trailer wheels must be at least $B^* = 0.45 G_A$, including a rolling resistance of $0.01 G_A$. This represents a braking force of $0.44 G_A$. In this case, the maximum permitted thrust on the coupling shall be:

$D^* = 0.06 G_A$ in the case of multi-axle trailers,

$D^* = 0.09 G_A$ in the case of single-axle trailers.

In order to check whether these conditions are observed, the following inequalities must be applied:

- 9.3.1.1. In the case of inertia brakes with mechanical transmission:

$$\left[\frac{B \cdot R}{\rho} + n P_o \right] \frac{1}{(D^* - K) \cdot \eta_H} \leq i_H$$

- 9.3.1.2. In the case of inertia brakes with hydraulic transmission:

$$\left[\frac{B \cdot R}{n \cdot \rho'} + P_o \right] \frac{1}{(D^* - K) \cdot \eta_H} \leq \frac{i_h}{F_{HZ}}$$

9.4. **Control travel test**

- 9.4.1. In the case of control devices for multi-axle trailers of which the brake rod system is dependent upon the position of the towing vehicle, the travel of the control s must be greater than the available travel of the control s' ; the difference in length must be at least equivalent to the loss of travel s_0 . The travel s_0 must not exceed 40 mm.

- 9.4.2. The available travel of the control s' shall be determined in the following way:

- 9.4.2.1. if the brake rod system is affected by the relative position of the towing device, then:

$$s' = s - s_0;$$

- 9.4.2.2. if there is no loss of travel, then:

$$s' = s;$$

- 9.4.2.3. in the case of hydraulic braking systems:

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

- 9.4.3. The following inequalities shall be applied in order to check whether the travel of the control is adequate:

- 9.4.3.1. in the case of inertia brakes with mechanical transmission:

$$i_H \leq \frac{s'}{S_B \cdot i_g}$$

- 9.4.3.2. in the case of inertia brakes with hydraulic transmission:

▼B

$$\frac{i_h}{F_{HZ}} \leq \frac{s'}{2s_B * \cdot n F_{RZ} \cdot i'_g}$$

9.5. Additional tests

- 9.5.1. In the case of inertia brakes with mechanical transmission, a check shall be made as to whether the rod system by which the forces are transmitted from the control device is correctly fitted.
- 9.5.2. In the case of inertia brakes with hydraulic transmission, a check shall be made as to whether the travel of the master cylinder actuator reaches a minimum level of s/i_h .
A lower level will not be permitted.
- 9.5.3. A road test must be carried out to determine the general reaction of the vehicle to braking.

10. GENERAL COMMENTS

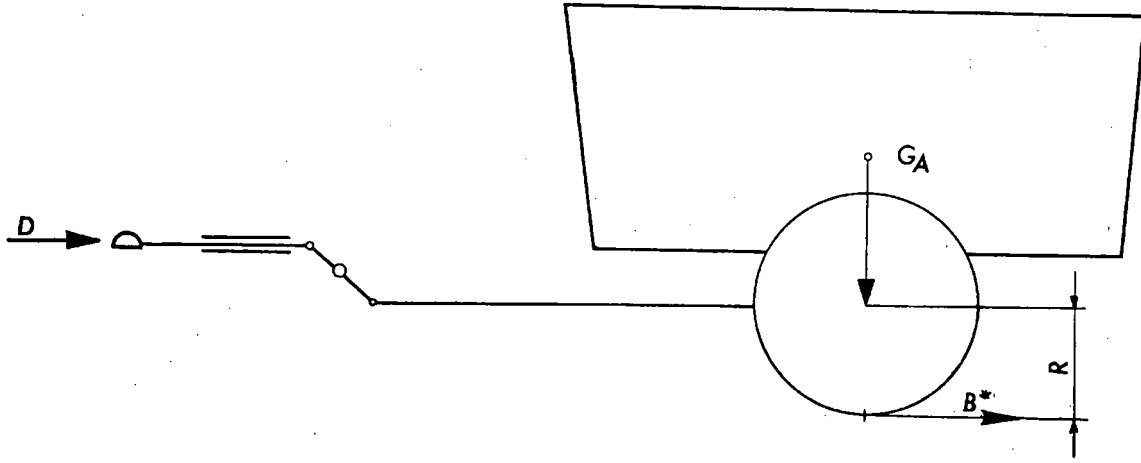
The above provisions apply to the latest models of inertia brakes with mechanical or hydraulic transmission; in the case of these models, in particular, all the wheels of the trailer are fitted with the same type of brake and the same type of tyre.

When testing special models, the above requirements are to be adapted.

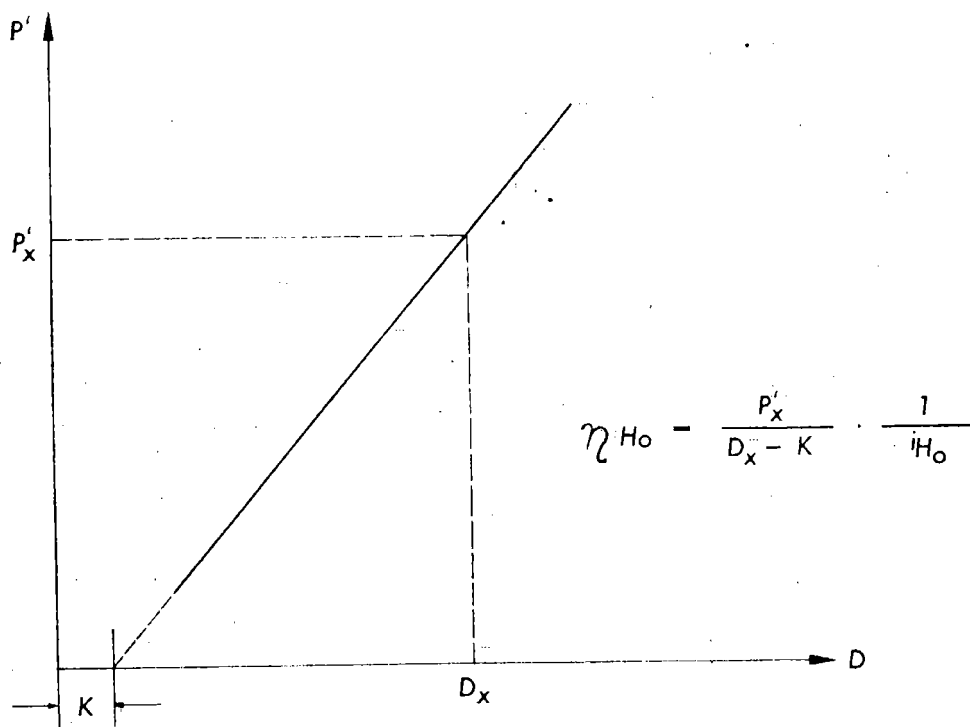
▼B

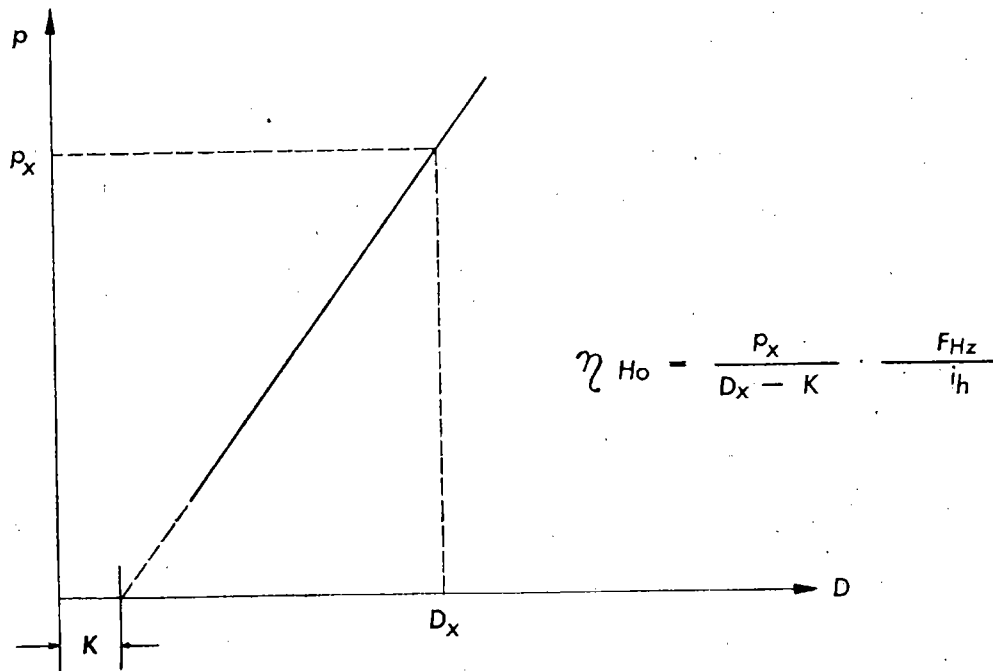
Appendix 1

See 2.2



See 2.2.10 and 5.3.2 (devices with mechanical transmission)



▼B*See 2.2.10 and 5.4.2 (devices with hydraulic transmission)*

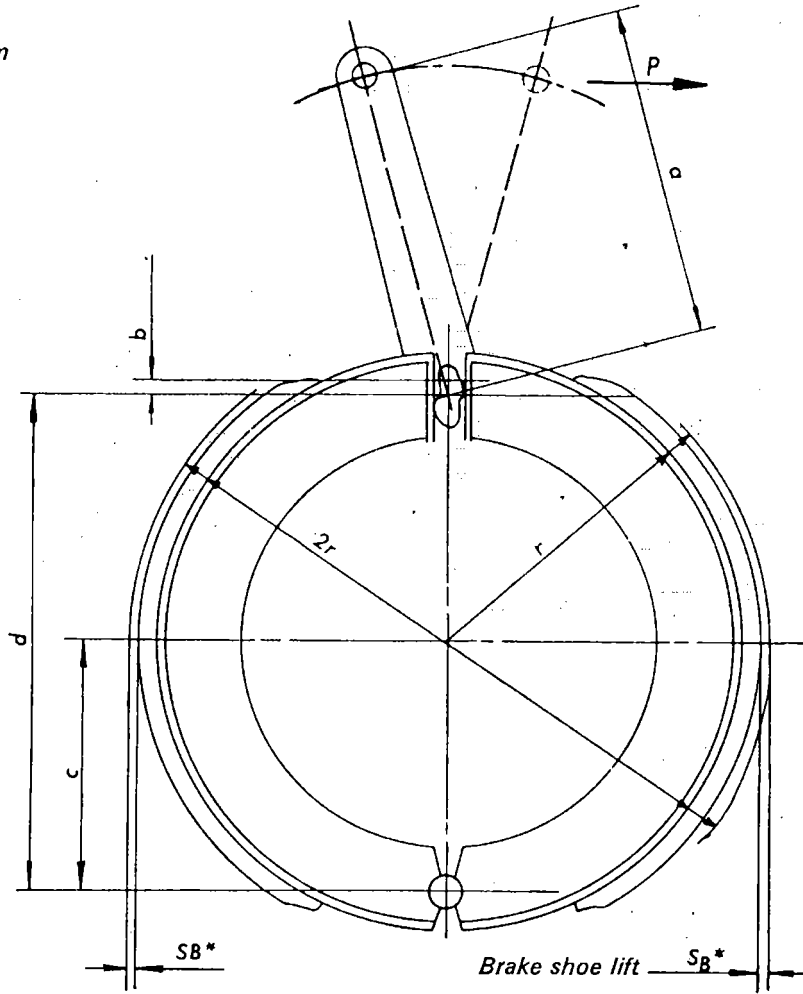
▼B

See 2.2.22 and 2.3.4

Push rod cam

$$i_a = \frac{a}{2b}$$

$$i_g = \frac{a \cdot d}{b \cdot c}$$



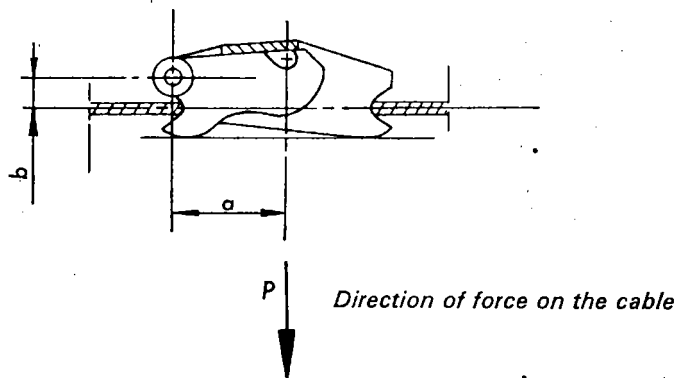
Brake shoe centre lift

$$S_B^* = 1.2 \frac{m}{m} + 0.2 \% \cdot 2r$$

Retractor

$$i_a = \frac{a}{b}$$

$$i_g = 2 \cdot \frac{a \cdot d}{b \cdot c}$$

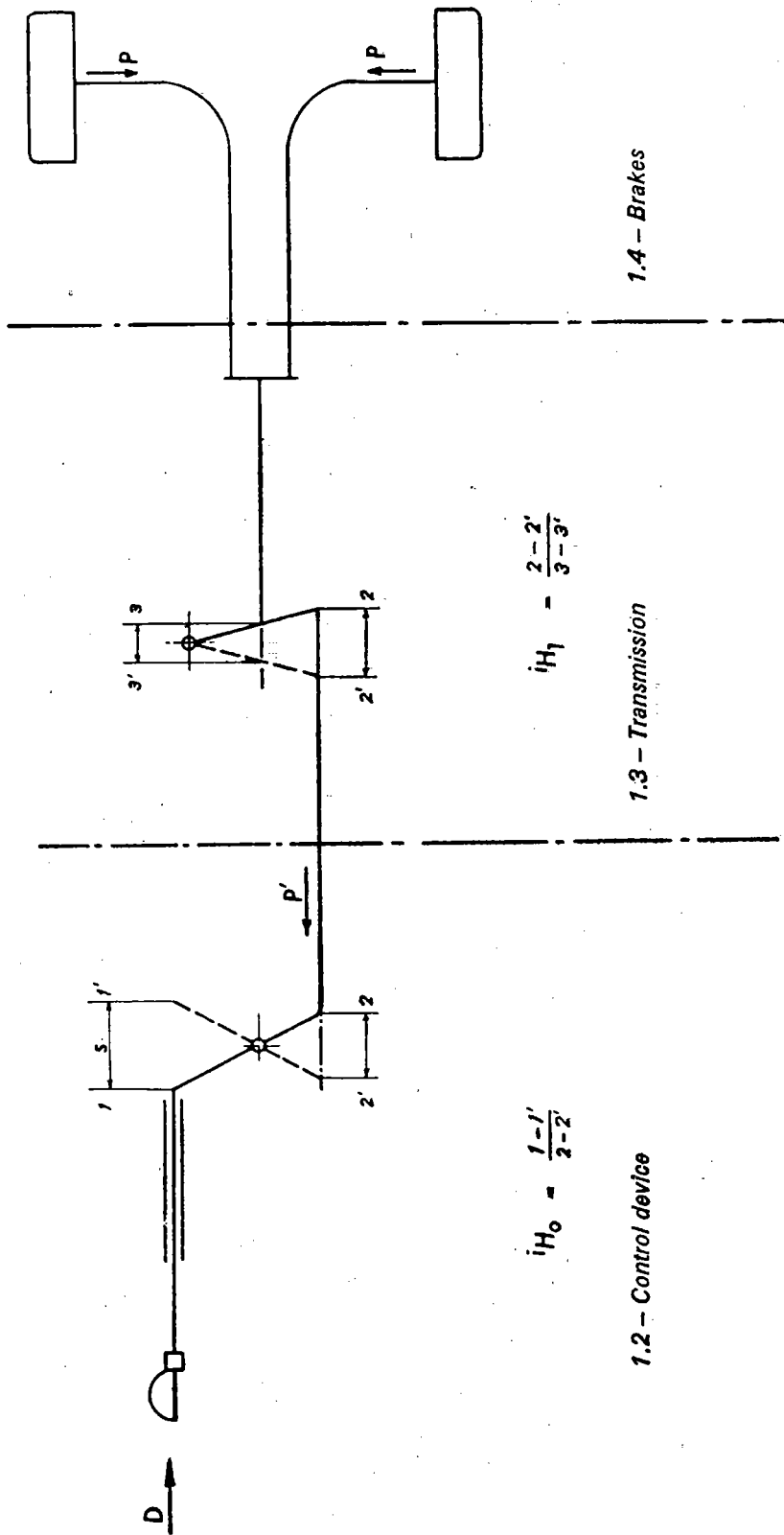


Tests to be carried out on the brakes

▼ B

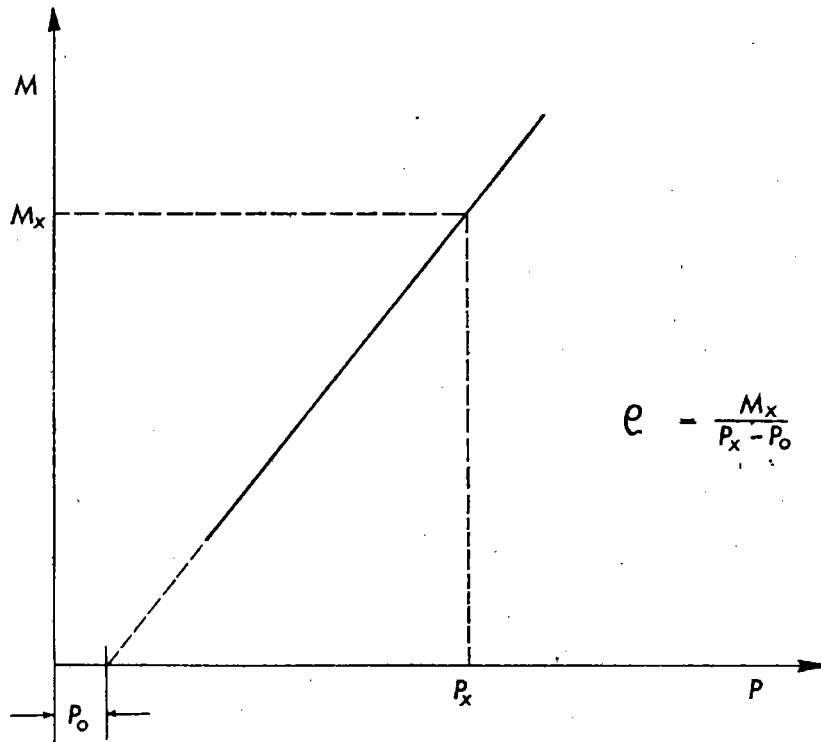
Brakes with mechanical transmission

See 2.3

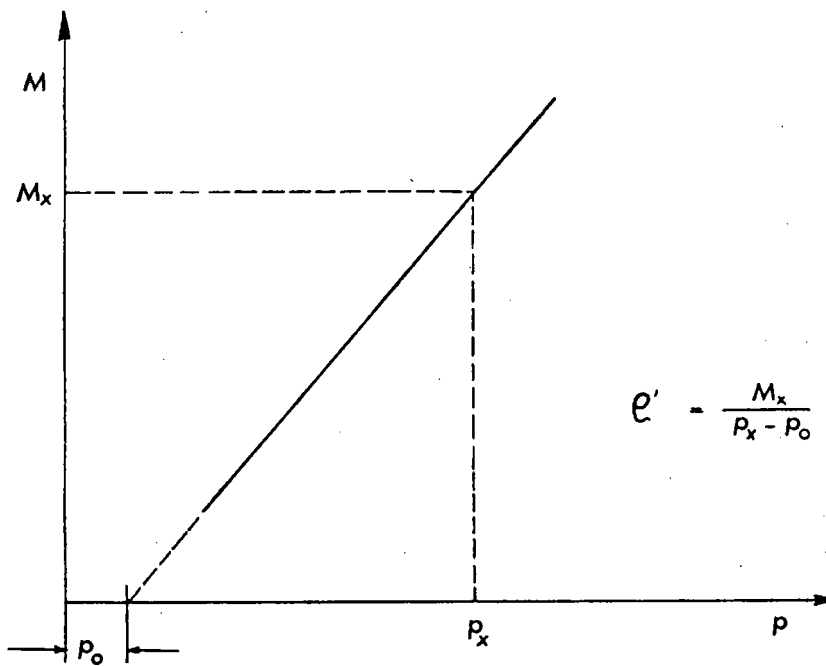


▼ B

See 2.3.6 and 7.2.3.1 (mechanical brake)



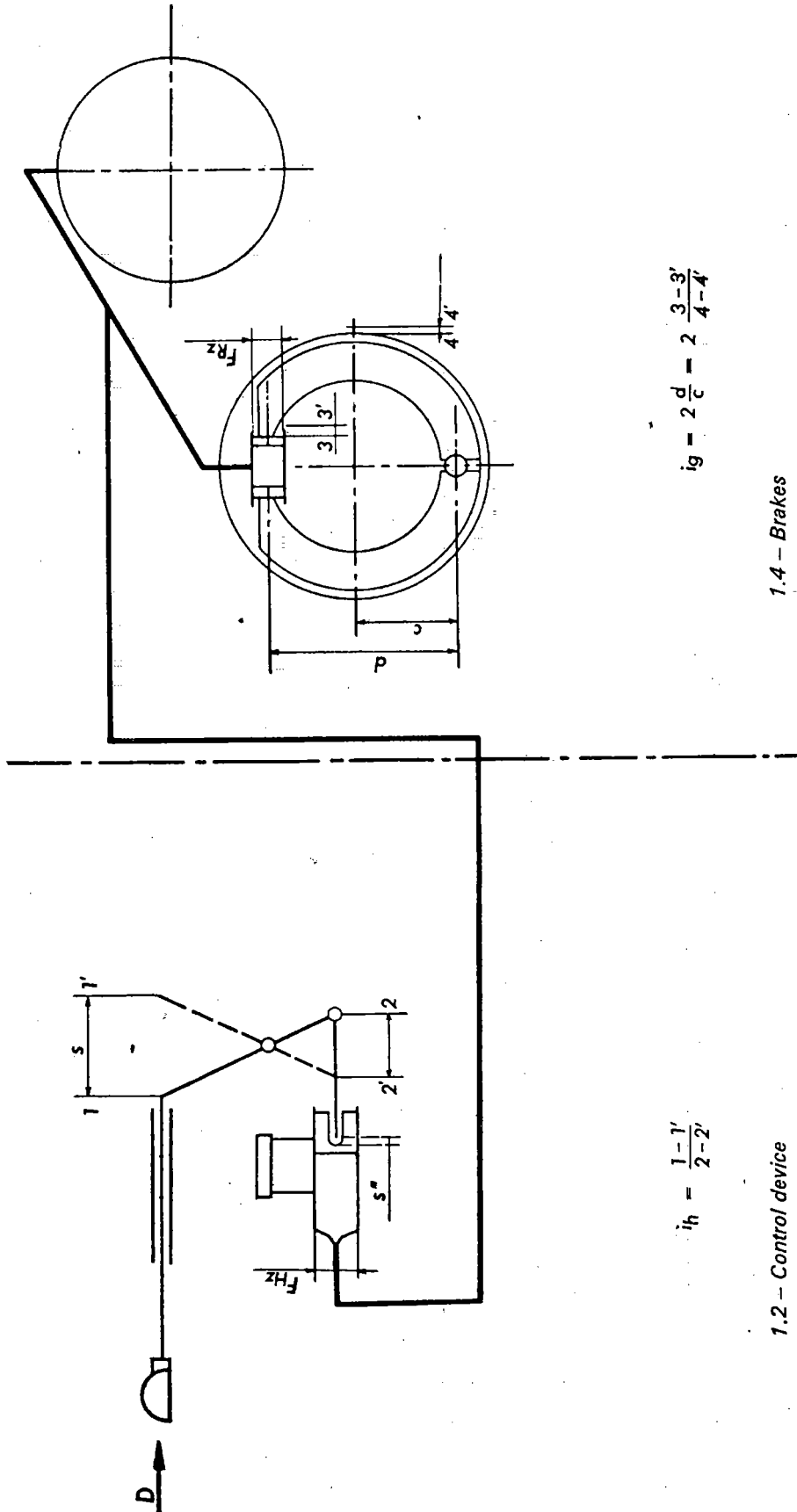
See 2.4.6 and 7.2.3.2 (hydraulic brake)



▼B

Brakes with hydraulic transmission

See 2.4



$$i_g = 2 \frac{d}{c} = 2 \frac{3-3'}{4-4'}$$

1.4 — Brakes

$$i_h = \frac{1-1'}{2-2'}$$

1.2 — Control device

▼B

Appendix 2

Test report on inertia brake control device

1. Manufacturer
2. Make
3. Type
4. Characteristics of the trailers for which the control device is intended by the manufacturer:
 - 4.1. weight $G'A =$ kg
 - 4.2. permissible vertical static force at the head of the towing device kg
 - 4.3. single-axle trailer^a or multi-axle trailer^a.
5. Brief description
(List of attached plans and dimensional drawings)
6. Main diagram of the control device
7. Travel $s =$ mm
8. Reduction ratio of the control device:
 - 8.1. in the case of a device with mechanical transmission^a
 $i_{H_0} =$ from to^b
 - 8.2. in the case of a device with hydraulic transmission^a
 $i_h =$ from to^b
FHZ = cm²
travel of the master cylinder^a actuator mm.
9. Test results:
 - 9.1. Efficiency
 - in the case of a device with mechanical transmission $\eta_H =$
 - in the case of a device with hydraulic transmission $\eta_H =$
 - 9.2. Complementary force $K =$ kg
 - 9.3. Maximum damping force $D_1 =$ kg
 - 9.4. Maximum pulling force $D_2 =$ kg
 - 9.5. Threshold force $K_A =$ kg
 - 9.6. Loss of travel and safe travel:
 - where the position of the towing device has an effect $s_0^a =$
 - in the case of a device with hydraulic transmission $s''^a =$
 - 9.7. Available travel of the control $s' =$ mm
 - 9.8. A device within the meaning of item 3.3 of the testing conditions (stress reducer) is/is not^a fitted
 - 9.8.1. where the device is operated mechanically^a :
minimum value of the weight G_B in accordance with item 4.3 of the testing conditions
 $G_{Bmin} =$ kg;
 - 9.8.2. where the device is operated hydraulically^a :
maximum hydraulic pressure which can be created by the inertia control device,
 $p'_{max} =$ kg/cm².
 - 9.9. A recoil blocking device is/is not fitted^a
10. Technical service which carried out the tests
11. The control device described above does/does not^a comply with the requirements of items 3, 4 and 5 of the testing conditions for vehicles fitted with inertia brakes.

Signature

^a Delete as appropriate.^b Indicate the lengths whose ratio was used to determine i_{H_0} or i_h .

▼B

Appendix 3

Brake test report

1. Manufacturer
2. Make
3. Type
4. Technically permissible maximum weight per wheel G_{Bo} = kg
5. Maximum braking moment M_{max} = m kg
6. Diameter of pneumatic tyre used during the test: m
7. Brief description
(list of plans and dimensional drawings)
8. Main diagram of the brake
9. Test result:

mechanical brake ^a	hydraulic brake ^a
9.1. Reduction ratio $i_g =$ ^b	9.1a. Reduction ratio $i_g' =$ ^b
9.2. Half shoe centre lift $s_B =$ mm	9.2a. Half shoe centre lift $s_B =$ mm
9.3. Half minimum shoe centre lift $s_B^* =$ mm	9.3a. Half minimum shoe centre lift $s_B^* =$ mm
9.4. Withdrawal force $P_o =$ kg	9.4a. Withdrawal pressure $p_o =$ kg/cm ²
9.5. Coefficient $\rho =$ m	9.5a. Coefficient $\rho' =$ m cm ²
9.6. A device within the meaning of item 3.3 of the testing conditions (stress reducer) is/is not ^a fitted	9.6a. A device within the meaning of item 3.3 of the testing conditions (stress reducer) is/is not ^a fitted.
	9.7a. Surface area of the wheel cylinder FRZ = cm ²
	9.8a. Maximum permissible pressure for M_{max} : $p_{max} =$ kg/cm ²
10. Technical service which carried out the tests
11. The above brake does/does not^a conform to the requirements of items 3 and 6 of the testing conditions for vehicles equipped with inertia brakes. It may/may not^a be combined with inertia control devices which are not equipped with a recoil blocking device (see item 9.9 of Appendix 2)

Signature

^a Delete as appropriate.^b Indicate the lengths which have been used to determine i_g or i_g' .

▼B

Appendix 4

Test report on the compatibility of the inertia control device, the transmission and the brakes on the trailer

1. Control device
described in the attached test report (see Appendix 2)
Reduction ratio selected:
 $i_{H_0}^a = \dots\dots\dots^b$ or $i_h^a = \dots\dots\dots^b$
(must be between the limits specified in Appendix 2, item 8.1 or 8.2)
2. Brakes
described in the attached test report (see Appendix 3)
3. Transmission devices on the trailer
 - 3.1. Brief description with main diagram
 - 3.2. Reduction ratio and efficiency of the mechanical transmission device on the trailer
 $i_{H_1}^a = \dots\dots\dots^b$
 $\eta_{H_1}^a = \dots\dots\dots$
4. Trailer
 - 4.1. Manufacturer
 - 4.2. Make
 - 4.3. Type
 - 4.4. Number of axles^c
 - 4.5. Number of brakes $n = \dots\dots\dots$
 - 4.6. Technically permissible total weight $G_A = \dots\dots\dots$ kg
 - 4.7. Radius of tyres under load $R = \dots\dots\dots$ m
 - 4.8. Permissible force on the coupling $D^* = 0.09 G_A^a \dots\dots\dots$ kg
or $D^* = 0.06 G_A^a = \dots\dots\dots$ kg
 - 4.9. Required braking force $B^* = 0.45 G_A = \dots\dots\dots$ kg
 - 4.10. Braking force $B = 0.44 G_A = \dots\dots\dots$ kg
5. Compatibility — Test results
 - 5.1. Threshold ratio $100 K_A/G_A \dots\dots\dots$
(must be between 2 and 4)
 - 5.2. Maximum damping force $100 D_1/G_A \dots\dots\dots$
(must not exceed 9 for single-axle trailers^c, or 6 for multi-axle trailers)
 - 5.3. Maximum towing force $100 D_2/G_A \dots\dots\dots$
(must be between 10 and 50)
 - 5.4. Technically permissible total weight for the inertia control device
 $G'_A = \dots\dots\dots$ kg
(must not be less than G_A)
 - 5.5. Technically permissible total weight for all the trailer brakes $G_B = n \cdot G_{B_0}$
 $= \dots\dots\dots$ kg
(must not be less than G_A)
 - 5.6. The device within the meaning of item 3.3 of the testing conditions (stress reducer) is fitted on the brakes/on the inertia control device^a.
 - 5.6.1. Where the equipment is fitted on the inertia control device^a:
 - 5.6.1.1. in the case of mechanically operated device^a
 $G_{B_{min}}$ as specified in item 9.8.1. of Appendix 2 = ^a $\dots\dots\dots$ kg/cm²
(must not be greater than G_B as specified in item 4.3)

▼ B

5.6.1.2. in the case of hydraulically operated device^a
 p'_{\max} as specified in item 9.8.2 of Appendix 2 = ^a kg/cm²
 (must not be greater than p_{\max} as specified in item 9.8a of Appendix 3)

5.7. Inertia braking device with mechanical transmission^a

5.7.1. $i_H = i_{H0} \cdot i_{H1} =$

5.7.2. $\eta_H = \eta_H \cdot \eta_{H1} =$

5.7.3. $\left[\frac{B \cdot R}{\rho} + n \cdot P_0 \right] \cdot \frac{1}{(D^* - K) \cdot \eta_H}$
 (must be not greater than i_H).

5.7.4. $\frac{s'}{s_{B^*} \cdot i_g} =$

5.8. Inertia controlled braking device with hydraulic transmission^a

5.8.1. $i_h/FHZ =$

5.8.2. $\left[\frac{B \cdot R}{n \cdot \rho} + P_0 \right] \cdot \frac{1}{(D^* - K) \cdot \eta_H}$
 (must be not greater than i_h/FHZ).

5.8.3. $\frac{s'}{2s_{B^*} \cdot n \cdot FRZ \cdot i_g} =$
 (must be not less than i_h/FHZ).

5.8.4. $s/i_h =$

(must be not greater than the travel of the master cylinder actuator as specified in item 8.2. of Appendix 2)

6. Technical service which carried out the tests

7. The inertia braking device described above does/does not^a comply with the requirements of items 3 to 9 of the testing conditions for vehicles fitted with inertia brakes

Signature

^a Delete as appropriate.

^b Indicate the lengths which have been used to determine i_{H0} , i_h , i_{H1} .

^c Two axles with a wheelbase of less than 1 metre (tandem axle) shall, for the purposes of these testing conditions, be deemed to be one axle.

▼B

ANNEX IX

Name of administration

MODEL
 COMMUNICATION CONCERNING THE TYPE
 APPROVAL OF A VEHICLE WITH REGARD TO BRAKING

- Type Approval No
1. Make (name of company or firm).....
 2. Type and commercial description
 3. Vehicle category
 4. Name and address of manufacturer
 5. Name and address of manufacturer's authorised representative (if any).....

 6. Maximum weight of vehicle.....
 7. Distribution of the weight on each axle
 (maximum value)
 8. Make and type of brake linings.....
 9. In the case of a motor vehicle:
 - 9.1. engine type
 - 9.2. number and ratios of gears.....
 - 9.3. ratio(s) of the driving axle(s)
 -
 - 9.4. if applicable, weight of trailer which may be coupled
 -
 10. Tyre dimensions
 11. Number and arrangement of axles
 12. Brief description of the braking device
 -
 13. Weight of vehicle at the time of testing;

	unladen (kg)	laden (kg)
Axle No 1 ¹
Axle No 2
Axle No 3
Axle No 4
Total:

▼B

14. Result of the tests:

	Test speed km/h	Measured performance	Measured force applied to the control (kg)
14.1. Type O tests, engine disconnected service braking secondary braking			
14.2. Type O tests, engine connected service braking secondary braking			
14.3. Type I tests with repeated braking ² with continuous braking ³			
14.4. Type II or II A ⁴ tests, as appropriate service braking			

14.5. Was the secondary braking device used during the Type II/II A⁴ test?
yes/no⁴

14.6. Reaction time seconds

14.7. Cases in which Type I and/or II (or II A) tests do not have to be carried out (Annex VII)

14.7.1. Type Approval No of the reference vehicle

14.7.2.

	Vehicle axles			Reference axles		
	Weight per axle	Required braking force to the wheels	Speed	Weight per axle	Actual braking force developed at the wheels	Speed
	kg	kg	km/h	kg	kg	km/h
Axle 1						
Axle 2						
Axle 3						
Axle 4						

* This is the technically permissible maximum weight per axle.

14.7.3.

Total weight of the vehicle presented for type approvalkg
Required braking force to the wheelskg
Required retarding torque on the main shaft of the brakem kg
Retarding torque obtained on the main shaft of the brake (according to diagram)m kg

▼ B

15. Reservoirs and energy sources using compressed air:
- 15.1. Total volume of the brake reservoirs
- 15.2. Value p_2 declared by manufacturer
- 15.3. Pressure in the reservoir after a test of eight brake applications
.....
- 15.4. Characteristics of the compressor
-
- 15.5. Charging time T_1
- 15.6. Charging time T_2
- 15.7. Total volume of the reservoirs of auxiliary systems
.....
- 15.8. Charging time T_3
16. Spring brakes
- 16.1. Description of the braking system and of its release device(s)
-
- 16.2. Maximum pressure in the spring chamber
-
- 16.3. Pressure at which the springs begin to operate the brake
-
- 16.4. Warning-device release pressure
-
17. Parking braking by mechanical locking of the brake cylinders (lock actuators)
- 17.1. Description of the braking system, of its method of supply and of its release
.....
-
- ⁽¹⁾ 17(a). Distribution of braking among the axles of a vehicle
- 17(a) 1. Does the vehicle fulfil the requirements contained in the Appendix (see item 1.1.4.2.) ... yes/no ⁽⁴⁾ ◀
18. Vehicle submitted for type approval on
19. Technical service conducting type approval tests
.....
20. Date of the report issued by that service
-
21. Number of the report issued by that service
-
22. Type approval in respect of braking is granted/refused⁴
23. Place
24. Date
25. Signature
-
- ¹ In the case of a semi-trailer, indicate here the laden weight on the fifth wheel lead.
- ² Applies only to vehicles of categories M₁, M₂, M₃, N₁, N₂ and N₃.
- ³ Applies only to vehicles of categories O₃ and O₄.
- ⁴ Delete as appropriate.