

Regulation No 78 of the Economic Commission for Europe of the United Nations (UN/ECE) — Uniform provisions concerning the approval of vehicles of category L with regard to braking (*)

1. SCOPE
 - 1.1. This regulation applies to the braking of power-driven vehicles having two or three wheels of the types defined in paragraph 2 below.
 - 1.2. This Regulation does not cover:
 - 1.2.1. Vehicles with a maximum design speed not exceeding 25 km/h;
 - 1.2.2. Vehicles fitted for invalid drivers.
2. DEFINITIONS

For the purposes of this Regulation,

 - 2.1. 'Approval of a vehicle' means the approval of a vehicle type with regard to braking;
 - 2.2. 'Vehicle type' means a category of power-driven vehicles which do not differ in such essential respects as:
 - 2.2.1. the vehicle category, as defined in the Consolidated Resolution (R.E.3),
 - 2.2.2. the maximum mass, as defined in paragraph 2.14,
 - 2.2.3. the distribution of mass between the axles,
 - 2.2.4. the maximum design speed,
 - 2.2.5. a different type of braking device,
 - 2.2.6. the number and arrangement of the axles,
 - 2.2.7. the engine type,
 - 2.2.8. the number and ratios of gears,
 - 2.2.9. the final drive ratios,
 - 2.2.10. the tyre dimensions;
 - 2.3. '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 paragraph 5.1.2 below. The device consists of the control, the transmission, and the brake proper;
 - 2.4. 'Control' means the part actuated directly by the driver to furnish to the transmission the energy required for braking or controlling it. This energy may be the muscular energy of the driver, or the energy from another source controlled by the driver, or a combination of these various kinds of energy;

(*) Publication in accordance with Article 4(5) of Council Decision 97/836/EC of 27 November 1997 (OJ L 346, 17.12.1997, p. 78).

- 2.5. 'Transmission' means the combination of components comprised between the control and the brake and linking them functionally. Where the braking power is derived from or assisted by a source of energy independent of the driver but controlled by him, the reserve of energy in the device is likewise part of the transmission;
- 2.6. 'Brake' means the parts of the braking device in which the forces opposing the movement of the vehicle are developed; it may be a friction brake (when the forces are generated by friction between two parts of the vehicle moving relatively to one another), an electrical brake (when the forces are generated by electro-magnetic 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 an artificial increase in the braking action, transmitted to the wheels of the engine);
- 2.7. 'Different types of braking devices' means devices which differ in such essential respects as:
- 2.7.1. components having different characteristics,
- 2.7.2. a component made of materials having different characteristics, or a component differing in shape or size,
- 2.7.3. a different assembly of the components;
- 2.8. 'Component(s) of the braking device' means one or more of the individual parts which, when assembled, constitute the braking device;
- 2.9. 'Combined braking system' means
- 2.9.1. in the case of vehicles of categories L₁ and L₃, a system whereby at least two brakes on different wheels are actuated in combination by the operation of a single control. This method of actuation requires a control which is independent of the second braking device which operates on one wheel only;
- 2.9.2. in the case of vehicles of categories L₂ and L₅, a braking device which operates on all the wheels;
- 2.9.3. in the case of vehicles of category L₄, a braking device which operates at least on the front and rear wheel. Therefore a braking device which operates simultaneously on the rear wheel and on the sidecar wheel is regarded as a rear brake.
- 2.10. 'Progressive and graduated braking' means braking during which, within the normal operating range of the device, and whether during application or during release of the brakes,
- 2.10.1. the driver can at any moment increase or decrease the braking force by acting on the control,
- 2.10.2. the braking force varies proportionally to the action on the control (monotonic function), and,
- 2.10.3. the braking force can be easily regulated with sufficient precision;
- 2.11. 'Maximum design speed' means the speed which the vehicle cannot exceed, on the level and without undue external influence, taking into account any special limitations imposed on the design and construction of the vehicle;
- 2.12. 'Laden vehicle' means, except where otherwise stated, a vehicle so laden as to attain its 'maximum mass';
- 2.13. 'Unladen vehicle' means the vehicle alone, as submitted for the tests, plus the rider alone and any necessary test equipment or instrumentation.

- 2.14. 'Maximum mass' means the maximum mass stated by the vehicle manufacturer to be technically permissible (this mass may be higher than the 'permissible maximum mass' laid down by the national administration).
- 2.15. 'Wet brake' means a brake or brakes which has or have been treated in accordance with paragraph 1.6 of annex 3 of this Regulation.
3. APPLICATION FOR APPROVAL
- 3.1. The application for approval of a vehicle type with regard to braking shall be submitted by the vehicle manufacturer or by his duly accredited representative.
- 3.2. It shall be accompanied by the undermentioned documents in triplicate and by the following particulars:
- 3.2.1. a description of the vehicle type with regard to the items specified in paragraph 2.2 above. The numbers and/or symbols identifying the vehicle type and the engine type shall be specified;
- 3.2.2. a list of components, duly identified, constituting the braking device;
- 3.2.3. a diagram of the assembled braking device and an indication of the position of its components on the vehicle;
- 3.2.4. detailed drawings of each component to enable it to be easily located and identified.
- 3.3. A vehicle, representative of the vehicle type to be approved, shall be submitted to the technical service responsible for conducting the approval tests.
4. APPROVAL
- 4.1. If the vehicle type submitted for approval pursuant to this Regulation meets the requirements of paragraphs 5 and 6 below, approval of that vehicle type shall be granted.
- 4.2. An approval number shall be assigned to each type approved. Its first two digits (at present 01 corresponding to the series 01 of amendments which entered into force on 22 November 1990) shall indicate the series of amendments incorporating the most recent major technical amendments made to the Regulation at the time of issue of the approval. The same Contracting Party shall not assign the same number to the same vehicle type equipped with another type of braking device, or to another vehicle type.
- 4.3. Notice of approval or refusal or extension or withdrawal of approval or production definitely discontinued of a vehicle type pursuant to this Regulation shall be communicated to the Parties to the Agreement which apply this Regulation by means of a form conforming to the model in annex 1 to this Regulation.
- 4.4. There shall be affixed, conspicuously and in a readily accessible place specified on the approval form, to every vehicle conforming to a vehicle type approved under this Regulation an international approval mark consisting of:
- 4.4.1. a circle surrounding the letter 'E' followed by the distinguishing number of the country which has granted approval ⁽¹⁾;

(¹) 1 for the Federal Republic of Germany, 2 for France, 3 for Italy, 4 for the Netherlands, 5 for Sweden, 6 for Belgium, 7 for Hungary, 8 for Czechoslovakia, 9 for Spain, 10 for Yugoslavia, 11 for the United Kingdom, 12 for Austria, 13 for Luxembourg, 14 for Switzerland, 15 for the German Democratic Republic, 16 for Norway, 17 for Finland, 18 for Denmark, 19 for Romania, 20 for Poland, 21 for Portugal and 22 for the Union of Soviet Socialist Republics. Subsequent numbers shall be assigned to other countries in the chronological order in which they ratify or accede to the Agreement concerning the Adoption of Uniform Conditions of Approval and Reciprocal Recognition of Approval for Motor Vehicle Equipment and Parts, and the numbers thus assigned shall be communicated by the Secretary-General of the United Nations to the Contracting Parties to the Agreement.

- 4.4.2. the number of this Regulation, followed by the letter 'R', a dash and the approval number to the right of the circle prescribed in Paragraph 4.4.1.
- 4.5. If the vehicle conforms to a vehicle type approved, under one or more other Regulations annexed to the Agreement, in the country which has granted approval under this Regulation, the symbol prescribed in paragraph 4.4.1 need not be repeated; in such a case, the Regulation and approval numbers and the additional symbols of all the Regulations under which approval has been granted in the country which has granted approval under this Regulation shall be placed in vertical columns to the right of the symbol prescribed in paragraph 4.4.1.
- 4.6. The approval mark shall be clearly legible and be indelible.
- 4.7. The approval mark shall be placed close to or on the vehicle data plate affixed by the manufacturer.
- 4.8. Annex 2 to this Regulation gives examples of arrangements of approval marks.
5. SPECIFICATIONS
- 5.1. *General*
- 5.1.1. *Braking device*
- 5.1.1.1. The braking device shall 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 provisions of this Regulation.
- 5.1.1.2. In particular, the braking device shall be so designed, constructed and fitted as to be able to resist the corroding and ageing phenomena to which it is exposed.
- 5.1.1.3. Brake linings shall not contain asbestos.
- 5.1.2. *Functions of the braking device*
- The braking device defined in paragraph 2.3 above must fulfil the following functions:
- 5.1.2.1. *Service braking*
- The service braking must make it possible 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.
- 5.1.2.2. *Secondary braking (if fitted)*
- The secondary (emergency) braking must make it possible to halt the vehicle within a reasonable distance in the event of 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 purpose of these provisions it is assumed that not more than one failure of the service braking can occur at one time.
- 5.1.2.3. *Parking brake (if fitted)*
- The Parking braking must make it possible to hold the vehicle 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.

5.2. *Characteristics of Braking Devices*

- 5.2.1. Every vehicle of categories L₁ and L₃ shall be equipped with two service braking devices, with independent controls and transmissions, one acting at least on the front wheel and the other at least on the rear wheel.
- 5.2.1.1. The two service braking devices may have a common brake so long as a failure in one braking device does not affect the performance of the other. Certain parts such as the brake itself, the brake cylinders and their pistons (except the seals), the push rods and the cam assemblies of the brakes, shall not be regarded as liable to breakage if they are amply dimensioned, are readily accessible for maintenance and exhibit sufficient safety features.
- 5.2.1.2. A parking braking device is not compulsory.
- 5.2.2. Every vehicle of category L₄ shall be equipped with the braking devices which would be required if it had no sidecar; if these devices enable the required level of performance to be achieved in tests of the vehicle with sidecar, a brake on the sidecar wheel shall not be required; a parking braking device is not compulsory.
- 5.2.3. Every vehicle of category L₂ shall be equipped:
- 5.2.3.1. with either two independent service braking devices which together actuate the brakes on all the wheels, or
- 5.2.3.2. with a service braking device which operates on all the wheels and a secondary (emergency) braking device which may be the parking brake.
- 5.2.3.3. In addition, every vehicle of category L₂ shall be equipped with a parking brake device acting on the wheel or wheels of at least one axle. The parking brake device, which may be one of the two devices specified in paragraph 5.2.3.1 above, must be independent of the device acting on the other axle or axles.
- 5.2.4. Every vehicle of category L₅ shall be equipped:
- 5.2.4.1. with a foot-controlled service braking device which operates on all the wheels, and a secondary (emergency) braking device which may be the parking brake, and
- 5.2.4.2. with a parking braking device acting on the wheels of at least one axle. The control of the parking braking device must be independent of the control of the service braking device.
- 5.2.5. The braking devices must act on brake surfaces permanently connected to the wheels either rigidly or through components unlikely to fail.
- 5.2.6. The component parts of all braking devices, where attached to the vehicle, shall be so secured that the braking devices do not fail in their function under normal operating conditions.
- 5.2.7. The braking devices shall operate freely when correctly lubricated and adjusted.
- 5.2.7.1. Wear of the brakes must be capable of being easily taken up by means of either manual or automatic adjustment. The brakes shall be capable of being adjusted to an efficient operating position until the brake linings have worn to the point of requiring replacement.
- 5.2.7.2. 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 and the brake linings have reached maximum permitted degree of wear, effective braking is ensured without immediate adjustment being necessary.

- 5.2.7.3. When correctly adjusted, the components of a braking device shall not, when operated, contact anything other than the intended parts.
- 5.2.8. In braking devices where the transmission is hydraulic, the receptacles containing the reserve fluid must be so designed and constructed that the level of the reserve fluid can be easily checked.
6. TESTS
- Braking tests which the vehicles submitted for approval are required to undergo, and the braking performance required, are prescribed in annex 3 to this Regulation.
7. MODIFICATIONS OF VEHICLE TYPE OR BRAKING DEVICE AND EXTENSION OF APPROVAL
- 7.1. Every modification of the vehicle type or of its braking device shall be communicated to the administrative department which approved the vehicle type. That department may then either:
- 7.1.1. consider that the modifications made are unlikely to have an appreciable adverse effect and that in any case the vehicle still complies with the requirements; or
- 7.1.2. require a further test report from the technical service responsible for conducting the tests.
- 7.2. Confirmation or refusal of approval, specifying the alterations, shall be communicated, by the procedure specified in paragraph 4.3 above, to the Parties to the Agreement which apply this Regulation.
- 7.3. The competent authority issuing the extension of approval shall assign a series number to each communication form drawn up for such an extension.
8. CONFORMITY OF PRODUCTION
- 8.1. Vehicle (device) approved to this Regulation shall be so manufactured as to conform to the type approved by meeting the requirements set forth in paragraph 5 above.
- 8.2. In order to verify that the requirements of paragraph 8.1 are met, suitable controls of the production shall be carried out.
- 8.3. The holder of the approval shall in particular:
- 8.3.1. ensure existence of procedures for the effective control of the quality of products,
- 8.3.2. have access to the control equipment necessary for checking the conformity to each approved type,
- 8.3.3. ensure that data of test results are recorded and that annexed documents shall remain available for a period to be determined in accordance with the administrative service,
- 8.3.4. analyse the results of each type of test, in order to verify and ensure the stability of the product characteristics making allowance for variation of an industrial production,
- 8.3.5. ensure that for each type of product at least the tests prescribed in annexes 3 and 4 to this Regulation are carried out,

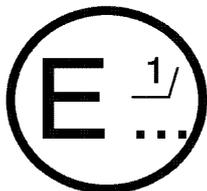
- 8.3.6. ensure that any sampling of samples or test pieces giving evidence of non-conformity with the type of test considered shall give rise to another sampling and another test. All the necessary steps shall be taken to re-establish the conformity of the corresponding production.
- 8.4. The competent authority which has granted type approval may at any time verify the conformity control methods applicable to each production unit.
- 8.4.1. In every inspection, the test books and production survey records shall be presented to the visiting inspector.
- 8.4.2. The inspector may take samples at random which will be tested in the manufacturer's laboratory. The minimum number of samples may be determined according to the results of the manufacturer's own verification.
- 8.4.3. When the quality level appears unsatisfactory or when it seems necessary to verify the validity of the tests carried out in application of paragraph 8.4.2, the inspector shall select samples to be sent to the technical service which has conducted the type-approval tests.
- 8.4.4. The competent authority may carry out any test prescribed in this Regulation.
- 8.4.5. The normal frequency of inspections authorized by the competent authority shall be once every two years. In the case where negative results are recorded during one of these visits, the competent authority shall ensure that all necessary steps are taken to re-establish the conformity of production as rapidly as possible.
9. TRANSITIONAL PROVISIONS
- 9.1. As from the official date of entry into force of the 01 series of amendments to this Regulation, no Contracting Party applying this Regulation shall refuse an application for approval under this Regulation as amended by the 01 series of amendments. At the request of the manufacturer, Contracting Parties applying this Regulation may agree to the application of these amendments before the official date of their entry into force.
- 9.2. As from 24 months after the official date of entry into force mentioned in paragraph 9.1 above, Contracting Parties applying this Regulation shall grant approvals only if the type of vehicle corresponds to the requirements of the Regulation as amended by the 01 series of amendments.
- 9.3. Approvals granted before the end of the 24-month period following the official date of entry into force shall cease to be valid 48 months after the date of entry into force mentioned in paragraph 9.1, unless the Contracting Party which granted the approval notifies the other Contracting Parties applying this Regulation that the type-approved vehicle meets the requirements of this Regulation as amended by the 01 series of amendments.
- 9.4. Approvals granted to vehicles of category L in accordance with the 05 series of amendments to Regulation No 13 continue to be considered equivalent to approvals granted in accordance with the original text of this Regulation.
10. PENALTIES FOR NON-CONFORMITY OF PRODUCTION
- 10.1. The approval granted in respect of a vehicle type pursuant to this Regulation may be withdrawn if the requirements laid down in paragraph 8.1 above are not complied with or if a vehicle of this type has failed to pass the checks prescribed in paragraph 8.3 above.

- 10.2. If a Party to the Agreement which applies this Regulation withdraws an approval it has previously granted, it shall forthwith so notify the other Contracting Parties applying this Regulation, by means of a copy of the approval form bearing at the end, in large letters, the signed and dated annotation 'APPROVAL WITHDRAWN'.
11. PRODUCTION DEFINITELY DISCONTINUED
- If the holder of the approval completely ceases to manufacture a type of vehicle approved in accordance with this Regulation, he shall so inform the authority which granted the approval. Upon receiving the relevant communication, that authority shall inform thereof the other Parties to the Agreement applying this Regulation by means of a copy of the approval form bearing at the end, in large letters, the signed and dated annotation 'PRODUCTION DISCONTINUED'.
12. TRANSITIONAL PROVISIONS
- 12.1. No Contracting Party shall refuse to grant approvals under this Regulation as amended by the 02 series of amendments.
- 12.2. As from 1 January 1995 Contracting Parties applying this Regulation shall grant approvals only if the vehicle type approved meets the requirements of this Regulation as amended by the 02 series of amendments.
- 12.3. As from 1 January 1997, Contracting Parties applying this Regulation may refuse first national registration (first entry into service) of a vehicle which does not meet the requirements of the 02 series of amendments to this Regulation.
13. NAMES AND ADDRESSES OF TECHNICAL SERVICES RESPONSIBLE FOR CONDUCTING APPROVAL TESTS AND OF ADMINISTRATIVE DEPARTMENTS
- Agreement applying this Regulation shall communicate to the United Nations Secretariat the names and addresses of the technical services responsible for conducting approval tests and of administrative departments which grant approval and to which forms certifying approval or extension or refusal or withdrawal of approval, issued in other countries, are to be sent.
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ANNEX 1 (*)

COMMUNICATION

(Maximum format: A4 (210 × 297 mm))



Issued by: Name of administration (1)

.....
.....
.....

concerning (2) APPROVAL GRANTED

APPROVAL EXTENDED

APPROVAL REFUSED

APPROVAL WITHDRAWN

PRODUCTION DEFINITELY DISCONTINUED

of a type of vehicle of category L with regard to braking pursuant to Regulation No 78

Approval No Extension No

1. Trade name or mark of the vehicle:

2. Vehicle type designation by the manufacturer:

3. Name and address of the manufacturer:

4. Name and address of the manufacturer's representative (if applicable):

5. Summarized description:

5.1. Vehicle:

Category of vehicle:

Maximum mass of vehicle:

5.2. Engine:

5.3. Transmission:

Number and ratios of gears:

Final drive ratio:

Tyre dimensions:

(*) At the request of (an) applicant(s) for Regulation No 90 approval, the information shall be provided by the Type Approval Authority, as contained in appendix 1 to this annex. However, this information shall not be provided for purposes other than Regulation No 90 approvals.

(1) Distinguishing number of the country which has granted/extended/refused/withdrawn approval (see approval provisions in the Regulation).

(2) Strike out what does not apply.

- 5.4. Braking device:
- Make(s) and type(s) of linings:
- Service brake(s) (front, rear, combined) ⁽¹⁾
- Secondary braking, parking brake (if applicable) ⁽¹⁾
- Other devices (anti-lock brakes, etc.)
- 6. Technical service conducting approval tests:
- 7. Date of test report:
- 8. Number of test report:
- 9. Reason for extension of approval (if applicable):
-
- 10. Other remarks (if applicable), (right or left hand driven):
- 11. Place:
- 12. Date:
- 13. Signature:
- 14. Annexed the list of parts constituting the approval documents, which can be obtained on request, submitted to the Administrative Service which has delivered the approval.

⁽¹⁾ Strike out what does not apply.

Appendix 1

List of vehicle data for the purpose of Regulation No 90 approvals (*)

1. Description of the vehicle type:
- 1.1. Trade name or mark of the vehicle, if available:
- 1.2. Vehicle category:
- 1.3. Vehicle type according to Regulation No 78 approval:
- 1.4. Models or trade names of vehicles constituting the vehicle type, if available:
- 1.5. Manufacturer's name and address:
2. Make and type of brake linings:
3. Minimum mass of vehicle:
- 3.1. Distribution of mass of each axle (maximum value):
4. Maximum mass of vehicle:
- 4.1. Distribution of mass of each axle (maximum value):
5. Maximum vehicle speed: km/h
6. Tyre and wheel dimensions:
7. Configuration of the independent braking systems:
8. Specifications of brake valves (if applicable):
- 8.1. Adjustment specifications of the load sensing valve:
- 8.2. Setting of pressure valve:
9. Specification of brake:
- 9.1. Disc brake type (e.g. number of pistons with diameter(s), ventilated or solid disc):
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- 9.2. Drum brake type (e.g. simplex, with piston size and drum dimensions):
10. Master cylinder type and size (if applicable):

(*) At the request of (an) applicant(s) for Regulation No 90 approval, the information shall be provided by the Type Approval Authority, as contained in appendix 1 to this annex. However, this information shall not be provided for purposes other than Regulation No 90 approvals.

ANNEX 2

ARRANGEMENTS OF APPROVAL MARKS

Model A

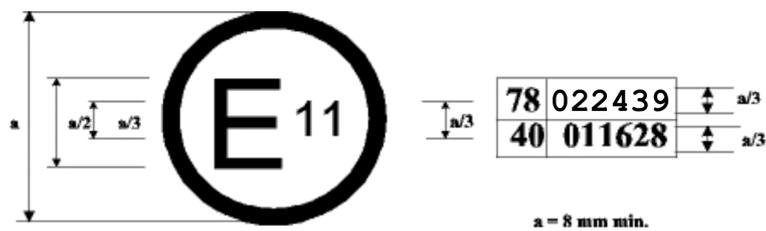
(see paragraph 4.4 of this Regulation)



The above approval mark affixed to a vehicle shows that the vehicle type concerned has, with regard to braking, been approved in the United Kingdom (E 11) pursuant to Regulation No 78 under approval number 022439. The first two digits of the approval number indicate that Regulation No 78 already included the 02 series of amendments when the approval was granted.

Model B

(see paragraph 4.5 of this Regulation)



The above approval mark affixed to a vehicle shows that the vehicle type concerned has been approved in the United Kingdom (E 11) pursuant to Regulations Nos 78 and 40 ⁽¹⁾. The first two digits of the approval numbers indicate that, at the dates when the respective approvals were granted, Regulation No 78 included the 02 series of amendments and Regulation No 40 included the 01 series of amendments.

⁽¹⁾ This latter number is given merely as an example.

ANNEX 3

BRAKING TESTS AND PERFORMANCE

1. BRAKING TESTS

1.1. *General*

1.1.1. The performance prescribed for braking devices shall be based on the stopping distance and/or the mean fully developed deceleration. The performance of a braking device shall be determined by measuring the stopping distance in relation to the initial speed of the vehicle and/or measuring the mean fully developed deceleration during the test.

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 braking system until the moment when the vehicle stops; the initial vehicle speed, V_1 , shall be the speed at the moment when the driver begins to actuate the control of the braking system; the initial speed shall not be less than 98 per cent of the prescribed speed for the test in question. The mean fully developed deceleration (d_m) shall be calculated as the deceleration averaged with respect to distance over the interval V_b to V_e according to the following formula:

$$d_m = \frac{V_b^2 - V_e^2}{25,92 (s_e - s_b)} \text{ m/s}^2$$

Where:

d_m = mean fully developed deceleration

V_1 = as defined above

V_b = vehicle speed at 0,8 V_1 in km/h

V_e = vehicle speed at 0,1 V_1 in km/h

s_b = distance travelled between V_1 and V_b in metres

s_e = distance travelled between V_1 and V_e in metres

The speed and distance shall be determined using instrumentation having an accuracy of ± 1 per cent at the prescribed speed for the test. The ' d_m ' may be determined by other methods than the measurement of speed and distance; in this case, the accuracy of the ' d_m ' shall be within ± 3 per cent.

1.2. For the approval of the vehicle, the braking performance shall be measured during road tests conducted under the following conditions:

1.2.1. the vehicle's condition as regards its mass shall be as prescribed for each type of test and shall be specified in the test report;

1.2.2. the test shall be carried out at the speed and in the manner prescribed for each type of test: if the maximum speed of the vehicle does not conform to the speed prescribed, the test shall be carried out under the special, alternative conditions provided;

1.2.3. the prescribed performance must be obtained without locking of the wheel(s), without deviation of the vehicle from its course and without any abnormal vibration;

1.2.4. 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.

1.3. *Test Conditions*

1.3.1. The service braking tests shall be carried out under the following conditions:

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

1.3.1.2. the vehicle shall be loaded, when required to be tested in the laden condition, with the weight distributed in accordance with the manufacturer's requirement;

1.3.1.3. for all type-O tests 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.

- 1.3.1.4. the driver shall be seated in the saddle as for normal driving and shall maintain the same position throughout the test;
- 1.3.1.5. the test area must be level, dry and have a surface affording good adhesion;
- 1.3.1.6. the tests must be performed when there is no wind liable to affect the test result.
- 1.4. *Type-O test (service braking)*
- 1.4.1. **General**
- The limits prescribed for minimum performance are those laid down hereunder for each category of vehicle; the vehicle shall satisfy both the prescribed stopping distance and the prescribed mean fully developed deceleration for the relevant vehicle category, but it may not be necessary to measure both parameters
- 1.4.2. **Type-O test with engine disconnected**
- 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. In the case of vehicles where the two service brakes can be applied separately, the braking devices shall be tested separately. The minimum performance for each braking device for each category of vehicle must be attained;
- 1.4.2.1. in the case of a vehicle with a manual gear box or an automatic transmission where the gear box can be disengaged manually, the tests shall be carried out with the gear box inoperative and/or the engine disconnected by clutch disengagement or otherwise;
- 1.4.2.2. in the case of a vehicle with other types of automatic transmission, the tests shall be carried out under the normal operating conditions.
- 1.4.3. **Type-O test with engine connected for vehicles of categories L₃, L₄ and L₅**
- Tests must be carried out in the unladen condition at various speeds, the lowest being equal to 30 % of the maximum speed of the vehicle and the highest being equal to 80 % of that speed or 160 km/h whichever is the lower.
- The maximum practical performance figures shall be measured and together with the behaviour of the vehicle must be recorded in the test report.
- In the case where two service braking devices can be applied separately, both these braking devices shall be tested together and simultaneously, with the vehicle unladen.
- 1.4.4. **Type-O test with engine disconnected: with wet brakes**
- This test shall (subject to the exemption contained in paragraph 1.5.1 below) be carried out on vehicles of categories L₁, L₂, L₃ and L₄. The test procedure is identical to that for the type-O test with engine disconnected, except for the provisions for wetting the brakes described in paragraph 1.5 of this annex.
- 1.5. *Special provisions relating to testing with wet brakes*
- 1.5.1. Enclosed brakes: it shall not be necessary to carry out this series of type-O tests on vehicles equipped with conventional drum brakes or with fully enclosed disc brakes which are not subject to water penetration under normal running conditions.
- 1.5.2. The test with brakes subject to wetting shall be carried out under the same conditions as the test with dry brakes. There shall be no adjustment or alteration of the braking system other than fitting the equipment to allow brake wetting.
- 1.5.3. The test equipment shall continuously wet the brakes for each test run at a flow rate of 15 l/h for each brake. Two disc brakes on one wheel will be considered as two brakes.
- 1.5.4. For exposed or partly exposed disc brakes, the prescribed amount of water shall be directed on to the rotating disc in such a manner that it is equally distributed on the surface or surfaces of the disc swept by the friction pad or pads:
- 1.5.4.1. for fully exposed disc brakes, the water shall be directed on to the surface(s) of the disc 45° in advance of the friction pad(s);

- 1.5.4.2. for partly exposed disc brakes, the water shall be directed on to the surface(s) of the disc 45° in advance of the shield or baffle.
- 1.5.4.3. The water shall be directed on the surface(s) of the disc(s) in a continuous jet, in a direction perpendicular to the surface of the disc, from single jet nozzles so positioned as to be between the inner extremity and a point two thirds of the distance from the outer extremity of that part of the disc swept by the friction pad(s) (see figure in appendix).
- 1.5.5. For fully enclosed disc brakes, where the provisions of paragraph 1.5.1 above do not apply, the water shall be directed on to both sides of the shield or baffle at a point and in a manner corresponding with that described in subparagraphs 1.5.4.1 and 1.5.4.3 of this annex. Where the nozzle would be coincident with a ventilation or inspection port, the water shall be applied one quarter of a revolution in advance of the said port.
- 1.5.6. Where in the preceding paragraphs 1.5.3 and 1.5.4, it is not possible to apply the water in the position specified owing to the presence of some fixed part of the vehicle, the water shall be applied at the first point, exceeding 45° where uninterrupted application is possible.
- 1.5.7. For drum brakes, where the provisions of paragraph 1.5.1 above do not apply, the prescribed amount of water shall be distributed equally on either side of the braking device (that is, on the stationary back plate and the rotating drum) from nozzles so positioned as to be two-thirds of the distance from the outer circumference of the rotating drum to the wheel hub.
- 1.5.8. Subject to the requirements of the preceding subparagraph and to the requirement that no nozzle shall be within 15° of or coincident with a ventilation or inspection port on the stationary back plate, the test equipment for drum brakes shall be so positioned as to obtain the optimum uninterrupted application of water.
- 1.5.9. To ensure the correct wetting of the brake(s), the vehicle shall be driven, immediately before the commencement of the test series
- with the wetting equipment functioning continuously as prescribed in this annex
 - at the prescribed test speed
 - without the operation of the braking device(s) to be tested
- For a distance of not less than 500 m prior to the point at which the test is to be carried out.
- 1.6. *Type-I test (fade test)*
- 1.6.1. *Special provisions*
- 1.6.1.1. The service brakes of all vehicles of categories L₃, L₄ and L₅ must be tested by a series of repeated stops, the vehicle being in the laden condition, in accordance with the requirements set out below (table under paragraph 2). For vehicles equipped with a combined braking system, it will be sufficient to submit this service braking device to the type-I test.
- 1.6.1.2. The type-I test shall be carried out in three parts:
- 1.6.1.2.1. a single type-O test as required by paragraphs 2.1.2 or 2.2.2.1 of this annex;
 - 1.6.1.2.2. a series of 10 repeated stops carried out in accordance with the requirements of paragraph 1.6.2 below;
 - 1.6.1.2.3. a single type-O test, carried out in the same conditions (and in particular at a control force as constant as possible of which the mean value is no greater than the mean force actually used in paragraph 1.6.1.2.1) as those used for the test in subparagraph 1.6.1.2.1 above as soon as possible after the completion of the test specified in subparagraph 1.6.1.2.2 above but, in any case, within one minute thereof.
- 1.6.2. *Test conditions*
- 1.6.2.1. The vehicle and the brake(s) to be tested shall be substantially free from moisture and the brake(s) shall be cold (< 100 °C).
- 1.6.2.2. The initial test speed shall be:
- 1.6.2.2.1. for testing the front brake(s)
- whichever is the lower of 70 % of the vehicle's maximum speed and 100 km/h;

- 1.6.2.2.2. for testing the rear brake(s)
whichever is the lower of 70 % of the vehicle's maximum speed and 80 km/h;
- 1.6.2.2.3. for testing a combined braking system
whichever is the lower of 70 % of the vehicle's maximum speed and 100 km/h.
- 1.6.2.3. The distance between the initiation of one stop and the initiation of the next shall be 1 000 meters.
- 1.6.2.4. The use of the gear box and/or clutch shall be as follows:
- 1.6.2.4.1. In the case of a vehicle with a manual gear box or an automatic transmission where the gear box can be disengaged manually, the highest gear, consistent with attaining the initial test speed, shall be engaged during the stops.

When the vehicle speed has fallen to 50 % of the initial test speed, the engine shall be disengaged.
- 1.6.2.4.2. In the case of a vehicle with a fully automatic transmission, the test shall be carried out under the normal operating conditions for such equipment.

For the approach, the gear suitable to the initial test speed shall be used.
- 1.6.2.5. After each stop, the vehicle shall immediately be subjected to maximum acceleration to reach the initial test speed and maintained at that speed until the initiation of the next stop. If appropriate, the vehicle may be turned round on the test track before acceleration.
- 1.6.2.6. The force applied to the control must be so adjusted as to maintain a mean deceleration of 3 m/s² or the maximum deceleration achievable with that brake, whichever is the lower, at the first stop: this force must remain constant throughout the succeeding stops required by subparagraph 1.6.1.2.2 above.
- 1.6.3. **Residual performance**

At the end of the type-I test the residual performance of the service braking device must be measured in the same conditions (and in particular at a control force as constant as possible, the mean value of which is not greater than the mean force actually used) as for the type-O test with the engine disconnected (the temperature conditions may be different).

This residual performance must not be:
- if expressed as a deceleration, less than 60 % of the deceleration figure achieved during the type-O test
 - if expressed as a stopping distance, more than the stopping distance figure, calculated in accordance with the following formula:

$$S_2 \leq 1,67 S_1 - 0,67 a \cdot V$$

where

S_1 = the stopping distance achieved in the Type-O test

S_2 = the stopping distance as recorded in the residual performance test

a = 0,1

V = the initial speed at the beginning of braking as defined in paragraph 2.1.1 or 2.2.1 of this annex.

2. PERFORMANCE OF BRAKING DEVICES

2.1. Provisions relating to tests of vehicles with braking devices operating on the wheel or wheels of the front or rear axle only.

2.1.1. Prescribed speed

$V = 40 \text{ km/h}$ ⁽¹⁾ for categories L₁ and L₂,

$V = 60 \text{ km/h}$ ⁽¹⁾ for categories L₃ and L₄.

2.1.2. Braking performance with the vehicle laden

For the purposes of the type-I residual performance test (vehicles of categories L₃ and L₄), the recorded performance levels in terms of stopping distances, mean fully developed deceleration, as well as the control force used, shall be recorded.

2.1.2.1. Braking with the front brake only

Category	Stopping distance (S) (m)	Corresponding mean fully developed deceleration (m/s ²)
L ₁	$S \leq 0,1 \cdot V + V^2/90$	3,4
L ₂	$S \leq 0,1 \cdot V + V^2/70$	2,7 (*)
L ₃	$S \leq 0,1 \cdot V + V^2/115$	4,4 (*)
L ₄	$S \leq 0,1 \cdot V + V^2/95$	3,6

2.1.2.2. Braking with the rear brake only

Category	Stopping distance (S) (m)	Corresponding mean fully developed deceleration (m/s ²)
L ₁	$S \leq 0,1 \cdot V + V^2/70$	2,7
L ₂	$S \leq 0,1 \cdot V + V^2/70$	2,7 (*)
L ₃	$S \leq 0,1 \cdot V + V^2/75$	2,9 (*)
L ₄	$S \leq 0,1 \cdot V + V^2/95$	3,6

2.1.3. Braking performance with the vehicle unladen

A practical test of the vehicle ridden by the driver alone shall not be required if a calculation shows that the distribution of the mass on the braked wheels allows a mean fully developed deceleration of at least $2,5 \text{ m/s}^2$ or a stopping distance $S \leq 0,1 \cdot V + V^2/65$ to be achieved with each of the single axle braking devices.

2.2. Provisions relating to tests of vehicles of which (at least) one of the braking devices is a combined braking system.

For the purposes of the type-I residual performance test (vehicles of categories L₃, L₄ and L₅), the recorded performance levels in terms of stopping distance, mean fully developed deceleration, as well as the control force used, shall be recorded.

2.2.1. Prescribed speed

$V = 40 \text{ km/h}$ ⁽¹⁾ for categories L₁ and L₂,

$V = 60 \text{ km/h}$ ⁽¹⁾ for categories L₃, L₄ and L₅.

⁽¹⁾ Vehicles of which the maximum speed (V_{max}) is lower than 45 km/h in the case of categories L₁ and L₂, or 67 km/h in the case of categories L₃ and L₄, shall be tested at a speed equal to $0,9 V_{\text{max}}$.

(*) If the values for single braking devices cannot be achieved because of limited adhesion, the following values shall be substituted for a test with the vehicle laden using both braking devices together: L₂, 4,4 m/s²; L₃, 5,8 m/s².

2.2.2. The vehicle shall be tested unladen and laden.

2.2.2.1. Braking with the combined braking system only.

Category	Stopping distance (S) (m)	Corresponding mean fully developed deceleration (m/s ²)
L ₁ , L ₂	$S \leq 0,1 \cdot V + V^2/115$	4,4
L ₃	$S \leq 0,1 \cdot V + V^2/132$	5,1
L ₄	$S \leq 0,1 \cdot V + V^2/140$	5,4
L ₅	$S \leq 0,1 \cdot V + V^2/130$	5,0

2.2.2.2. Braking with the second service or the secondary (emergency) braking device, all categories:

the stopping distance must be:

$$S \leq 0,1 \cdot V + V^2/65 \text{ (corresponding mean fully developed deceleration: } 2,5 \text{ m/s}^2\text{).}$$

2.3. Braking performance with the parking braking device (if applicable).

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

2.4. Forces applied to service brake controls:

hand control $\leq 200 \text{ N}$

foot control $\leq 350 \text{ N}$ (L₁, L₂, L₃, L₄)

$\leq 500 \text{ N}$ (L₅)

parking brake control (if applicable):

with manual control $\leq 400 \text{ N}$

with foot control $\leq 500 \text{ N}$

In the case of hand brake levers, the point of application of the manual force shall be assumed to be 50 mm from the outer end of the lever.

2.5. Performance levels (minimum and maximum) to be attained with wet brakes.

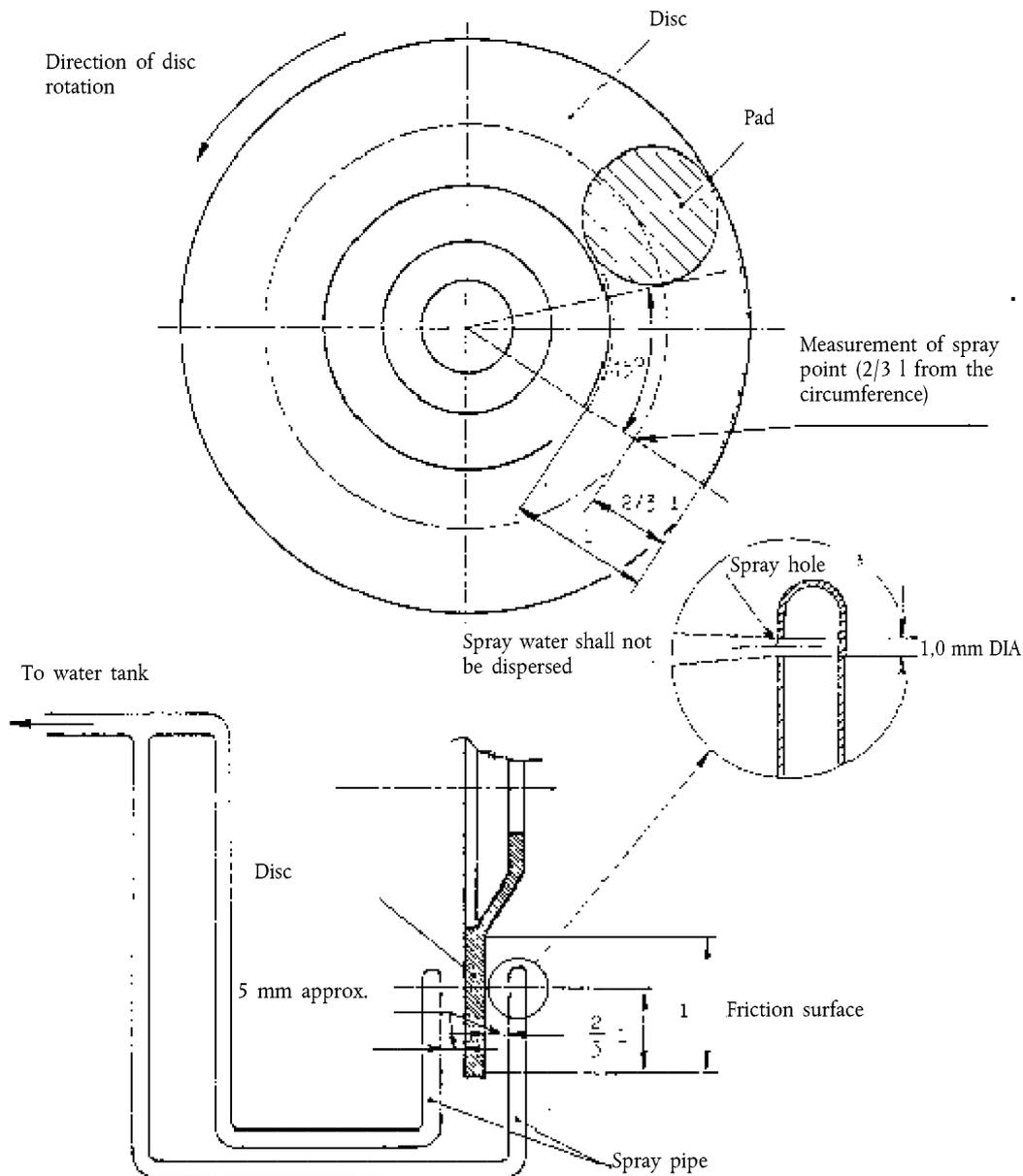
2.5.1. The mean deceleration to be attained with wet brake(s) between 0,5 and 1,0 second after application of the brake shall be at least 60 % of that attained with dry brake(s) when the same control force is applied.

2.5.2. The control force used, which must be applied as quickly as possible, shall be equivalent to that required to attain a deceleration of 2,5 m/s² with dry brake(s).

2.5.3. At no time during the type-O test with wet brake(s) shall the deceleration exceed 120 % of that attained with dry brake(s).

Appendix

Method of water application



ANNEX 4

REQUIREMENTS APPLICABLE TO VEHICLES OF CATEGORIES L₁ AND L₃ EQUIPPED WITH ANTI-LOCK DEVICES

1. GENERAL

- 1.1. The purpose of these provisions is to define minimum performances for braking systems with anti-lock devices fitted to vehicles of categories L₁ and L₃. This does not make it compulsory to fit vehicles with anti-lock devices but if such devices are fitted to a vehicle they must meet the requirements below.
- 1.2. The devices known at present comprise a sensor or sensors, a controller or controllers and a modulator or modulators. Any devices of a different design will be deemed to be anti-lock devices within the meaning of this annex if they provide performances at least equal to those prescribed by this annex.

2. DEFINITIONS

- 2.1. An 'anti-lock device' is a component of a service braking system which automatically controls the degree of slip, in the direction of rotation of the wheel(s) on one or more wheels of the vehicle during braking;
- 2.2. 'Sensor' means a component designed to identify and transmit to the controller the conditions of rotation of the wheel(s) or the dynamic conditions of the vehicle;
- 2.3. 'Controller' means a component designed to evaluate the data transmitted by the sensor(s) and to transmit a signal to the modulator;
- 2.4. 'Modulator' means a component designed to vary the braking force(s) in accordance with the signal received from the controller.

3. NATURE AND CHARACTERISTICS OF THE SYSTEM

- 3.1. Each controlled wheel shall be such that it can bring at least its own device into operation.
- 3.2. Any break in the supply of electricity to the device and/or in the wiring external to the electronic controller(s) shall be signalled to the driver by an optical warning signal, which must be visible even in daylight; it must be easy for the driver to check that it is in working order ⁽¹⁾.
- 3.3. In the event of a failure in an anti-lock device, the braking efficiency of the laden vehicle shall not be less than that prescribed for whichever is the lower of the two requirements for the vehicle defined in paragraph 2.1.2.1 or paragraph 2.1.2.2 of annex 3 of this Regulation.
- 3.4. The operation of the device must not be affected adversely by electro-magnetic fields ⁽²⁾.
- 3.5. Anti-lock devices must maintain their performance when the brake is fully applied for the duration of any stop.

4. UTILIZATION OF ADHESION

4.1. *General*

- 4.1.1. In the case of vehicles of category L₃, braking systems equipped with an anti-lock device shall be deemed acceptable when the condition $\epsilon \geq 0,70$ is satisfied where ϵ represents the adhesion utilized as defined in the appendix to this annex ⁽³⁾.
- 4.1.2. The coefficient of adhesion utilization ϵ shall be measured on road surfaces with a coefficient of adhesion not exceeding 0,45 and of not less than 0,8.
- 4.1.3. Tests shall be carried out with the vehicle unladen.

⁽¹⁾ The Technical Service should examine the electronic controller and/or any drive system with regard to possible failure modes.

⁽²⁾ Until uniform test procedures have been agreed, the manufacturers shall provide the Technical Service with their test procedures and results.

⁽³⁾ For L₁ vehicles, until a minimum value for ϵ has been established, the measured value shall be recorded in the test report.

- 4.1.4. The test procedure to determine the coefficient of adhesion (K) and the formula for calculating the adhesion utilization (ϵ) shall be those prescribed in the appendix to this annex.

5. ADDITIONAL CHECKS

The following additional checks shall be carried out with the vehicle unladen.

- 5.1. Any wheel controlled by an anti-lock device must not lock when the full force ⁽¹⁾ is suddenly applied to its control device, on the two kinds of road surface specified in paragraph 4.1.2 above at initial speeds of up to $0,8 V_{\max}$ but not exceeding 80 km/h ⁽²⁾.
- 5.2. When a wheel controlled by an anti-lock device passes from a high-adhesion surface to a low-adhesion surface as described in paragraph 4.1.2 above with the full force ⁽¹⁾ applied to the control device, the wheel must not lock. The running speed and the instant of applying the brakes shall be so calculated that, with the anti-lock device fully cycling on the high-adhesion surface, the passage from one surface to the other is made at about $0,5 V_{\max}$ not exceeding 50 km/h.
- 5.3. When a vehicle passes from a low-adhesion surface to a high-adhesion surface as described in paragraph 4.1.2 above with the full force ⁽¹⁾ applied to the control device, the deceleration of the vehicle must rise to the appropriate high value within a reasonable time and the vehicle must not deviate from its initial course. The running speed and the instant of applying the brakes shall be so calculated that, with the anti-lock device fully cycling on the low-adhesion surface, the passage from one surface to the other occurs at about $0,5 V_{\max}$ not exceeding 50 km/h.
- 5.4. Where both independent braking devices are equipped with an anti-lock device, the tests prescribed in paragraphs 5.1, 5.2 and 5.3 shall also be performed using both independent braking devices together, whereupon the stability of the vehicle shall be maintained at all times.
- 5.5. However, in the tests provided for in paragraphs 5.1, 5.2, 5.3, and 5.4 above, periods of wheel locking or of extreme wheel slip shall be allowed provided that the stability of the vehicle is not adversely affected. Below vehicle speeds of 10 km/h wheel locking is permitted.

⁽¹⁾ 'Full force' means the maximum force prescribed in paragraph 2.4 of annex 3 for the category of vehicle: a higher force may be used if required to activate the anti-lock device.

⁽²⁾ On low adhesion surfaces ($\leq 0,35$) the initial speed may be reduced for safety reasons: in such cases, the K value and the initial speed shall be noted in the test report.

Appendix

1. DETERMINATION OF THE COEFFICIENT OF ADHESION (K)
 - 1.1. The coefficient of adhesion shall be determined from the maximum braking rate, without wheel lock, of the vehicle with the anti-lock device(s) disconnected and braking both wheels simultaneously ⁽¹⁾.
 - 1.2. Braking tests should be carried out by applying the brakes at an initial speed of about 60 km/h (or, in the case of vehicles unable to attain 60 km/h, at a speed of about $0,9 V_{\max}$) with the vehicle unladen (except for any necessary test instrumentation and/or safety equipment). Constant brake control forces must be used throughout the tests.
 - 1.3. A series of tests may be carried out up to the critical point reached immediately before the wheel(s) lock by varying both the front and the rear brake forces, in order to determine the maximum braking rate of the vehicle ⁽²⁾.
 - 1.4. The braking rate (Z) will be determined by reference to the time taken for the speed of the vehicle to reduce from 40 km/h to 20 km/h, using the formula:

$$Z = \frac{0,56}{t}$$

where t is measured in seconds.

Alternatively, for vehicles unable to attain 50 km/h, the braking rate shall be determined by reference to the time taken for the speed of the vehicle to reduce from $0,8 V_{\max}$ to $(0,8 V_{\max} - 20)$ where V_{\max} is measured in km/h.

The maximum value of $Z = K$.

2. DETERMINATION OF THE ADHESION UTILIZATION (ϵ)
 - 2.1. The adhesion utilized is defined as the quotient of the maximum braking rate with the anti-lock device in operation (Z_{\max}) and the maximum braking rate with the anti-lock device disconnected (Z_m). Separate tests must be carried out on each wheel equipped with an anti-lock device.
 - 2.2. Z_{\max} shall be based on the average of three tests using the time taken for the speed of the vehicle to achieve the reductions in speed specified in paragraph 1.4 above.
 - 2.3. The adhesion utilized is given by the formula:

$$\epsilon = \frac{Z_{\max}}{Z_m}$$

⁽¹⁾ Additional requirements may have to be established in the case of vehicles equipped with combined braking systems.

⁽²⁾ As an initial step, to facilitate these preliminary tests, the maximum control force applied before the critical point may be obtained for each individual wheel.