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States relating to the braking devices of certain categories of motor vehicles and of their trailers (71/320/EEC) (repealed)

[^F1^ANNEX II

Braking Tests and performance of braking systems

Textual Amendments

F1 Substituted by Commission Directive 98/12/EC of 27 January 1998 adapting to technical progress Council Directive 71/320/EEC on the approximation of the laws of the Member States relating to the braking devices of certain categories of motor vehicles and their trailers (Text with EEA relevance).

---

1.   BRAKING TESTS

1.1.   *General*

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

V_1	=	as defined above
V_b	=	vehicle speed at 0,8 V_1 km/h
V_e	=	vehicle speed at 0,1 V_1 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 % 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 %.

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 mass shall be as prescribed for each type of test and be specified in the test report, (Annex IX, Appendix 2).

1.1.3.2. The test shall 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 shall be performed at the maximum speed of the vehicle.

1.1.3.3. During the tests, the force applied to the control of the braking system in order to obtain the prescribed performance shall not exceed the maximum force laid down for the test vehicle's category.

1.1.3.4. Without prejudice to the requirements contained in point 1.1.4.2, the road shall possess a surface having good adhesion.

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

1.1.3.6. At the start of the tests the tyres shall 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 shall be obtained without locking of the wheels, without deviation of the vehicle from its course, and without abnormal vibration. Wheel-locking is permitted where specifically mentioned.

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 shall be checked.

1.1.4.2. The braking behaviour of vehicles of categories M, N, O_3 and O_4 on a road surface having reduced adhesion shall fulfil the conditions laid down in the Appendix to this Annex.

1.2. *Type O test* (ordinary performance test with brakes cold)

1.2.1. *General*

1.2.1.1. The brakes shall 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 shall be conducted in the following conditions:

1.2.1.2.1. The vehicle shall be laden, the distribution of its mass among the axles being that stated by the manufacturer. Where provision is made for several arrangements of the load on the axles the distribution of the maximum mass among the axles shall be such that the load on each axle is proportional to the maximum permissible load for each axle; in the case of tractive units for semi-trailers, the load may be re-positioned approximately half-way between the kingpin position resulting from the above loading conditions and the centreline of the rear axle(s).

1.2.1.2.2. Every test shall be repeated on the unladen vehicle. In the case of a motor vehicle there may be, in addition to the driver, a second person on the front seat who is responsible for noting the results of the test. In the case of a motor vehicle designed to tow a semi-trailer, the unladen tests shall be conducted with the tractive unit only, without its trailer, but carrying a load representing the fifth wheel. It will also include a load representing a spare wheel, if this is included in the standard specification of the vehicle. In the case of a vehicle presented as a bare chassis-cab, a supplementary load may be added to simulate the mass of the body, not exceeding the minimum mass declared by the manufacturer in Annex XVIII.

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, 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 actually measure both parameters.

1.2.1.2.4. The road shall be level.

1.2.2.	*Type O test with engine disconnected*

1.2.2.1.	The test shall 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 shall be attained.

1.2.3.	*Type 0 test with engine connected*

1.2.3.1.	Apart from the test prescribed in point 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 maximum practical performance figures shall be measured and the behaviour of the vehicle shall be recorded in the test report. Tractive units for semi-trailers, artificially loaded to simulate the effects of a laden semi-trailer, shall not be tested beyond 80 km/h.

1.2.3.2.	Further tests shall be carried out with the engine connected, from the speed prescribed for the category to which the vehicle belongs. The minimum performance prescribed for each category shall be attained. Tractive units for semi-trailers, artificially loaded to simulate the effects of a laden semi-trailer, shall not be tested beyond 80 km/h.

1.2.4.	*Type 0 test for vehicle of category O equipped with compressed-air brakes*

1.2.4.1.	The braking performance of the trailer can be calculated either from the braking rate of the towing vehicle plus the trailer and the measured thrust on the coupling or, in certain cases, from the braking rate of the towing vehicle plus the trailer with only the trailer being braked. The engine of the towing vehicle shall be disconnected during the braking test. In the case where only the trailer is braked, to take account of the extra mass being retarded, the performance will be taken to be the mean fully developed deceleration.

1.2.4.2.	With the exception of cases according to points 1.2.4.3 and 1.2.4.4, it is necessary for the determination of the braking rate of the trailer to measure the braking rate of the towing vehicle plus the trailer and the thrust on the coupling. The towing vehicle shall meet the requirements laid down in the Appendix to point 1.1.4.2 of Annex II with regard to the relation between the ratio

$$\frac{TM}{PM}$$

and the pressure p_m. The braking rate of the trailer shall be calculated according to the following formula:

$$Z_R = Z_{R+M} + \frac{D}{P} R$$

where:

Z_R	=	braking rate of the trailer
Z_{R+M}	=	braking rate of the towing vehicle plus the trailer
D	=	thrust on the coupling
		(tractive force D > 0)
		(compressive force D < 0)

P_R = total normal static reaction between road surface and wheels of the trailer

1.2.4.3. If a trailer has a continuous or semi-continuous braking system where the pressure in the brake actuators does not change during braking despite the dynamic axle load shifting, and in the case of semi-trailers, the trailer alone may be braked. The braking rate of the trailer shall be calculated according to the following formula:

$$Z_R = (Z_{R+M} - R) \times \frac{(P_M + P_R)}{P} R + R$$

where:

R   = rolling resistance value = 0,01
P_M = total normal static reaction between road surface and wheels of towing vehicles for trailers

1.2.4.4. Alternatively, the evaluation of the braking rate of the trailer may be done by braking the trailer alone. In this case the pressure used shall be the same as that measured in the brake actuators during the braking of the combination.

1.3.   *Type I test* (fade test)

1.3.1.   *With repeated braking*

1.3.1.1. The service braking system of all motor vehicles 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	$\Delta t(s)$	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
N_3	80 % V_{max} ≤ 60	½ V_1	60	20

where:

V_1 = refer to point 1.1.2
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 shall be allowed in each cycle for stabilising the speed v_1.

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

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

1.3.1.5. For regaining speed after braking, the gearbox shall 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 braking system of trailers of categories O_2 and O_3 shall be tested in such a manner that, the vehicle being laden, the energy input to the brakes shall be 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 towed by a motor vehicle; during the test, the force applied to the control shall be adjusted so as to keep the resistance of the trailer constant (7 % of the maximum stationary axle load 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. *Hot performance*

1.3.3.1. At the end of the Type I test (test described in point 1.3.1 or test described in point 1.3.2 of this Annex) the hot performance of the service braking system shall be measured under the same conditions (and in particular at a constant control force no greater than the mean force actually used) as for the Type 0 test with the engine disconnected (the temperature conditions may be different). For motor vehicles, this hot performance shall not be less than 80 % of that prescribed for the category in question nor less than 60 % of the figure recorded in the Type 0 test with the engine disconnected. However in the case of trailers, the hot brake force at the periphery of the wheels when tested at 40 km/h shall not be less than 36 % of the maximum stationary wheel load, or less than 60 % of the figure recorded in the Type 0 test at the same speed.

1.3.3.2. In the case of a motor vehicle which satisfies the 60 % requirement specified in point 1.3.3.1, but which cannot comply with the 80 % requirement specified in point 1.3.3.1, a further hot performance test may be carried out using a control force not exceeding

that specified in point 2.1.1.1 of this Annex. The results of both tests are entered in the report.

1.4.   *Type II test* (downhill behaviour test)

1.4.1.   Laden motor 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 and the retarder, if the vehicle is fitted with one, being used. The gear engaged shall be such that the speed 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/s^2.

1.4.3.   At the end of the test, the hot performance of the service braking system shall be measured in the same conditions as for the Type 0 test with the engine disconnected (the temperature conditions, of course, may be different). This hot performance shall give a stopping distance not exceeding the following values and a mean fully developed deceleration not less than the following values, using a control force not exceeding 700 N:

category M$_3$:

$$s = 0{,}15\ v + \frac{1{,}33\ v^2}{130}$$

(the second term corresponding to a mean fully developed deceleration of 3,75 m/s^2);

category N$_3$:

$$s = 0{,}15\ v + \frac{1{,}33\ v^2}{115}$$

(the second term corresponding to a mean fully developed deceleration of 3,3 m/s^2).

1.5.   *Type IIA test*

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 systems shall not be engaged. The gear engaged shall be such that the speed of the engine does not exceed the maximum value prescribed by the manufacturer. An integrated retarder may be used, provided that it is suitably phased such that the service braking system is not applied; this may be verified by checking that these brakes remain cold, as defined in point 1.2.1.1 of this Annex.

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 0,6m/s^2.

1.6.   *Type III test* (Fade test for vehicles of category O_4)

1.6.1.   Track test

For the road test the conditions should be as follows:

Number of brake applications:	20
Duration of braking cycle:	60 s
Initial speed at the beginning of braking:	60 km/h
Braking applications:	corresponding to a trailer deceleration of 3 m/s^2

The braking rate of a trailer shall be calculated according to point 1.2.4.3 of this Annex:

$$z_R = (z_{R+M} - R) \times \frac{(P_M + P_R)}{P} R + R$$

The speed at the end of braking (Annex VII, appendix 1, point 3.1.5):

$$v_2 = v_1 \sqrt{\frac{P_M + P_1 + \left(\frac{P_2}{4}\right)}{P_M + P_1 + P_2}}$$

where:

Z_R	=	braking rate of the trailer
Z_{R+M}	=	braking rate of the vehicle combination (motor vehicle and trailer)
R	=	rolling resistance value = 0,01
P_M	=	total normal static reaction between the road surface and the wheels of trailer (kg)
P_R	=	total normal static reaction between the road surface and the wheels of towing vehicle for trailer (kg)
P_1	=	part of the mass of the trailer borne by the unbraked axle(s) (kg)
P_2	=	part of the mass of the trailer borne by the braked axle(s) (kg)
v_1	=	initial speed (km/h)
v_2	=	final speed (km/h)

1.6.2.   *Hot performance*

At the end of the test according to point 1.6.1, the hot performance of the service braking system shall be measured under the same conditions as for the Type 0 test with, however, different temperature conditions and starting from an initial speed of 60 km/h. The hot brake-force at the periphery of the wheels shall not be less than 40 % of the maximum stationary wheel load, and not less than 60 % of the figure recorded in the Type 0 test at the same speed.]