42-3 Dynamic Braking: Effective from 2018/1/1

Refer to: R13 11, R13H 00-S7/C1, R78 03-C2

42-3.1 Effective date and Scope:

42-3.1.1 Effective date from 2018/1/1, the new vehicle variant of category symbols M1, N1, O1, O2, L3 and L5 and from 2020/1/1 all vehicle variant of category symbols M1 and N1, shall comply with this regulation. Category symbols O1, O2, L3 and L5 conform to “42-2 Dynamic Braking”, regard as conform to this regulation.

42-3.1.1.1 As an alternative to the requirement of paragraph 42-3.5.6 and paragraph 42-3.6.9.,vehicles of categories M1 and N1 with a mass in running order more than 1,735 kg may be equipped with an electronic stability control systems or a vehicle stability function.

42-3.1.2 Effective date from 2019/1/1, the new vehicle variant of category symbols M2, M3, N2, and N3 and from 2020/1/1 the new vehicle variant of category symbols O3 and O4, shall comply with this regulation.

42-3.1.2.1 The following new vehicle could except from the requirement of paragraph 42-3.6.9 "vehicles equipped with a vehicle stability function (VSF)". However if it's equip with VSF, it shall conform to paragraph 42-3.6.9.

42-3.1.2.1.1 All vehicles of categories symbols M2, M3, N2 and N3 having more than 3 axles.

42-3.1.2.1.2 All vehicles of categories symbols O3 and O4 having more than 3 axles and not equipped with air suspension.

42-3.1.2.1.3 Vehicle of category symbol G, hydro-static driven vehicles in which the hydraulic drive system is also used for braking and auxiliary functions, vehicles have standing passengers, articulated buses and coaches, N2 tractors for semi-trailer with a gross vehicle mass (GVM) between 3.5 and 7.5 tones.

42-3.1.3 Effective date from 2021/1/1, all vehicle variant of category symbols M2, M3, N2, and N3 and from 2022/1/1 all vehicle variant of category symbols O3 and O4, shall comply with this regulation.

42-3.1.3.1 The following vehicle that confirmed to “42-2 Dynamic Braking” regard as conform to this regulation.

42-3.1.3.1.1 The vehicles of categories symbols M2, M3, N2 and N3 having more than 3 axles but not equipped with VSF.

42-3.1.3.1.2 The vehicle of categories symbols O3 and O4 have not equipped with air suspension and VSF.

42-3.1.3.1.3 Vehicle of category symbol G.

42-3.1.3.1.4 Hydro-static driven vehicles in which the hydraulic drive system is also used for braking and auxiliary functions.

42-3.1.3.1.5 Vehicles have standing passengers.

42-3.1.3.1.6 Articulated buses and coaches.

42-3.1.3.1.7 N2 tractors for semi-trailer with a gross vehicle mass (GVM) between 3.5 and 7.5 tones.

42-3.1.4 This regulation does not suitable for:

42-3.1.4.1 Vehicles with a design speed not exceeding 25km/hr.

42-3.1.4.2 Trailers which may not be coupled to power-driven vehicles with a design speed exceeding 25 km/h.

42-3.1.5 The same applicant applying for low volume safety approval and the amounts of vehicle not exceed 3 at same year and the category symbols M1, L3 or L5 of same variant and specification, could exempt from regulation of “dynamic braking”.

42-3.1.6 The same applicant applying for vehicle-by-vehicle low volume safety approval and the amounts of vehicle not exceed 20 at same year and small passenger vehicle of same type and specification, could exempt from regulation of “dynamic braking”.

42-3.1.7 The same applicant applying for vehicle-by-vehicle low volume safety approval and the amounts of vehicle not exceed 20 at same year and small passenger vehicle of same type and specification of category symbols M1 or N1, or category symbols N2, N3,

Class III or Class IV imported by organization and school could exempt from regulation of performance test of secondary braking system, energy storage devices test, paragraph 42-3.5.2.3.2.3. or paragraph 42-3.6.2.3.4.3. of “dynamic braking”.

42-3.2 Definitions

42-3.2.1 Category symbols M, N and O

42-3.2.1.1 Transmission: means the combination of components comprised between the control system and the brake and linking them functionally. 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, the reserve of energy in the system is likewise part of the transmission. The transmission is divided into 2 independent functions: the control transmission and the energy transmission. Whenever the term “transmission” is used alone in this regulation, it means both the “control transmission” and the “energy transmission.

42-3.2.1.2 Control Transmission: means the combination of the components of the transmission which control the operation of the brakes (including the control function and the necessary reserve(s) of energy).

42-3.2.1.3 Energy Transmission: means the combination of the components which supply to the brakes the necessary energy for their function (including the reserve(s) of energy necessary for the operation of the brakes).

42-3.2.1.4 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 the breakage of a coupling, the effectiveness of the braking of the remainder of the combination not being thereby destroyed.

42-3.2.1.5 Endurance Braking System: means an additional braking system having the capability to provide and to maintain a braking effect over a long period of time without a significant reduction in performance.

42-3.2.1.6 Electric Regenerative Braking: means a braking system which, during deceleration, provides for the conversion of vehicle kinetic energy into electrical energy.

42-3.2.1.6.1 Electric regenerative braking system of category A: means an electric regenerative braking system which is not part of the service braking system.

42-3.2.1.6.2 Electric regenerative braking system of category B: means an electric regenerative braking system which is part of the service braking system.

42-3.2.1.7 Automatically Commanded Braking: means a function within a complex electronic control system where actuation of the braking system(s) or brakes of certain axles is made for the purpose of generating vehicle retardation with or without a direct action of the driver, resulting from the automatic evaluation of on-board initiated information.

42-3.2.1.8 Selective Braking: means a function within a complex electronic control system where actuation of individual brakes is made by automatic means in which vehicle retardation is secondary to vehicle behaviour modification.

42-3.2.1.9 Braking signal: logic signal indicating brake activation as specified in paragraph 42-3.5.1.12 and 42-3.6.1.20.

42-3.2.1.10 Emergency braking signal: logic signal indicating emergency braking as specified in paragraph 42-3.5.1.13 and 42-3.6.1.21.

42-3.2.1.11 Full cycling: means that the anti-lock system is repeatedly modulating the brake force to prevent the directly controlled wheels from locking. Brake applications where modulation only occurs once during the stop shall not be considered to meet this definition.

42-3.2.1.12 Axle group: means multiple axles where the axle spread between one axle and its adjacent axle is equal to or less than

2.0 m. Where the axle spread between one axle and its adjacent axle is greater than 2.0 m, each individual axle shall be considered as an independent axle group.

42-3.2.1.13 "Ackerman steer angle" means the angle whose tangent is the wheelbase divided by the radius of the turn at a very low speed.

42-3.2.1.14 "Electronic Stability Control System" or "ESC System" means a system that has all of the following attributes:

42-3.2.1.14.1 That improves vehicle directional stability by at least having the ability to automatically control individually the braking torques of the left and right wheels on each axle to induce a correcting yaw moment based on the evaluation of actual vehicle behaviour in comparison with a determination of vehicle behaviour demanded by the driver;

42-3.2.1.14.2 That is computer controlled with the computer using a closed-loop algorithm to limit vehicle oversteer and to limit vehicle understeer based on the evaluation of actual vehicle behaviour in comparison with a determination of vehicle behaviour demanded by the driver;

42-3.2.1.14.3 That has a means to determine directly the value of the vehicle's yaw rate and to estimate its side-slip or side-slip derivative with respect to time;

42-3.2.1.14.4 That has a means to monitor driver steering inputs; and

42-3.2.1.14.5 That has an algorithm to determine the need, and a means to modify propulsion torque, as necessary, to assist the driver in maintaining control of the vehicle.

42-3.2.1.15 "Lateral acceleration" means the component of the acceleration vector of a point in the vehicle perpendicular to the vehicle x axis (longitudinal) and parallel to the road plane.

42-3.2.1.16 "Oversteer" means a condition in which the vehicle's yaw rate is greater than the yaw rate that would occur at the vehicle's speed as a result of the Ackerman steer angle.

42-3.2.1.17 "Side-slip or side-slip angle" means the arctangent of the ratio of the lateral velocity to the longitudinal velocity of the centre of gravity of the vehicle.

42-3.2.1.18 "Understeer" means a condition in which the vehicle's yaw rate is less than the yaw rate that would occur at the vehicle's speed as a result of the Ackerman steer angle.

42-3.2.1.19 "Yaw rate" means the rate of change of the vehicle's heading angle measured in degrees/ second of rotation about a vertical axis through the vehicle's centre of gravity.

42-3.2.1.20 "Common space" means an area on which more than one tell-tale, indicator, identification symbol, or other message may be displayed but not simultaneously.

42-3.2.1.21 "Static stability factor" means one-half the track width of a vehicle divided by the height of its center of gravity, also expressed as SSF = T/2H, where: T = track width (for vehicles with more than one track width the average is used; for axles with dual wheels, the outer wheels are used when calculating "T") and H = height of the center of gravity of the vehicle.

42-3.2.1.22 "Vehicle Stability Function" means an electronic control function for a vehicle which improves the dynamic stability of the vehicle.

42-3.2.1.22.1 A vehicle stability function includes one or both of the following:

(1) directional control

(2) roll-over control

42-3.2.1.22.2 Control functions within a vehicle stability function:

42-3.2.1.22.2.1 "Directional control" means a function within a vehicle stability function that assists the driver, in the event of under steer and over steer conditions, within the physical limits of the vehicle in maintaining the direction intended by the driver in the case of a power-driven vehicle, and assists in maintaining the direction of the trailer with that of the towing vehicle in the case of a trailer.

42-3.2.1.22.3 "Roll-over control" means a function within a vehicle stability function that reacts to an impending roll-over in order to stabilise the power-driven vehicle or towing vehicle and trailer combination or the trailer during dynamic manoeuvres within the physical limits of the vehicle.

42-3.2.1.23 “Mass of a vehicle in running order” means the mass of an unladen vehicle with bodywork, and with coupling device in the case of a towing vehicle, or the mass of the chassis with cab if the manufacturer does not fit the bodywork and/or coupling device, including coolant, oils, 90 per cent of fuel, 100 per cent of other liquids except used waters, tools, spare wheel, driver (75 kg) and, for buses and coaches, the mass of the crew member (75 kg) if there is a crew seat in the vehicle.

42-3.2.2 Category symbols L

42-3.2.2.1 Baseline test: means a stop or a series of stops carried out in order to confirm the performance of the brake prior to subjecting it to a further test such as the heating procedure or wet brake stop.

42-3.2.2.2 Brake: means those parts of the brake system where the forces opposing the movement of the vehicle are developed.

42-3.2.2.3 Brake system: means the combination of parts consisting of the control, transmission, and brake, but excluding the engine, whose function it is to progressively reduce the speed of a moving vehicle, bring it to a halt, and keep it stationary when halted.

42-3.2.2.4 "Combined braking system" means 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. For vehicle categories L2 and L5: a service brake system where the brakes on all wheels are operated by the actuation of a single control.

42-3.2.2.5 Components of the braking system: means one of the individual parts which, when assembled, constitute the braking system.

42-3.2.2.6 Control: means the part actuated directly by the rider in order to supply or control the energy required for braking the vehicle to the transmission.

42-3.2.2.7 Different types of braking systems: means devices which differ in such essential respects as:

(a) Components having different characteristics;

(b) A component made of materials having different characteristics, or a component differing in shape or size;

(c) A different assembly of the components.

42-3.2.2.8 Driver mass: means the nominal mass of a driver that shall be 75 kg (subdivided into 68 kg occupant mass at the seat and 7 kg luggage mass).

42-3.2.2.9 Engine disconnected: means when the engine is no longer connected to the driving wheel(s).

42-3.2.2.10 Gross vehicle mass or maximum mass: means the technically permissible maximum laden mass as declared by the manufacturer.

42-3.2.2.11 Initial brake temperature: means the temperature of the hottest brake before any brake application.

42-3.2.2.12 Laden: means so loaded as to attain the gross vehicle mass as defined in paragraph 2.12.

42-3.2.2.13 Lightly loaded: means mass in running order plus 15 kg for test equipment, or the laden condition, whichever is less. In

the case of ABS tests on a low friction surface, the mass for test equipment is increased to 30 kg to account for outriggers.

42-3.2.2.14 Mass in running order: means the sum of the unladen vehicle mass and driver mass.

42-3.2.2.15 Peak braking coefficient (PBC): means the measure of tyre to road surface friction based on the maximum deceleration of a rolling tyre.

42-3.2.2.16 Power-assisted braking system: means a brake system in which the energy necessary to produce the braking force is supplied by the physical effort of the rider assisted by one or more energy supplying devices, for example vacuum assisted (with vacuum booster).

42-3.2.2.17 Secondary brake system: means the second service brake system on a vehicle equipped with a combined brake system.

42-3.2.2.18 Service brake system: means a brake system which is used for slowing the vehicle when in motion.

42-3.2.2.19 Single brake system: means a brake system which acts on only one axle

42-3.2.2.20 Split service brake system (SSBS): means a brake system that operates the brakes on all wheels, consisting of two or more subsystems actuated by a single control designed so that a single failure in any subsystem (such as a leakage type failure of a hydraulic subsystem) does not impair the operation of any other subsystem.

42-3.2.2.21 Stopping distance: means the distance travelled by the vehicle from the point the rider begins to actuate the brake control to the point at which the vehicle reaches a full stop. For tests where the simultaneous actuation of two controls is specified, the distance travelled is taken from the point the first control is actuated.

42-3.2.2.22 Test speed: means the vehicle speed measured the moment the driver begins to actuate the brake control(s). For tests where the simultaneous actuation of two controls is specified, the vehicle speed is taken from the point the first control is actuated.

42-3.2.2.23 Transmission: means the combination of components that provide the functional link between the control and the brake.

42-3.2.2.24 Unladen vehicle mass: means the nominal mass of the vehicle as indicated by the manufacturer(s) including all factory fitted equipment for normal operation of that vehicle (e.g. fire extinguisher, tools, spare wheel), plus coolant, oils, 90 per cent of fuel and 100 per cent of other gas or liquids, as specified by the manufacturer.

42-3.2.2.25 Vmax: means either the speed attainable by accelerating at a maximum rate from a standing start for a distance of 1.6 km on a level surface, with the vehicle lightly loaded, or the speed measured in accordance with ISO 7117:1995. Both of them can measured the maximum rate till 180 km/h.

42-3.2.2.26 Wheel lock: means the condition that occurs when there is a slip ratio of 1.00.

42-3.3 Dynamic Braking shall according to suitable types and range of principle are as below：

42-3.3.1 The same vehicle category symbol.

42-3.3.2 The same axle set type.

42-3.3.3 The same brand and vehicle type series.

42-3.3.4 The chassis vehicle have had same axle set type

42-3.3.5 The same chassis brand.

42-3.3.6 Chassis manufacturers announced that the same chassis vehicle type series.

42-3.3.7 If use chassis vehicle instead of completed vehicle for entire or partial testing, which shall according to suitable types and range of principle are as below：

42-3.3.7.1 The chassis vehicle have had same axle set type.

42-3.3.7.2 The same brand.

42-3.3.7.3 Chassis manufacturers announced that the same chassis vehicle type series.

42-3.3.8 If use combined braking （including entire system's unit device(inc. the electronic control unit(s) of ABS, modulation unit(s), wheel speed sensor), layer structure, dimension, axis and tyre allocated installation ）of trailer instead of completed vehicle for entire or partial testing, which shall according to suitable types and range of principle are as below：

42-3.3.8.1 The same vehicle category.

42-3.3.8.2 The combined braking have had same axle set type.

42-3.3.8.3 The same combined braking brand.

42-3.3.8.4 The same combined braking type series.

42-3.3.8.5 The same ABS controlling unit(s) brand.

42-3.3.8.6 The same ABS controlling unit(s) type units.

42-3.4 Specifications:

42-3.4.1 The braking system of category symbols M, N and O must fulfill the following functions.

42-3.4.1.1 Service Braking system: The service braking system 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.

42-3.4.1.2 Secondary Braking System (optional for vehicles of category symbol L): The secondary braking system must make it possible to halt the vehicle within a reasonable distance in the event of failure of the service braking system. 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 (both hands for M1) on the steering control.

42-3.4.1.3 Parking Braking system: (optional for vehicles of category symbol L)

42-3.4.1.3.1 The parking braking system 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.

42-3.4.1.3.2 On every trailer which is required to be equipped with a service braking system, parking braking must be assured even when the trailer is separated from the towing vehicle. The parking braking device must be capable of being actuated by a person standing on the ground; however, in the case of a trailer used for the carriage of passengers, this brake must be capable of being actuated from inside the trailer.

42-3.4.1.3.3 If the operation of the parking braking system on the power-driven vehicle also operates a braking system on the trailer, then the following additional requirements shall be met:

42-3.4.1.3.3.1 When the power-driven vehicle is equipped according to paragraph 42-3.4.1.4.1 below, the actuation of the parking brake system of the power-driven vehicle shall actuate a braking system on the trailer via the pneumatic control line.

42-3.4.1.3.3.2 When the power-driven vehicle is equipped according to paragraph 42-3.4.1.4.2, the actuation of the parking brake system on the power-driven vehicle shall actuate a braking system on the trailer as prescribed in paragraph a. above. In addition, the actuation of the parking brake system may also actuate a

braking system on the trailer via the electric control line..

42-3.4.1.3.3.3 When the power-driven vehicle is equipped according to paragraph 42-3.4.1.4.3, the actuation of the parking braking system on the power-driven vehicle shall actuate a braking system on the trailer via the electric control line. When the electrical energy for the braking equipment of the power-driven vehicle is switched off, the braking of the trailer shall be effected by evacuation of the supply line (in addition, the pneumatic control line may remain pressurised); the supply line may only remain evacuated until the electrical energy for the braking equipment of the power-driven vehicle is restored and simultaneously the braking of the trailer via the electric control line is restored.

42-3.4.1.4 The connection of the compressed-air braking system between power-driven vehicles and trailers shall be provided according to:

42-3.4.1.4.1 One pneumatic supply line and one pneumatic control line.

42-3.4.1.4.2 One pneumatic supply line, one pneumatic control line and one electric control line.

42-3.4.1.4.3 One pneumatic supply line and one electric control line; Until uniform technical standards have been agreed, which ensure compatibility and safety, connections between power-driven vehicles and trailers, shall not be permitted.

42-3.4.1.5 Shut-off devices which are not automatically actuated shall not be permitted. In the case of articulated vehicle combinations, the flexible hoses and cables shall be a part of the power-driven vehicle. In all other cases, the flexible hoses and cables shall be a part of the trailer.

42-3.5 Dynamic Braking for vehicles of category M1 and category of N1 which intends to comply with paragraph 5

42-3.5.1 Declaration of design compliance: applicant shall ensure and declare to comply with the following requirements.

42-3.5.1.1 The braking equipment 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. In particular, the braking equipment shall be so designed, constructed and fitted as to be able to resist the corroding and ageing phenomena to which it is exposed.

42-3.5.1.2 The effectiveness of the braking equipment shall not be adversely affected by magnetic or electrical fields.

42-3.5.1.3 Brake linings shall not contain asbestos. It shall be possible to easily check this wear on service brake linings from the outside or underside of the vehicle utilizing only the tools or equipment normally supplied with the vehicle. Alternatively, acoustic or optical devices warning the driver at his driving position when lining replacement is necessary are acceptable.. The yellow warning signal may be used as the optical warning signal. Wear adjustment shall be automatic for the service brakes.

42-3.5.1.4 In the event of failure in any part of the transmission of a braking system, the feed to the part not affected by the failure must continue to be ensured if required for the purpose of halting the vehicle. Malfunctions of the electric control transmission shall not apply the brakes contrary to the driver's intentions.

42-3.5.1.5 The service braking system shall act on all wheels of the vehicle and shall distribute its action appropriately among axles. No apparent failure occurs after being braked repeatedly.

42-3.5.1.6 In hydraulic-transmission braking systems, the filling ports of the fluid reservoirs must be readily accessible; in addition, the receptacles containing the reserve fluid must be so designed and constructed that the level of the reserve fluid can be easily checked without the receptacles having to be opened. The type of fluid to be used in hydraulic transmission braking

systems shall be identified by the symbol and the appropriate marking. The symbol and the marking must be affixed in a visible position in indelible form within obvious distance of the filling ports of the fluid reservoirs.

42-3.5.1.7 The control of the service braking system must be independent of the control of the parking braking system.

42-3.5.1.8 The parking braking system shall be so designed that it can be actuated when vehicle is in motion.

42-3.5.1.9 Optical brake failure and Defect warning signals:

42-3.5.1.9.1 The warning signal shall be visible, even by daylight; the satisfactory condition of the signals shall be easily verifiable by the driver from the driver's seat; the failure of a component of the warning devices shall not entail any loss of the braking system's performance.

42-3.5.1.9.2 The warning signal(s) shall remain displayed as long as the failure/defect persists and the ignition (start) switch is in the "on" (run) position; and the warning signal shall be constant (not flashing).

42-3.5.1.9.3 The below-mentioned failure of a part of a hydraulic transmission system shall be signalled to the driver by a device comprising a red tell-tale signal lighting up:

42-3.5.1.9.3.1 Before or upon application of a differential pressure of not more than 15.5 bar between the active and failed brake equipment; and when the fluid in the reservoir is below a certain level specified by the manufacturer is permitted.

42-3.5.1.9.3.2 Application of the parking brake must also be indicated to the driver.

42-3.5.1.9.3.3 indicating failures defined elsewhere in this Regulation within the vehicle braking equipment which preclude achievement of the prescribed service braking performance and/or which preclude the functioning of at least one of two independent service braking circuits.

42-3.5.1.9.3.4 A red warning signal, indicating failures defined elsewhere in this Regulation within the vehicle braking equipment which preclude achievement of the prescribed service braking performance and/or which preclude the functioning of at least one of two independent service braking circuits;

42-3.5.1.9.4 When the barking electrical control system happening to below situations, it shall be indicated with the yellow warning signal:

42-3.5.1.9.4.1 A break in the wiring within the electric transmission, or a failure in the control of the parking braking system shall be signalled to the driver.

42-3.5.1.9.4.2 Compensation by the electric control transmission for deterioration or defect within the braking system.

42-3.5.1.9.4.3 Where applicable, a yellow warning signal indicating an electrically detected defect within the vehicle braking equipment, which is not indicated by the red warning signal.

42-3.5.1.9.5 A failure within the electric control transmission, that affects the function and performance of systems addressed in this Regulation, shall be indicated to the driver by the red or yellow warning signal.

42-3.5.1.9.6 When the battery voltage falls below a value nominated by the manufacturer at which the prescribed service braking performance can no longer be guaranteed and/or which precludes at least two independent service braking circuits from each achieving the prescribed secondary braking performance, the red warning signal specified in paragraph 42-3.5.1.9.3.4 shall be activated. After the warning signal has been activated, it shall be possible to apply the service braking control and obtain at least the secondary performance prescribed in paragraph 42-3.5.3.2. It should be understood that sufficient energy is available in the energy transmission of the service braking system.

42-3.5.1.10 Braking Tfor vehicles fitted with an electric regenerative braking system of category A , transient conditions as gear changes or accelerator control release must not affect the behaviour of the vehicle.

42-3.5.1.11 Where use is made of energy other than the muscular energy of the driver, there need not be more than one source of such energy (hydraulic pump, air compressor, etc.), but the means by which the device constituting that source is driven must be as safe as practicable.

42-3.5.1.11.1 In the event of failure in any part of the transmission of a braking system, the feed to the part not affected by the failure must continue to be ensured if required for the purpose of halting the vehicle with the degree of effectiveness prescribed for secondary braking.

42-3.5.1.11.2 Furthermore, storage devices located down-circuit of this device must be such that in the case of a failure in the energy supply after four full-stroke actuations of the service brake control, it is still possible to halt the vehicle at the fifth application, with the degree of effectiveness prescribed for secondary braking.

42-3.5.1.11.3 Vehicles equipped with a hydraulic braking system with stored energy which cannot meet the requirements of paragraph 42-3.5.1.11.1. of this Regulation shall be deemed to satisfy that paragraph if the following requirements are met: After any single transmission failure it shall still be possible after eight full-stroke actuations of the service brake control to achieve, at the ninth application, at least the performance prescribed for the secondary braking system.

42-3.5.1.11.4 Any vehicle fitted with a service brake actuated from an energy reservoir must, where the prescribed secondary braking performance cannot be obtained by means of this brake without the use of the stored energy, be provided with a warning device, giving an optical or acoustic signal when the stored energy, in any part of the system, falls to a value at which without re-charging of the reservoir and irrespective of the load conditions of the vehicle, it is possible to apply the service brake control a fifth time after our full-stroke actuations and obtain the prescribed secondary braking performance (without faults in the service brake transmission device and with the brakes adjusted as closely as possible). This warning device must be directly and permanently connected to the circuit. When the engine is running under normal operating conditions and there are no faults in the braking system, as is the case in type approval tests, the warning device must give no signal except during the time required for charging the energy reservoir(s) after start-up of the engine.

42-3.5.1.12 Generation of a signal to illuminate stop lamps.

42-3.5.1.12.1 Activation of the service braking system by the driver shall generate a signal that will be used to illuminate the stop lamps.

42-3.5.1.12.2 Activation of the service braking system by "automatically commanded braking" shall generate the signal mentioned above. However, when the retardation generated is less than 0.7 m/s2, the signal may be suppressed.

42-3.5.1.12.3 Activation of part of the service braking system by "selective braking" shall not generate the signal mentioned above.

42-3.5.1.12.4 Electric regenerative braking systems, which produce a retarding force upon release of the accelerator control, shall generate the signal mentioned above according to the following provisions：

Vehicle decelerations	Signal generation
≤ 0.7 m/s^2	The signal shall not be generated
> 0.7 m/s^2 and ≤ 1.3 m/s^2	The signal may be generated
> 1.3 m/s^2	The signal shall be generated

In all cases the signal shall be de-activated at the latest when the deceleration has fallen below 0.7 m/s^2.

42-3.5.1.13 When a vehicle is equipped with the means to indicate emergency braking, activation and de-activation of the emergency braking signal shall only be generated by the application of the service braking system when the following conditions are fulfilled:

42-3.5.1.13.1 The signal shall not be activated when the vehicle deceleration is below 6 m/s^2 but it may be generated at any deceleration at or above this value, the actual value being defined by the vehicle manufacturer. The signal shall be de-activated at the latest when the deceleration has fallen below 2.5 m/s^2

42-3.5.1.13.2 Signal may also be generated in the following conditions:

(a) The signal may be generated from a prediction of the vehicle deceleration resulting from the braking demand respecting the activation and de-activation thresholds defined in paragraph 42-3.5.1.13.1 above;

(b) The signal may be activated at a speed above 50 km/h and the antilock system is fully cycling.

The signal shall be deactivated when the antilock braking system is no longer fully cycling.

42-3.5.1.14 Checking the wear of the service brake friction components

42-3.5.1.14.1 It shall be possible to easily assess this wear on service brake linings from the outside or underside of the vehicle, without the removal of the wheels, by the provision of appropriate inspection holes or by some other means. This may be achieved by utilizing simple standard workshop tools or common inspection equipment for vehicles. Alternatively, a sensing device per wheel (twin wheels are considered as a single wheel), which will warn the driver at his driving position when lining replacement is necessary, is acceptable. The yellow warning signal specified in paragraph 42-3 5.1.9.4.3 below may be used.

42-3.5.1.14.2 Assessment of the wear condition of the friction surfaces of brake discs or drums may only be performed by direct measurement of the actual component or examination of any brake disc or drum wear indicators, which may necessitate some level of disassembly. Therefore, at the time of type approval, the vehicle manufacturer shall define the following:

42-3.5.1.14.2.1 The method by which wear of the friction surfaces of drums and discs may be assessed, including the level of disassembly required and the tools and process required to achieve this.

42-3.5.1.14.2.2 Information defining the maximum acceptable wear limit at the point at which replacement becomes necessary. This information shall be made freely available, e.g. vehicle handbook or electronic data record.

42-3.5.1.15 In the case of vehicles with electric regenerative braking systems of category B, the braking input from other sources of

braking, may be suitably phased to allow the electric regenerative braking system alone to be applied, provided that both the following conditions are met:

42-3.5.1.15.1 intrinsic variations in the torque output of the electrical regenerative braking system (e.g. as a result of changes in the electric state of charge in the traction batteries) are automatically compensated by appropriate variation in the phasing relationship as long as the requirements of one of the following annexes to this Regulation are satisfied:

paragraph 42-3.5.2.1.10.2 of this regulation, or

paragraph 43.6.3 of Anti-lock braking system (ABS). (including the case with the electric motor engaged), and

42-3.5.1.15.2 wherever necessary, to ensure that braking rate remains related to the driver's braking demand, having regard to the available tyre/road adhesion, braking shall automatically be caused to act on all wheels of the vehicle.

42-3.5.1.16 The service, secondary and parking braking systems shall act on braking surfaces connected to the wheels through components of adequate strength.

Where braking torque for a particular axle or axles is provided by both a friction braking system and an electrical regenerative braking system of category B, disconnection of the latter source is permitted, providing that the friction braking source remains permanently connected and able to provide the compensation referred to in paragraph 42-3.5.1.15.1.

However in the case of short disconnection transients, incomplete compensation is accepted, but within 1 s, this compensation shall have attained at least 75 per cent of its final value.

Nevertheless, in all cases the permanently connected friction braking source shall ensure that both the service and secondary braking systems continue to operate with the prescribed degree of effectiveness.

Disconnection of the braking surfaces of the parking braking system shall be permitted only on condition that the disconnection is controlled exclusively by the driver from his driving seat, by a system incapable of being brought into action by a leak.

42-3.5.1.17 Additional requirements for vehicles equipped with electric regenerative braking systems.

42-3.5.1.17.1 Vehicles fitted with an electric regenerative braking system of category A.

42-3.5.1.17.1.1 the electric regenerative braking shall only be activated by the accelerator control and/ or the gear neutral position.

42-3.5.1.17.2 Vehicles fitted with an electric regenerative braking system of category B.

42-3.5.1.17.2.1 it must not be possible to disconnect, partially or totally, one part of the service braking system other than by automatic means. This should not be construed as a departure from the requirements of paragraph 42-3.5.1.16;

42-3.5.1.17.2.2 the service braking system must have only one control device;

42-3.5.1.17.2.3 the service braking system must not be adversely affected by the disengagement of the motor(s) or by the gear ratio used;

42-3.5.1.17.2.4 if the operation of the electric component of braking is ensured by a relation established between information coming from the control of the service brake and the braking force to the wheels which of it results, a failure of this relation leading to the non-respect of the prescriptions of distribution of braking among the axles (paragraph 42-3.5.2.8, which is applicable) must be warned to the driver by an optical

warning signal at the latest when the control is actuated and having to remain lit as long as this defect exists and that the switch of "contact" is in the position "go".

42-3.5.1.17.3 For vehicles fitted with an electric regenerative braking system of either category, all the relevant prescriptions shall apply except paragraph 42-3.5.1.17.1.1 above. In this case, the electric regenerative braking may be actuated by the accelerator control and/or the gear neutral position. Additionally, the action on the service braking control must not reduce the above braking effect generated by the release of the accelerator control.

42-3.5.1.17.4 The operation of the electric braking must not be adversely affected by magnetic or electric fields.

42-3.5.1.17.5 For vehicles equipped with an anti-lock device, the anti-lock device must control the electric braking system.

42-3.5.1.17.6 The state of charge of the traction batteries is determined by the method set out in paragraph 42-3.5.5 to this Regulation.

42-3.5.1.18 Category B. In the case of a vehicle contribution of the electric regenerative braking system to the braking force generated shall not exceed that minimum level guaranteed by the system design.

This condition is deemed to be satisfied if the state of charge of the batteries is in one of the following conditions:

42-3.5.1.18.1 at the maximum charge level recommended by the manufacturer, as listed in the vehicle specification.

42-3.5.1.18.2 at a level not less than 95% of the full charge level, where the manufacturer has made no specific recommendation.

42-3.5.1.18.3 at a maximum level resulting from automatic charge control on the vehicle.

42-3.5.2 test:

42-3.5.2.1 General:

42-3.5.2.1.1 The performance prescribed for braking systems is based on the stopping distance and/or the mean fully developed deceleration.

42-3.5.2.1.1.1 Stopping Distance: means 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.

42-3.5.2.1.1.2 Mean Fully Developed Deceleration (dm): the deceleration average with respect to distance over the interval V_b toV_e:

$$d_m = \frac{v_b^2 - v_e^2}{25.92(s_e - s_b)}$$

where:

V_0= initial vehicle speed (km/h); not less than 98% of the prescribed speed for the test in question

V_b= vehicle speed at 0.8 V_0 (km/h),

V_e= vehicle speed at 0.1 V_0 (km/h),

S_b= distance travelled between V_0 and V_b(m),

S_e= distance travelled between V_0 and V_e (m).

42-3.5.2.1.2 The tests must be performed when there is no wind liable to affect the results.

42-3.5.2.1.3 The road must have a surface affording good adhesion, unless specified otherwise in the relevant regulation.

42-3.5.2.1.4 The prescribed performance must be obtained without locking of the wheels at speeds exceeding 15km/h, without deviation of the vehicle from a 3.5m wide lane, without exceeding a yaw angle of 15 degrees and without abnormal

vibrations.

42-3.5.2.1.5 However, systems or functions, which use the braking system as the means of achieving a higher level objective, must not be deactivated during type Approval Testing of the braking system.

42-3.5.2.1.6 For vehicles powered completely or partially by an electric motor (or motors), permanently connected to the wheels, all tests must be carried out with these motor(s) connected;

42-3.5.2.1.7 For vehicles as described in paragraph 42-3.5.2.1.6. above, fitted with an electric regenerative braking system of category A, behaviour tests shall be carried out on a track with a low adhesion coefficient (as defined in paragraph 43.6.2.1 of Anti-lock braking system (ABS). At a speed equal to 80 per cent of the maximum speed but not exceeding 120 km/h, to check that stability is retained.

42-3.5.2.1.7.1 Moreover, for vehicles fitted with an electric regenerative braking system of category A, transient conditions as gear changes or accelerator control release must not affect the behaviour of the vehicle in condition described in paragraph 42-3.5.2.1.7.;

42-3.5.2.1.8 In the tests provided in paragraphs 42-3.5.2.1.7 and 42-3.5.2.1.7.1 wheel locking is not allowed. However, steering correction is permitted if the angular rotation of the steering control is within 120 degrees during the initial 2 seconds and not more than 240 degrees in all;

42-3.5.2.1.9 For a vehicle with electrically actuated service brakes powered from traction batteries (or an auxiliary battery) which receive(s) energy only from an independent external charging system, these batteries shall, during braking performance testing, be at an average of not more than 5 per cent above that state of charge at which the brake failure warning prescribed in paragraph 42-3.5.1.9.6 is required to be given. If this warning is given, the batteries may receive some recharge during the tests, to keep them in the required state of charge range.

42-3.5.2.1.10 Behaviour of the vehicle during braking

42-3.5.2.1.10.1 In braking tests, and in particular in those at high speed, the general behaviour of the vehicle during braking must be checked.

42-3.5.2.1.10.2 Behaviour of the vehicle during braking on a road on which adhesion is reduced must meet the relevant requirements of 42-3.5.2.8 and/or Anti-lock braking system (ABS).

42-3.5.2.1.10.2.1 In the case of a braking system according to paragraph 42-3.5.1.15 where the braking for a particular axle (or axles) is comprised of more than one source of braking torque, and any individual source can be varied with respect to the other(s), the vehicle shall satisfy the paragraph 42-3.5.2.8, or alternatively, 43 Anti-lock braking system (ABS) under all relationships permitted by its control strategy.

42-3.5.2.2 Type-0 Test: ordinary performance test with cold brakes

42-3.5.2.2.1 General:

42-3.5.2.2.1.1 The vehicle must be tested under both laden and unladen conditions.

42-3.5.2.2.1.1.1 Laden: means a vehicle so laden as to attain its "maximum mass”.

42-3.5.2.2.1.1.2 Unladen: means a vehicle with the testing instruments, a driver and a recording operator.

42-3.5.2.2.1.2 In the case of a vehicle equipped with an electric regenerative braking system:

42-3.5.2.2.1.2.1 Category A: Any separate electric regenerative braking control which is provided, shall not be

used during the Type-0 tests.

42-3.5.2.2.1.2.2 Equipped Category B: In the case of a vehicle contribution of the electric regenerative braking system to the braking force generated, when the state of charge of the batteries is in one of the following conditions to paragraph 42-3.5.1.18 , any separate electric regenerative braking control which is provided shall not exceed that minimum level guaranteed by the system design.

42-3.5.2.2.1.3 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; the vehicle must satisfy both the prescribed stopping distance and the prescribed mean fully developed deceleration.

42-3.5.2.2.1.4 The road must be level; unless otherwise specified each test may comprise up to six stops including any needed for familiarization.

42-3.5.2.2.2 Type-0 Test with engine disconnected (Neutral Gear) is carried out at the speed of 100 km/h. The minimum performance must be attained.

42-3.5.2.2.3 Type-0 Test with engine connected (Driving Gear) is carried out at the speed of 80% Vmax declared by the manufacturer but not greater than 160km/hr. The minimum performance must be attained. This test is not run if the maximum speed of the vehicle is □125km/h.

42-3.5.2.3 Type-I Test: Fade and Recovery Test

42-3.5.2.3.1 Heating procedure

42-3.5.2.3.1.1 The service brakes of all vehicles must be tested by successively applying and releasing the brakes a number of times, the vehicle being laden, in the conditions as below:

42-3.5.2.3.1.1.1 The initial speed (V1) is 80% Vmax, but □ 120 km/hr.

42-3.5.2.3.1.1.2 The speed at end of braking is 0.5V1.

42-3.5.2.3.1.1.3 The duration of a braking cycle is 45 seconds.

42-3.5.2.3.1.1.4 The number of brake application is 15.

42-3.5.2.3.1.2 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 stabilizing the speed V1.

42-3.5.2.3.1.3 In these tests, the force applied to the control must be so adjusted as to attain a mean deceleration of 3 m/s2 during every brake application.

42-3.5.2.3.1.4 For vehicles not having sufficient autonomy to carry out the cycles of heating of the brakes, the tests shall be carried out by achieving the prescribed speed before the first braking application and thereafter by using the maximum acceleration available to regain speed and then braking successively at the speed reached at the end of each 45 second cycle duration.

42-3.5.2.3.1.5 For the vehicles equipped with an electric regenerative braking system of category B, the condition of the vehicle batteries at the start of the test, as mentioned in paragraph 42-3.5.1.18.2, shall be such that the braking force contribution provided by the electric regenerative braking system does not exceed the minimum guaranteed by the system design.

42-3.5.2.3.2 Hot Performance:

42-3.5.2.3.2.1 At the end of the Type-I test, the hot performance of the service braking system must be measured in the same conditions as for the Type-0 test (with the engine disconnected, Neutral Gear) and in particular at a mean control force no greater than the mean force actually used (the temperature conditions may be different).

42-3.5.2.3.2.2 For vehicles fitted with an electric regenerative braking system of category A, during brake applications, the highest gear must be continuously engaged and the separate electric braking control, if any, not used.

42-3.5.2.3.2.3 In the case of vehicles equipped with an electric regenerative braking system of category B, having carried out the heating cycles according to paragraph 42-3.5.2.3.1.4. of this annex, the hot performance test shall be carried out at the maximum speed which can be reached by the vehicle at the end of the brake heating cycles, unless the speed specified in paragraph 42-3.5.2.2.2 of this annex can be reached.

For comparison, a later Type-0 test with cold brakes shall be repeated from this same speed and with a similar electric regenerative braking contribution, as set by an appropriate state of battery charge, as was available during the hot performance test.

Following the recovery process and test, further reconditioning of the linings shall be permitted before the test is made to compare this second cold performance with that achieved in the hot test, against the criteria of paragraphs 42-3.5.3.5.1 or 42-3.5.3.5.2 of this Regulation.

42-3.5.2.3.3 Recovery Procedure: Immediately after the hot performance test, make 4 stops from 50 km/h with the engine connected, at a mean deceleration of 3 m/s^2. Allow an interval of 1.5 km between the start of successive stops. Immediately after each stop, accelerate at maximum rate to 50 km/h and maintain that speed until making the next stop.

42-3.5.2.3.3.1 Vehicles equipped with an electrical regenerative braking system of category B, may have their batteries recharged or replaced by a charged set, in order to complete the recovery procedure.

42-3.5.2.3.4 Recovery performance: At the end of the recovery procedure, the recovery performance of the service braking system must be measured in the same conditions as for the Type-0 test with the engine disconnected (the temperature conditions may be different), using a mean force on the control, which is not more than the mean control force used in the corresponding Type-0 test.

42-3.5.2.3.4.1 For vehicles equipped with an electrical regenerative braking system of category B, the recovery test shall be made with no regenerative braking component, i.e. under the conditions of paragraph 42-3.5.2.3.4 above.

After the further reconditioning of the linings, a second repeat Type-0 test shall be made from the same speed and with no electric regenerative braking contribution as in the recovery test with the engine/motors disconnected, and comparison shall be made between these test results.

42-3.5.2.4 Test for Secondary Braking System:

42-3.5.2.4.1 The vehicle, under both laden and unladen conditions with the inactive auxiliary operation, inactive partial loop and damaged system components (assuming that not more than one failure or damage can occur at one time), the type-0 （Neutral Gear）test is carried out at the speed of 100 km/h.

42-3.5.2.4.2 The secondary braking effectiveness test shall be conducted by simulating the actual failure conditions in the service

braking system.

42-3.5.2.4.3 For vehicle employing electric regenerative braking systems, the braking performance shall additionally be checked under the two following failure conditions:

42-3.5.2.4.3.1 For a total failure of the electric component of the service braking output.

42-3.5.2.4.3.2 In the case where the failure condition causes the electric component to deliver its maximum braking force.

42-3.5.2.5 Test for Parking Braking System:

42-3.5.2.5.1 The parking braking system must be, with the vehicle laden, tested on a 20 % up or down gradient.

42-3.5.2.5.2 On vehicles to which the coupling of a trailer is authorized, the parking braking system of the motor vehicle must be capable of holding the combination of vehicles stationary on a 12 per cent up or down gradient.

42-3.5.2.5.3 To check compliance with the requirement specified in paragraph 42-3.5.1.8, a Type-0 test must be carried out, with the laden vehicle and the engine disconnected, at an initial test speed of 30 km/hr.

42-3.5.2.6 Response Time: Where a vehicle is equipped with a service braking system which is totally or partially dependent on a source of energy other than the muscular effort of the driver, it shall be exercised in an emergency manoeuver to measure the time elapsing between the moment when the control device begins to be actuated and the moment when the braking force on the least favorable placed axle reaches deceleration of the vehicle or the pressure at the least favorable brake cylinder of stipulation。

42-3.5.2.7 Energy Accumulators: Vehicles on which the braking equipment requires the use of stored energy provided by hydraulic fluid under pressure shall be equipped with energy storage devices (energy accumulators). However, the energy storage devices shall not be required to be of a prescribed capacity if the braking system is such that in the absence of any energy reserve it is possible with the service brake control to achieve a braking performance at least equal to that prescribed for the secondary braking system. It shall be conducted with following tests.

42-3.5.2.7.1 After eight full-stroke actuations of the service brake control, it shall still be conducted with the 9th braking performance test.

42-3.5.2.7.1.1 Testing shall commence at a pressure that may be specified by the manufacturer but is not higher than the cut-in pressure.

42-3.5.2.7.1.2 The energy storage device(s) shall not be fed; in addition, any energy storage device(s) for auxiliary equipment shall be isolated.

42-3.5.2.7.1.3 The rate of full-stroke actuations must be such as to provide an interval of at least 60 seconds between each actuation.

42-3.5.2.7.1.4 The engine is under idling speed.

42-3.5.2.7.2 Measure the time required for the pressure to rise from P_2 to P_1 in the energy storage device(s).

42-3.5.2.7.2.1 P_1 represents the maximum system operational pressure (cut-out pressure) in the energy storage device(s) specified by the manufacturer.

42-3.5.2.7.2.2 P_2 represents the pressure after four full-stroke actuations with the service brake control, starting at P_1, without having fed the energy storage device(s).

42-3.5.2.7.2.3 The engine is running at the speed corresponding to its maximum power or at the speed allowed by the over-speed governor.

42-3.5.2.7.2.4 Any energy storage device(s) for auxiliary equipment shall not be isolated other than automatically.

42-3.5.2.7.3 Characteristics of Warning Devices: With the engine stationary and commencing at a pressure that may be specified by the manufacturer but does not exceed the cut-in pressure, check whether the warning device operates following two full-stroke actuations of the service brake control.

42-3.5.2.8 Test for Distribution of Braking Force: Vehicles which are not equipped with a certified anti-lock system shall be conducted with the tests below:

42-3.5.2.8.1 The adhesion utilization curve

42-3.5.2.8.1.1 For all braking rates between 0.15 to 0.8, and all states of load of the vehicle, the manufacturer shall provide the adhesion utilization curves for the front and rear axles calculated by the formulae:

$$f_1 = \frac{T_1}{N_1} = \frac{T_1}{P_1 + z \cdot \frac{h}{E} \cdot P \cdot G}$$

$$f_2 = \frac{T_2}{N_2} = \frac{T_2}{P_2 - z \cdot \frac{h}{E} \cdot P \cdot G}$$

where, f_i = Adhesion utilized by axle i

T_i = Force exerted by the brakes on axle i under normal braking conditions on the road.

N_i = Normal reaction of road surface on axle i under braking

P_i = Normal reaction of road surface on axle i under static conditions

G = Acceleration due to gravity

z = Braking rate of vehicle

P = Mass of vehicle

h = height of centre of gravity specified by the manufacturer and agreed by the Technical Services conducting the approval test.

E = Wheelbase

42-3.5.2.8.1.2 The curves shall be plotted for the following load conditions:

42-3.5.2.8.1.2.1 unladen, in running order with the driver on board

42-3.5.2.8.1.2.2 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 considered.

42-3.5.2.8.2 Verify conformity with the requirements contained in the present regulation by carrying out the wheel lock sequence test:

42-3.5.2.8.2.1 laden and unladen, engine disconnected.

42-3.5.2.8.2.2 Test Speed:

42-3.5.2.8.2.2.1 65 km/h for a braking rate □ 0.5.

42-3.5.2.8.2.2.2 100 km/h for a braking rate > 0.5.

42-3.5.2.8.2.3 Pedal Force:

42-3.5.2.8.2.3.1 Pedal force is increased at a linear rate such that the 1st axle lockup occurs no less than 0.5 second and no more than 1.5 seconds after the initial application of the pedal.

42-3.5.2.8.2.3.2 The pedal is released when the second axle locks, or when the pedal force reaches l kN, or 0.1 seconds after the first lockup, whichever occurs first.

42-3.5.2.8.2.4 This test is conducted on road test surfaces on which wheel lockup occurs at braking rates between 0.15 and 0.8; only wheel lockups above a vehicle speed of 15 km/h.

42-3.5.2.8.3 When the requirements are fulfilled by means of a special device (e.g. controlled mechanically by the suspension of the vehicle), it shall be possible, in the event of the failure of its control, (e.g. by disconnecting the control linkage), to stop the vehicle under the conditions of the Type-0 test with the engine disconnected.

42-3.5.3 Performance:

42-3.5.3.1 Service Braking System:

42-3.5.3.1.1 Type-0 Test (Neutral Gear): The mean fully developed deceleration □ 6.43 m/s2 with the stopping distance □ 70m ;the force applied to foot control shall be between 65 N and 500 N.

42-3.5.3.1.2 Typ-0 Test (Driving Gear): The mean fully developed deceleration □ 5.76 m/s2 with the stopping distance □ (0.1V+0.0067V2)m where V is the test speed. The force applied to foot control shall be between 65 N and 500 N.

42-3.5.3.1.3 In the case of M1 authorised to tow an unbraked trailer, the minimum Type-0 (Neutral Gear) performance of the combination shall not be less than 5.4 m/s^2 in both the laden and unladen conditions.

42-3.5.3.2 Secondary Braking System:

The stopping distance of foresaid 42-3.5.2.4.1 test must not exceed $(0.1V+0.0158V^2)$m with the mean fully developed deceleration not less than 2.44 m/s2 and a force applied to the service brake control not less than 65 N and not exceeding 500 N.

42-3.5.3.3 Parking Braking System:

42-3.5.3.3.1 The parking braking system must be capable of holding the laden vehicle stationary on a 20 % up or down gradient.

42-3.5.3.3.2 On vehicles to which the coupling of a trailer is authorized, the parking braking system of the motor vehicle must be capable of holding the combination of vehicles stationary on a 12 % up or down gradient.

42-3.5.3.3.3 If the control device is manual, the force applied to it must not exceed 400 N; If it is a foot control device, the force exerted on the control must not exceed 500 N.

42-3.5.3.3.4 A parking braking system which has to be actuated several times before it attains the prescribed performance is admissible.

42-3.5.3.3.5 The mean fully developed deceleration of the test shall not be less than 1.5 m/s^2; the force exerted on the braking control device shall be between 65 N and 500 N.

42-3.5.3.4 Response Time: The time elapsing between the moment when the control device begins to be actuated and the moment when the braking force on the least favorable placed axle reaches the level corresponding to the prescribed performance

must not exceed 0.6 seconds.

42-3.5.3.5 Hot Performance:

42-3.5.3.5.1 The hot performance must not be less than 75% of that prescribed in paragraph 42-3.5.3.1.1 (It corresponds to a stopping distance of (0.1V+0.0080V2) m and a mean fully developed deceleration of 4.82 m/s2.), nor less than 60% of the figure recorded in the Type-0 test with the engine disconnected.

42-3.5.3.5.2 In the case of a vehicle which satisfies the 60% requirement specified in paragraph above, but which cannot comply with the 75 % requirement of paragraph above, a further hot performance test may be carried out using a control force not exceeding that specified in paragraph 42-3.5.3.1.1. The results of both tests shall be entered in the report. The results of both tests shall be entered in the report.

42-3.5.3.6 Recover Performance:

42-3.5.3.6.1 This recovery performance must not be less than 70%, nor more than 150%, of the figure recorded in the Type-0 test with the engine disconnected.

42-3.5.3.6.2 For vehicles equipped with an electrical regenerative braking system of category B, the recovery performance must not be less than 70 per cent, nor more than 150 per cent of the figure recorded in this final repeat Type-0 test.

42-3.5.3.7 Energy Accumulator:

42-3.5.3.7.1 It shall still be possible to achieve, on the ninth application, the performance prescribed for the secondary braking system.

42-3.5.3.7.2 The time required for the pressure to rise from p2 to p1 in the energy storage device(s) shall not exceed 20 seconds.

42-3.5.3.7.3 The warning device shall not operate following two full-stroke actuations of the service brake control.

42-3.5.3.8 Braking Distribution Test:

42-3.5.3.8.1 Adhesion Utilization Curve:

42-3.5.3.8.1.1 For all states of load of the vehicle, the adhesion utilization curve of the rear axle shall not be situated above that for the front axle:

42-3.5.3.8.1.2 For the adhesion coefficient (k) between 0.2 and 0.8, the braking rate (z): $z \geq 0.1 + 0.7(k - 0.2)$

42-3.5.3.8.2 Wheel-Lock Sequence Test:

42-3.5.3.8.2.1 Both rear wheels shall not reach a locked condition prior to both front wheels being locked - at vehicle braking rates between 0.15 and 0.8. A simultaneous lockup of the front and rear wheels refers to the condition when the time interval between the lockup of the last (second) wheel on the rear axle and the last (second) wheel on the front axle is < 0.1 seconds for vehicle speeds > 30 km/hr.

42-3.5.3.8.2.2 If the wheel-lock sequence test indicates that the rear wheels lock before the front wheels, then the test should be repeated on a different road surface and/or be submitted to the torque wheel tests.

42-3.5.3.8.3 In the event of the failure of its control, (e.g. by disconnecting the control linkage), to stop the vehicle under the conditions of the Type-0 test with the engine disconnected to give a stopping distance not exceeding $(0.1V+0.0100V^2)$ m and a mean fully developed deceleration not less than 3.86 m/s^2.

42-3.5.4 In the event of a modification of vehicle type resulting from the fitting of brake linings, it is admissible for the exemption from the foresaid tests. But, it is supposed to submit the test data record of the original vehicle type and is conducted with the inertia dynamometer test in conformity with below regulations:

42-3.5.4.1 5 sets of new types shall be provided for testing. If the test data record of the original vehicle type is not submitted, a set of original type shall be also provided for testing.

42-3.5.4.2 It shall be tested with the temperature below 100℃. Brake applications shall be made from an initial rotational speed equivalent to that given in paragraph 42-3.5.2.2.2 of this Regulation, and the brake shall be applied to achieve a mean torque equivalent to the deceleration prescribed in that paragraph 42-3.5.2.2.2. In addition, tests shall also be carried out at several rotational speeds, the highest being equivalent to 80% of that speed and the lowest being equivalent to 30% of the maximum speed of the vehicle. The mean braking torque shall be within the test limits +/-15% of the mean braking torque recorded with the brake linings of the original type conforming to the component identified in the relevant application for vehicle type approval.

42-3.5.4.3 The mean braking torque recorded during the paragraph 42-3.5.2.3 above hot performance tests on the linings being tested for the purpose of comparison shall, for the same input measurement, be within the test limits +/- 15% of the mean braking torque recorded with the brake linings conforming to the component identified in the relevant application for vehicle type approval.

42-3.5.4.4 Brake linings shall be visually inspected on completion of the above tests to check that they are in satisfactory condition for continued use in normal service.

42-3.5.5 Procedure for monitoring the state of battery charge: This procedure is applicable to vehicle batteries used for traction and regenerative braking. The procedure requires the use of a bi-directional DC Watt-hour meter.

42-3.5.5.1 Procedure

42-3.5.5.1.1 If the batteries are new or have been subject to extended storage, they shall be cycled as recommended by the manufacturer. A minimum 8-hour soak period at ambient temperature shall be allowed after completion of cycling.

42-3.5.5.1.2 A full charge shall be established using the manufacturer's recommended charging procedure.

42-3.5.5.1.3 When the braking tests of paragraphs 42-3.5.2.1.9, 42-3.5.1.18, 42-3.5.2.3.1.4, 42-3.5.2.3.1.5 and 42-3.5.2.3.2.3 of this Reglation are conducted the watt-hours consumed by the traction motors and supplied by the regenerative braking system shall be recorded as a running total which shall then be used to determine the state of charge existing at the beginning or end of a particular test.

42-3.5.5.1.4 To replicate a level of state of charge in the batteries for comparative tests, such as those of paragraph 42-3.5.2.3.2.3, the batteries shall be either recharged to that level or charged to above that level and discharged into a fixed load at approximately constant power until the required state of charge is reached. Alternatively, for vehicles with battery powered electric traction only, the state of charge may be adjusted by running the vehicle. Tests conducted with a battery partially charged at their start shall be commenced as soon as possible after the desired state of charge has been reached.

42-3.5.6 Electronic stability control systems (ESC, for vehicles of category symbol M1,N1)

42-3.5.6.1 General requirements

Vehicles equipped with an ESC system shall meet the functional requirements specified in paragraph 42-3 5.6.2. and the performance requirements in paragraph 42-3 5.6.3. under the test procedures specified in paragraph 42-3 5.6.5. and under the test conditions specified in paragraph 42-3 5.6.4.

42-3.5.6.2 Functional requirements

Each vehicle to which specified in paragraph 42-3 5.6 applies shall be equipped with an electronic stability control system that:

42-3.5.6.2.1 Is capable of applying braking torques individually to all four wheels and has a control algorithm that utilizes this capability;

42-3.5.6.2.2 Is operational over the full speed range of the vehicle, during all phases of driving including acceleration, coasting, and deceleration (including braking), except:

42-3.5.6.2.2.1 When the driver has disabled ESC;

42-3.5.6.2.2.2 When the vehicle speed is below 20 km/h;

42-3.5.6.2.2.3 While the initial start-up self test and plausibility checks are completed, not to exceed 2 minutes when driven under the conditions of paragraph 42-3 5.6.5.2.;

42-3.5.6.2.2.4 When the vehicle is being driven in reverse.

42-3.5.6.2.3 Remains capable of activation even if the antilock braking system or traction control system is also activated.

42-3.5.6.3 Performance requirements

During each test performed under the test conditions of paragraph 42-3 5.6.4. and the test procedure of paragraph 42-3 5.6.5.9., the vehicle with the ESC system engaged shall satisfy the directional stability criteria of paragraphs 42-3 5.6.3.1. and 42-3 5.6.3.2., and it shall satisfy the responsiveness criterion of paragraph 42-3 5.6.3.3. during each of those tests conducted with a commanded steering wheel angle of 5A or greater but limited as per paragraph 42-3 5.6.9.4., where A is the steering wheel angle computed in paragraph 42-3 5.6.5.6.1.

Where a vehicle has been physically tested in accordance with paragraph 42-3 5.6.4. , the compliance of versions or variants of that same vehicle type may be demonstrated by a computer simulation, which respects the test conditions of paragraph 42-3 5.6.4 and the test procedure of paragraph42-3 5.6.5.9. The use of the simulator is defined in paragraph 42-3 5.6.6.

42-3.5.6.3.1 The yaw rate measured 1 second after completion of the Sine with Dwell steering input (time T0 + 1 in diagram 6) shall not exceed 35 percent of the first peak value of yaw rate recorded after the steering wheel angle changes sign (between first and second peaks) (in Figure 6) during the same test run.

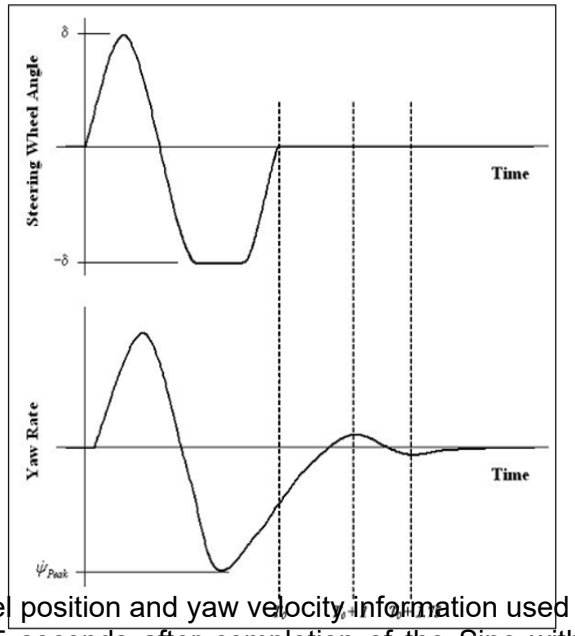


Diagram 6: Steering wheel position and yaw velocity information used to assess lateral stability

42-3.5.6.3.2 The yaw rate measured 1.75 seconds after completion of the Sine with Dwell steering input shall not exceed 20 percent of the first peak value of yaw rate recorded after the steering wheel angle changes sign (between first and second peaks) during the same test run.

42-3.5.6.3.3 The lateral displacement of the vehicle centre of gravity with respect to its initial straight path shall be at least 1.83 m for vehicles with a GVM of 3,500 kg or less, and 1.52 m for vehicles with a maximum mass greater than 3,500 kg when computed 1.07 seconds after the Beginning of Steer (BOS). BOS is defined in paragraph 42-3 5.6.5.11.6.

42-3.5.6.3.3.1 The computation of lateral displacement is performed using double integration with respect to time of the measurement of lateral acceleration at the vehicle centre of gravity, as expressed by the formula:

$$\text{Lateral Displacement} = \iint a_{y_{C.G.}} dt$$

An alternative measuring method may be allowed for type approval testing, provided it demonstrates at least an equivalent level of precision as the double integration method.

42-3.5.6.3.3.2 Time t = 0 for the integration operation is the instant of steering initiation, known as the Beginning of Steer (BOS). BOS is defined in paragraph 42-3 5.6.5.11.6.

42-3.5.6.3.4 ESC malfunction detection

The vehicle shall be equipped with a tell-tale that provides a warning to the driver of the occurrence of any malfunction that affects the generation or transmission of control or response signals in the vehicle's electronic stability control system.

42-3.5.6.3.4.1 The ESC malfunction tell-tale:

42-3.5.6.3.4.1.1 Shall be displayed in direct and clear view of the driver, while in the driver's designated seating position with the driver's seat belt fastened;

42-3.5.6.3.4.1.2 Shall appear perceptually upright to the driver while driving;

42-3.5.6.3.4.1.3 Shall be identified by the symbol shown for "ESC Malfunction Tell-tale" below or the text "ESC":

42-3.5.6.3.4.1.4 Shall be yellow or amber in colour;

42-3.5.6.3.4.1.5 When illuminated must be sufficiently bright to be visible to the driver under both daylight and night-time driving conditions, when the driver has adapted to the ambient roadway light conditions;

42-3.5.6.3.4.1.6 Except as provided in paragraph 42-3 5.6.3.4.1.7., the ESC malfunction tell-tale shall illuminate when a malfunction exists and shall remain continuously illuminated under the conditions specified in paragraph 42-3 5.6.3.4. for as long as the malfunction exists, whenever the ignition locking system is in the "On" ("Run") position;

42-3.5.6.3.4.1.7 Except as provided in paragraph 42-3 5.6.3.4.2., each ESC malfunction tell-tale shall be activated as a check of lamp function either when the ignition locking system is turned to the "On" ("Run") position when the engine is not running, or when the ignition locking system is in a position between "On" ("Run") and "Start" that is designated by the manufacturer as a check position;

42-3.5.6.3.4.1.8 Shall extinguish at the next ignition cycle after the malfunction has been corrected in accordance with paragraph 42-3 5.6.5.10.4.;

42-3.5.6.3.4.1.9 May also be used to indicate the malfunction of related systems/functions, including traction control, trailer stability assist, corner brake control, and other similar functions that use throttle and/or individual torque control to operate and share common components with ESC.

42-3.5.6.3.4.2 The ESC malfunction tell-tale need not be activated when a starter interlock is in operation.

42-3.5.6.3.4.3 The requirement of paragraph 42-3 5.6.3.4.1.7. does not apply to tell-tales shown in a common space.

42-3.5.6.3.4.4 The manufacturer may use the ESC malfunction tell-tale in a flashing mode to indicate ESC operation.

42-3.5.6.3.5 ESC Off and other system controls

The manufacturer may include an "ESC Off" control, which shall be illuminated when the vehicle's headlamps are activated, and which has a purpose to place the ESC system in a mode in which it will no longer satisfy the performance requirements of paragraphs 42-3 5.6.3., 42-3 5.6.3.1., 42-3 5.6.3.2. and 42-3 5.6.3.3. Manufacturers may also provide controls for other systems that have an ancillary effect upon ESC operation. Controls of either kind that place the ESC system in a mode in which it may no longer satisfy the performance requirements of paragraphs 42-3 5.6.3., 42-3 5.6.3.1., 42-3 5.6.3.2. and 42-3 5.6.3.3. are permitted, provided that the system also meets the requirements of paragraphs 42-3 5.6.3.5.1., 42-3 5.6.3.5.2. and 42-3 5.6.3.5.3.

42-3.5.6.3.5.1 The vehicle's ESC system shall always return to the manufacturer's original default mode that satisfies the requirements of paragraphs 42-3 5.6.2. and 42-3 5.6.3. at the initiation of each new ignition cycle, regardless of what mode the driver had previously selected. However, the vehicle's ESC system need not return to a mode that satisfies the requirements of paragraphs 42-3 5.6.3. through 42-3 5.6.3.3. at the initiation of each new ignition cycle if:

42-3.5.6.3.5.1.1 The vehicle is in a four-wheel drive configuration which has the effect of locking the drive gears at the front and rear axles together and providing an additional gear reduction between the engine speed and vehicle speed of at least 1.6, selected by the driver for low speed, off-road driving; or

42-3.5.6.3.5.1.2 The vehicle is in a four-wheel drive configuration selected by the driver that is designed for operation at higher speeds on snow-, sand-, or dirt-packed roads and that has the effect of locking the drive gears at the front and rear axles together, provided that in this mode the vehicle meets the stability performance requirements of paragraphs 42-3 5.6.3.1. and 42-3 5.6.3.2. under the test conditions specified in paragraph 42-3 5.6.4. However, if the system has more than one ESC mode that satisfies the requirements of paragraphs 42-3 5.6.3.1. and 42-3 5.6.3.2. within the drive configuration selected for the previous ignition cycle, the ESC shall return to the manufacturer's original default ESC mode for that drive configuration at the initiation of each new ignition cycle.

42-3.5.6.3.5.2 A control, whose only purpose is to place the ESC system in a mode in which it will no longer satisfy the performance requirements of paragraphs 42-3 5.6.3., 42-3 5.6.3.1., 42-3 5.6.3.2. and 42-3 5.6.3.3., shall be identified by the symbol shown for "ESC Off" below or the text "ESC OFF".

42-3.5.6.3.5.3 A control for an ESC system whose purpose is to place the ESC system in different modes, at least one of which may no longer satisfy the performance requirements of paragraphs 42-3 5.6.3., 42-3 5.6.3.1., 42-3 5.6.3.2., and 42-3 5.6.3.3., shall be identified by the symbol below with the text "OFF" adjacent to the control position for this mode.

Alternatively, in the case where the ESC system mode is controlled by a multifunctional control, the driver display shall identify clearly to the driver the control position for this mode using either the symbol in paragraph 42-3

5.6.3.5.2. or the text "ESC OFF".

42-3.5.6.3.5.4 A control for another system that has the ancillary effect of placing the ESC system in a mode in which it no longer satisfies the performance requirements of paragraphs 42-3 5.6.3., 42-3 5.6.3.1., 42-3 5.6.3.2. and 42-3 5.6.3.3. need not be identified by the "ESC Off" symbol of paragraph 42-3 5.6.3.5.2.

42-3.5.6.3.6 ESC OFF tell-tale

If the manufacturer elects to install a control to turn off or reduce the performance of the ESC system under paragraph 42-3 5.6.3.5., the tell-tale requirements of paragraphs 42-3 5.6.3.6.1. to 42-3 5.6.3.6.4. shall be met in order to alert the driver to the inhibited or reduced state of ESC system functionality. This requirement does not apply for the driver-selected mode referred to in paragraph 42-3 5.6.3.5.1.2.

42-3.5.6.3.6.1 The vehicle manufacturer shall provide a tell-tale indicating that the vehicle has been put into a mode that renders it unable to satisfy the requirements of paragraphs 42-3 5.6.3., 42-3 5.6.3.1., 42-3 5.6.3.2. and 42-3 5.6.3.3., if such a mode is provided.

42-3.5.6.3.6.2 The "ESC Off" tell-tale:

42-3.5.6.3.6.2.1 Shall be displayed in direct and clear view of the driver while in the driver's designated seating position with the driver's seat belt fastened;

42-3.5.6.3.6.2.2 Shall appear perceptually upright to the driver while driving;

42-3.5.6.3.6.2.3 Shall be identified by the symbol shown for "ESC Off" below or the text "ESC OFF";

or Shall be identified with the English word "OFF" adjacent to either the control referred to in paragraph 42-3 5.6.3.5.2. or 42-3 5.6.3.5.3. or the illuminated malfunction tell-tale;

42-3.5.6.3.6.2.4 Shall be yellow or amber in colour;

42-3.5.6.3.6.2.5 When illuminated, shall be sufficiently bright to be visible to the driver under both daylight and night time driving conditions, when the driver has adapted to the ambient roadway light conditions;

42-3.5.6.3.6.2.6 Shall remain continuously illuminated for as long as the ESC is in a mode that renders it unable to satisfy the requirements of paragraphs 42-3 5.6.3., 42-3 5.6.3.1., 42-3 5.6.3.2. and 42-3 5.6.3.3;

42-3.5.6.3.6.2.7 Except as provided in paragraphs 42-3 5.6.3.6.3. and 42-3 5.6.3.6.4. each "ESC Off" tell-tale shall be activated as a check of lamp function either when the ignition locking system is turned to the "On" ("Run") position when the engine is not running, or when the ignition locking system is in a position between "On" ("Run") and "Start" that is designated by the manufacturer as a check position.

42-3.5.6.3.6.2.8 Shall extinguish after the ESC system has been returned to the manufacturer's original default mode.

42-3.5.6.3.6.3 The "ESC Off" tell-tale need not be activated when a starter interlock is in operation.

42-3.5.6.3.6.4 The requirement of paragraph 42-3 5.6.3.6.2.7. does not apply to tell-tales shown in a common space.

42-3.5.6.3.6.5 The manufacturer may use the "ESC Off" tell-tale to indicate an ESC level of function other than the manufacturer's original default mode even if the vehicle would meet paragraphs 42-3 5.6.3., 42-3 5.6.3.1., 42-3 5.6.3.2. and 42-3 5.6.3.3. of this annex at that level of ESC function.

42-3.5.6.4 Test conditions

42-3.5.6.4.1 Ambient conditions

42-3.5.6.4.1.1 The ambient temperature is between 0 degrees C and 45 degrees C.

42-3.5.6.4.1.2 The maximum wind speed is no greater than 10 m/s for vehicles with SSF > 1.25, and 5 m/s for vehicles with SSF < 1.25.

42-3.5.6.4.2 Road test surface

42-3.5.6.4.2.1 Tests are conducted on a dry, uniform, solid-paved surface. Surfaces with irregularities and undulations, such as dips and large cracks, are unsuitable.

42-3.5.6.4.2.2 The road test surface has a nominal peak braking coefficient (PBC) of 0.9, unless otherwise specified, when measured using either:

42-3.5.6.4.2.2.1 The American Society for Testing and Materials (ASTM) E1136 standard reference test tyre, in accordance with ASTM Method E1337-90, at a speed of 40 mph; or

42-3.5.6.4.2.2.2 The k-test method specified in paragraph 42-3 6.2.5.1. of this Regulation.

42-3.5.6.4.2.3 The test surface has a consistent slope between level and 1 per cent.

42-3.5.6.4.3 Vehicle conditions

42-3.5.6.4.3.1 The ESC system is enabled for all testing.

42-3.5.6.4.3.2 Vehicle mass.

The vehicle is loaded with the fuel tank filled to at least 90 per cent of capacity, and a total interior load of 168 kg comprised of the test driver, approximately 59 kg of test equipment (automated steering machine, data acquisition system and the power supply for the steering machine), and ballast as required to make up for any shortfall in the weight of test drivers and test equipment. Where required, ballast shall be placed on the floor behind the passenger front seat or if necessary in the front passenger foot well area. All ballast shall be secured in a way that prevents it from becoming dislodged during testing.

42-3.5.6.4.3.3 Tyres

The tyres are inflated to the vehicle manufacturer's recommended cold inflation pressure(s) e.g. as specified on the vehicle's placard or the tyre inflation pressure label. Tubes may be installed to prevent tyre de-beading.

42-3.5.6.4.3.4 Outriggers

Outriggers may be used for testing if deemed necessary for test drivers' safety. In this case, the following applies for vehicles with a Static Stability Factor (SSF)< 1.25:

42-3.5.6.4.3.4.1 Vehicles with a mass in running order under 1,588 kg shall be equipped with "lightweight"

outriggers. Lightweight outriggers shall be designed with a maximum mass of 27 kg and a maximum roll moment of inertia of

$$27\ kg{\cdot}m^2.$$

42-3.5.6.4.3.4.2 Vehicles with a mass in running order between 1,588 kg and 2,722 kg shall be equipped with "standard" outriggers. Standard outriggers shall be designed with a maximum mass of 32 kg and a maximum roll moment of inertia of

$$35.9\ kg{\cdot}m^2.$$

42-3.5.6.4.3.4.3 Vehicles with a mass in running order equal to or greater than 2,722 kg shall be equipped with "heavy" outriggers. Heavy outriggers shall be designed with a maximum mass of 39 kg and a maximum roll moment of inertia of

$$40.7\ kg{\cdot}m^2.$$

42-3.5.6.4.3.5 Automated steering machine

A steering robot programmed to execute the required steering pattern shall be used in paragraphs 42-3 5.6.5.5.2., 42-3 5.6.5.5.3., 42-3 5.6.5.6. and 42-3 5.6.5.9. The steering machine shall be capable of supplying steering torques between 40 to 60 Nm. The steering machine shall be able to apply these torques when operating with steering wheel velocities up to 1,200 degrees per second.

42-3.5.6.5 Test procedure

42-3.5.6.5.1 Inflate the vehicles' tyres to the manufacturer's recommended cold inflation pressure(s) e.g. as provided on the vehicle's placard or the tyre inflation pressure label.

42-3.5.6.5.2 Tell-tale bulb check

With the vehicle stationary and the ignition locking system in the "Lock" or "Off" position, switch the ignition to the "On" ("Run") position or, where applicable, the appropriate position for the lamp check. The ESC malfunction tell-tale shall be illuminated as a check of lamp function, as specified in paragraph 42-3 5.6.3.4.1.7., and if equipped, the "ESC Off" tell-tale shall also be illuminated as a check of lamp function, as specified in paragraph 42-3 5.6.3.6.2.7. The tell-tale bulb check is not required for a tell-tale shown in a common space as specified in paragraphs 42-3 5.6.3.4.3. and 42-3 5.6.3.6.4.

42-3.5.6.5.3 "ESC Off" control check

For vehicles equipped with an "ESC Off" control, with the vehicle stationary and the ignition locking system in the "Lock" or "Off" position, switch the ignition locking system to the "On" ("Run") position. Activate the "ESC Off" control and verify that the "ESC Off" tell-tale is illuminated, as specified in paragraph 42-3 5.6.3.6.2.

Turn the ignition locking system to the "Lock" or "Off" position. Again, switch the ignition locking system to the "On" ("Run") position and verify that the "ESC Off" telltale has extinguished indicating that the ESC system has been restored as specified in paragraph 42-3 5.6.3.5.1.

42-3.5.6.5.4 Brake conditioning

Condition the vehicle brakes in the manner described in paragraphs 42-3 5.6.5.4.1. to 42-3 5.6.5.4.4.

42-3.5.6.5.4.1 Ten stops are performed from a speed of 56 km/h, with an average deceleration of approximately 0.5g.

42-3.5.6.5.4.2 Immediately following the series of ten 56 km/h stops, three additional stops are performed from 72 km/h at higher deceleration.

42-3.5.6.5.4.3 When executing the stops in paragraph 42-3 5.6.5.4.2., sufficient force is applied to the brake pedal to bring the vehicle's antilock braking system (ABS) into operation for a majority of each braking event.

42-3.5.6.5.4.4 Following completion of the final stop in 42-3 5.6.5.4.2., the vehicle is driven at a speed of 72 km/h for five minutes to cool the brakes.

42-3.5.6.5.5 Tyre Conditioning

Condition the tyres using the procedure of paragraphs 42-3 5.6.5.5.1. to 42-3 5.6.5.5.3. to wear away mould sheen and achieve operating temperature immediately before beginning the test runs of paragraphs 42-3 5.6.5.6. and 42-3 5.6.5.9.

42-3.5.6.5.5.1 The test vehicle is driven around a circle 30 meters in diameter at a speed that produces a lateral acceleration of approximately 0.5 to 0.6g for three clockwise laps followed by three anticlockwise laps.

42-3.5.6.5.5.2 Using a sinusoidal steering pattern at a frequency of 1 Hz, a peak steering wheel angle amplitude corresponding to a peak lateral acceleration of 0.5 to 0.6g, and a vehicle speed of 56 km/h, the vehicle is driven through four passes performing 10 cycles of sinusoidal steering during each pass.

42-3.5.6.5.5.3 The steering wheel angle amplitude of the final cycle of the final pass shall be twice that of the other cycles. The maximum time permitted between each of the laps and passes is five minutes.

42-3.5.6.5.6 Slowly increasing steer procedure

The vehicle is subjected to two series of runs of the slowly increasing steer test using a constant vehicle speed of 80 +/- 2 km/h and a steering pattern that increases by 13.5 degrees per second until a lateral acceleration of approximately 0.5g is obtained. Three repetitions are performed for each test series. One series uses anticlockwise steering, and the other series uses clockwise steering. The maximum time permitted between each test run is five minutes.

42-3.5.6.5.6.1 From the slowly increasing steer tests, the quantity "A" is determined. "A" is the steering wheel angle in degrees that produces a steady state lateral acceleration (corrected using the methods specified in paragraph 42-3 5.6.5.11.3.) of 0.3g for the test vehicle. Utilizing linear regression, A is calculated, to the nearest 0.1 degrees, from each of the six slowly increasing steer tests. The absolute value of the six A values calculated is averaged and rounded to the nearest 0.1 degrees to produce the final quantity, A, used below.

42-3.5.6.5.7 After the quantity A has been determined, without replacing the tyres, the tyre conditioning procedure described in paragraph 42-3 5.6.5.5. is performed again immediately prior to conducting the Sine with Dwell test of paragraph 42-3 5.6.5.9. Initiation of the first Sine with Dwell test series shall begin within two hours after completion of the slowly increasing steer tests of paragraph 42-3 5.6.5.6.

42-3.5.6.5.8 Check that the ESC system is enabled by ensuring that the ESC malfunction and "ESC Off" (if provided) tell-tales are not illuminated.

42-3.5.6.5.9 Sine with Dwell test of oversteer intervention and responsiveness

The vehicle is subjected to two series of test runs using a steering pattern of a sine wave at 0.7 Hz frequency with a 500 ms delay beginning at the second peak amplitude as shown in diagram 7 (the Sine with Dwell tests). One series uses

anticlockwise steering for the first half cycle, and the other series uses clockwise steering for the first half cycle.
The vehicle is allowed to cool-down between each test runs for a period of 1.5 to 5 minutes, with the vehicle stationary.

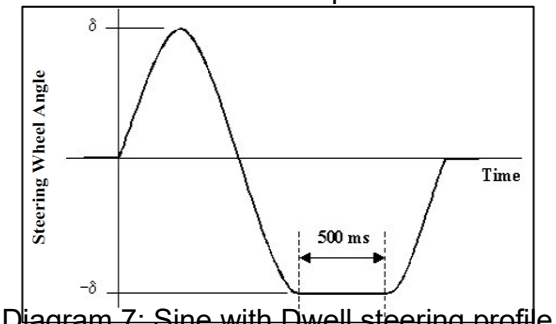


Diagram 7: Sine with Dwell steering profile

42-3.5.6.5.9.1 The steering motion is initiated with the vehicle coasting in high gear at 80 +/- 2 km/h.

42-3.5.6.5.9.2 The steering amplitude for the initial run of each series is 1.5 A, where A is the steering wheel angle determined in paragraph 42-3 5.6.5.6.1.

42-3.5.6.5.9.3 In each series of test runs, the steering amplitude is increased from run to run, by 0.5 A, provided that no such run will result in a steering amplitude greater than that of the final run specified in paragraph 5.9.4.

42-3.5.6.5.9.4 The steering amplitude of the final run in each series is the greater of 6.5 A or 270 degrees, provided the calculated magnitude of 6.5 A is less than or equal to 300 degrees.

If any 0.5 A increment, up to 6.5 A, is greater than 300 degrees, the steering amplitude of the final run shall be 300 degrees.

42-3.5.6.5.9.5 Upon completion of the two series of test runs, post processing of yaw rate and lateral acceleration data is done as specified in paragraph 42-3 5.6.5.11.

42-3.5.6.5.10 ESC malfunction detection

42-3.5.6.5.10.1 Simulate one or more ESC malfunction(s) by disconnecting the power source to any ESC component, or disconnecting any electrical connection between ESC components (with the vehicle power off). When simulating an ESC malfunction, the electrical connections for the tell-tale lamp(s) and/or optional ESC system control(s) are not to be disconnected.

42-3.5.6.5.10.2 With the vehicle initially stationary and the ignition locking system in the "Lock" or "Off" position, switch the ignition locking system to the "Start" position and start the engine. Drive the vehicle forward to obtain a vehicle speed of 48 +/- 8 km/h. 30 seconds, at the latest, after the engine has been started and within the next two minutes at this speed, conduct at least one left and one right smooth turning manoeuvre without losing directional stability and one brake application. Verify that the ESC malfunction indicator illuminates in accordance with paragraph 42-3 5.6.3.4. by the end of these manoeuvres.

42-3.5.6.5.10.3 Stop the vehicle, switch the ignition locking system to the "Off" or "Lock" position. After a five-minute period, switch the vehicle's ignition locking system to the "Start" position and start the engine. Verify that the ESC malfunction indicator again illuminates to signal a malfunction and remains illuminated as long as the engine is

running or until the fault is corrected.

42-3.5.6.5.10.4 Switch the ignition locking system to the "Off" or "Lock" position. Restore the ESC system to normal operation, switch the ignition system to the "Start" position and start the engine. Re-perform the manoeuvre described in paragraph 42-3 5.6.5.10.2. and verify that the tell-tale has extinguished within this time or immediately afterwards.

42-3.5.6.5.11 Post data processing - calculations for performance metrics

Yaw rate and lateral displacement measurements and calculations shall be processed utilizing the techniques specified in paragraphs 42-3 5.6.5.11.1. to 42-3 5.6.5.11.8.

42-3.5.6.5.11.1 Raw steering wheel angle data is filtered with a 12-pole phaseless Butterworth filter and a cut-off frequency of 10 Hz. The filtered data is then zeroed to remove sensor offset utilizing static pre-test data.

42-3.5.6.5.11.2 Raw yaw rate data is filtered with a 12-pole phaseless Butterworth filter and a cut-off frequency of 6 Hz. The filtered data is then zeroed to remove sensor offset utilizing static pre-test data.

42-3.5.6.5.11.3 Raw lateral acceleration data is filtered with a 12-pole phaseless Butterworth filter and a cut-off frequency of 6 Hz. The filtered data is then zeroed to remove sensor offset utilizing static pre-test data. The lateral acceleration data at the vehicle centre of gravity is determined by removing the effects caused by vehicle body roll and by correcting for sensor placement via the use of coordinate transformation. For data collection, the lateral accelerometer shall be located as close as possible to the position of the vehicle's longitudinal and lateral centres of gravity.

42-3.5.6.5.11.4 Steering wheel velocity is determined by differentiating the filtered steering wheel angle data. The steering wheel velocity data is then filtered with a moving 0.1 second running average filter.

42-3.5.6.5.11.5 Lateral acceleration, yaw rate and steering wheel angle data channels are zeroed utilizing a defined "zeroing range." The methods used to establish the zeroing range are defined in paragraphs 42-3 5.6.5.11.5.1. and 42-3 5.6.5.11.5.2.

42-3.5.6.5.11.5.1 Using the steering wheel rate data calculated using the methods described in paragraph 42-3 5.6.5.11.4., the first instant that the steering wheel rate exceeds 75 deg/sec is identified.

From this point, steering wheel rate shall remain greater than 75 deg/sec for at least 200 ms. If the second condition is not met, the next instant that the steering wheel rate exceeds 75 deg/sec is identified and the 200 ms validity check applied. This iterative process continues until both conditions are ultimately satisfied.

42-3.5.6.5.11.5.2 The "zeroing range" is defined as the 1.0 second time period prior to the instant the steering wheel rate exceeds 75 deg/sec (i.e., the instant the steering wheel velocity exceeds 75 deg/sec defines the end of the "zeroing range").

42-3.5.6.5.11.6 The Beginning of Steer (BOS) is defined as the first instance when the filtered and zeroed steering wheel angle data reaches -5 degrees (when the initial steering input is anticlockwise) or +5 degrees (when the initial steering input is clockwise) after a time defining the end of the "zeroing range." The value for time at the BOS is interpolated.

42-3.5.6.5.11.7 The Completion of Steer (COS) is defined as the time the steering wheel angle returns to zero at the completion of the Sine with Dwell steering manoeuvre. The value for time at the zero degree steering wheel angle

is interpolated.

42-3.5.6.5.11.8 The second peak yaw rate is defined as the first local yaw rate peak produced by the reversal of the steering wheel. The yaw rates at 1.000 and 1.750 seconds after COS are determined by interpolation.

42-3.5.6.5.11.9 Determine lateral velocity by integrating corrected, filtered and zeroed lateral acceleration data. Zero lateral velocity at the BOS point. Determine lateral displacement by integrating zeroed lateral velocity. Zero lateral displacement at the BOS point. The lateral displacement measurement is made at 1.07 seconds after BOS point and is determined by interpolation.

42-3.5.6.6 Use of the dynamic stability simulation

The effectiveness of the electronic stability control system may be determined by computer simulation. (refer to paragraph 42-3 5.6.3)

42-3.5.6.6.1 Use of the simulation

42-3.5.6.6.1.1 The vehicle stability function shall be demonstrated by the vehicle manufacturer to the Type Approval Authority or Technical Service by simulating the dynamic manoeuvres of paragraph 42-3 5.6.5.9..

42-3.5.6.6.1.2 The simulation shall be a means whereby the vehicle stability performance shall be demonstrated with:

(a) The yaw rate, one second after completion of the Sine with Dwell steering input (time T0 + 1);

(b) The yaw rate, 1.75 seconds after completion of the Sine with Dwell steering input;

(c) The lateral displacement of the vehicle centre of gravity with respect to its initial straight path.

42-3.5.6.6.1.3 The simulation shall be carried out with a validated modelling and simulation tool and using the dynamic manoeuvres of paragraph 42-3 5.6.5.9. under the test conditions of paragraph 42-3 5.6.4.

The method by which the simulation tool is validated is given in paragraph 42-3 5.6.7.

42-3.5.6.7 Dynamic stability simulation tool and its validation

42-3.5.6.7.1 Specification of the simulation tool

42-3.5.6.7.1.1 The simulation method shall take into account the main factors which influence the directional and roll motion of the vehicle. A typical model may include the following vehicle parameters in an explicit or implicit form:

(a) Axle/wheel;

(b) Suspension;

(c) Tyre;

(d) Chassis/vehicle body;

(e) Power train/driveline, if applicable;

(f) Brake system;

(g) Pay load.

42-3.5.6.7.1.2 The Vehicle Stability Function shall be added to the simulation model by means of:

(a) A subsystem (software model) of the simulation tool; or

(b) The electronic control box in a hardware-in-the-loop configuration.

42-3.5.6.7.2 Validation of the simulation tool

42-3.5.6.7.2.1 The validity of the applied modelling and simulation tool shall be verified by means of comparisons with practical vehicle tests. The tests utilised for the validation shall be the dynamic manoeuvres of paragraph 42-3

5.6.5.9.

During the tests, the following motion variables, as appropriate, shall be recorded or calculated in accordance with ISO 15037 Part 1:2005: General conditions for passenger cars or Part 2:2002: General conditions for heavy vehicles and buses (depending on the vehicle category):

(a) Steering-wheel angle (delta H);
(b) Longitudinal velocity (vX);
(c) Sideslip angle (beta) or lateral velocity (vY);(optional);
(d) Longitudinal acceleration (aX); (optional);
(e) Lateral acceleration (aY);
(f) Yaw velocity (d psi/dt);
(g) Roll velocity (d phi/dt);
(h) Pitch velocity (d theta/dt);
(i) Roll angle (phi);
(j) Pitch angle (theta).

42-3.5.6.7.2.2 The objective is to show that the simulated vehicle behaviour and operation of the vehicle stability function is comparable with that seen in practical vehicle tests.

42-3.5.6.7.2.3 The simulator shall be deemed to be validated when its output is comparable to the practical test results produced by a given vehicle type during the dynamic manoeuvres of paragraph 42-3 5.6.5.9. The relationship of activation and sequence of the vehicle stability function in the simulation and in the practical vehicle test shall be the means of making the comparison.

42-3.5.6.7.2.4 The physical parameters that are different between the reference vehicle and simulated vehicle configurations shall be modified accordingly in the simulation.

42-3.5.6.7.2.5 A simulator test report shall be produced, a model and a copy attached to the vehicle approval report.

42-3.6 Dynamic Braking for vehicles of categorys M2, M3, N2, N3 and O and category N1 which intends to comply with paragraph 6

42-3.6.1 Declaration of design compliance: applicant shall be ensure and declared comply with the following requirement.

42-3.6.1.1 The braking equipment 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. In particular, the braking equipment shall be so designed, constructed and fitted as to be able to resist the corroding and ageing phenomena to which it is exposed.

42-3.6.1.2 The effectiveness of the braking systems, including the electric control line, shall not be adversely affected by magnetic or electrical fields.

42-3.6.1.3 Brake linings shall not contain asbestos.

42-3.6.1.4 The control of the service braking system must be independent of the control of the parking braking system.

42-3.6.1.5 The service braking system and the parking braking system may use common components in their transmission(s), provided that in the event of a failure in any part of the transmission(s) the requirements for secondary braking are still ensured.

42-3.6.1.6 If the service braking system and the secondary braking system have the same control, the parking braking system must

be so designed that it can be actuated when the vehicle is in motion.

42-3.6.1.7 Where the secondary braking system and the service braking system have a common control and a common transmission:

42-3.6.1.7.1 if service braking is ensured by the action of the driver's muscular energy assisted by one or more energy reserves, secondary braking must, in the event of failure of that assistance, be capable of being ensured by the driver's muscular energy assisted by the energy reserves, if any, which are unaffected by the failure.(the force applied to the service brake control not exceeding the prescribed maximum).

42-3.6.1.7.2 if the service braking force and transmission depend exclusively on the use, controlled by the driver, of an energy reserve, there must be at least two completely independent energy reserves, each provided with its own transmission, likewise independent; 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 the aforesaid energy reserves must be equipped with a warning device as defined in 42-3.6.1.16 below. In each service braking circuit in at least one of the air reservoirs a device for draining and exhausting is required in an adequate and easily accessible position.

42-3.6.1.8 Where there are separate controls for the service braking system and the secondary braking system, simultaneous actuation of the two controls must not render both the service braking system and the secondary braking system inoperative, either when both braking systems are in good working order or when one of them is faulty.

42-3.6.1.9 Certain parts, such as the pedal and its bearing, the master cylinder and its piston or pistons, the control valve, the linkage between the pedal and the master cylinder or the control valve (hydraulic/pneumatic system), the brake cylinders and their pistons (hydraulic/pneumatic system, and 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 characteristics at least equal to those prescribed for other essential components (such as the steering linkage) of the vehicle. Any such part as aforesaid whose failure would make it impossible to brake the vehicle with a degree of effectiveness at least equal to that prescribed for secondary braking must be made of metal or of a material with equivalent characteristics and must not undergo notable distortion in normal operation of the braking systems.

42-3.6.1.10 The service braking system shall act on all wheels of the vehicle and shall distribute its action appropriately among the axles. After repeated operation, it shall not readily cause the notable disorder caused by braking system. In the case of vehicles with more than two axles, in order to avoid wheel-locking or glazing of the brake linings, the brake force on certain axles may be reduced to zero automatically when carrying a much reduced load, provided that the vehicle meets all the performance requirements prescribed in this Regulation.

42-3.6.1.11 The action of the service braking system shall be distributed between the wheels of one and the same axle symmetrically in relation to the longitudinal median plane of the vehicle. Compensation and functions, such as anti-lock, which may cause deviations from this symmetrical distribution, shall be declared.

42-3.6.1.12 Malfunctions of the electric control transmission shall not apply the brakes contrary to the driver's intentions.

42-3.6.1.13 Wear of the brakes must be capable of being easily taken up 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 and, if necessary, suitable means of compensation such that, when the brakes become heated, or the brake linings have

reached a certain degree of wear, effective braking is ensured without immediate adjustment being necessary:

42-3.6.1.13.1 Wear adjustment shall be automatic for the service brakes. However, the fitting of automatic brake adjustment devices is optional for vehicles of categories O1 and O2, off road vehicles of categories N2 and N3 and for the rear brakes of vehicles of category N1.

42-3.6.1.13.2 Checking the wear of the service brake friction components：

42-3.6.1.13.2.1 It shall be possible to easily assess this wear on service brake linings from the outside or underside of the vehicle, without the removal of the wheels, by the provision of appropriate inspection holes or by some other means. This may be achieved by utilizing simple standard workshop tools or common inspection equipment for vehicles. Alternatively, a sensing device per wheel (twin wheels are considered as a single wheel), which will warn the driver at his driving position when lining replacement is necessary, is acceptable. The yellow warning signal specified in paragraph 42-3.6.1.16 below may be used.

42-3.6.1.13.2.2 Assessment of the wear condition of the friction surfaces of brake discs or drums may only be performed by direct measurement of the actual component or examination of any brake disc or drum wear indicators, which may necessitate some level of disassembly. Therefore, at the time of type approval, the vehicle manufacturer shall define the following:

42-3.6.1.13.2.2.1 The method by which wear of the friction surfaces of drums and discs may be assessed, including the level of disassembly required and the tools and process required to achieve this.

42-3.6.1.13.2.2.2 Information defining the maximum acceptable wear limit at the point at which replacement becomes necessary. This information shall be made freely available, e.g. vehicle handbook or electronic data record.

42-3.6.1.14 In hydraulic-transmission braking systems, the filling ports of the fluid reservoirs must be readily accessible; in addition, the receptacles containing the reserve fluid must be so designed and constructed that the level of the reserve fluid can be easily checked.

42-3.6.1.15 Coupling Force Control：

42-3.6.1.15.1 Coupling force control shall only be permitted in the towing vehicle. The action of the coupling force control shall be to reduce the difference between the dynamic braking rates of towing and towed vehicles and in the testing report shall have coupling force control of confirmable function，the measure of confirmable function shall be approve by manufacturer and technical service then append to inspection and testing report.

42-3.6.1.15.2 A coupling force control system shall control only the coupling forces generated by the service braking system of the motor vehicle and the trailer, excluding endurance braking systems.

42-3.6.1.16 Warning Signal:

42-3.6.1.16.1 The warning signals shall be visible, even by daylight; the satisfactory condition of the signals shall be easily verifiable by the driver from the driver's seat; the failure of a component of the warning devices shall not entail any loss of the braking system's performance.

42-3.6.1.16.2 The warning signal(s) shall remain displayed as long as the failure/defect persists and the ignition (start) switch is in the "on" (run) position; and the warning signal shall be constant (not flashing).

42-3.6.1.16.3 The below-mentioned failure of a part of a hydraulic transmission system shall be signalled to the driver by a device

comprising a red tell-tale signal lighting up:

42-3.6.1.16.3.1 The failure of a part of a hydraulic transmission system shall be signalled to the driver by a device comprising a red warning signal. Alternatively, the lighting up of this device when the fluid in the reservoir is below a certain level specified by the manufacturer shall be permitted.

42-3.6.1.16.3.2 Actuation of the parking brake.

42-3.6.1.16.3.3 When the supply voltage to the trailer falls below a value nominated by the manufacturer at which the prescribed service braking performance can no longer be guaranteed, the separate yellow warning signal. In addition, trailers equipped with an electrical control line, when electrically connected to a towing vehicle with an electric control line, shall provide the failure information for actuation of the red warning signal via the data communication part of the electric control line.

42-3.6.1.16.3.4 a red warning signal, indicating failures, defined elsewhere in this Regulation, within the vehicle braking equipment which preclude achievement of the prescribed service braking performance and/or which preclude the functioning of at least one of two independent service braking circuits;

42-3.6.1.16.4 When the barking electrical control system happening to below situations, it shall be indicated with the yellow warning signal:

42-3.6.1.16.4.1 A break in the wiring within the electric transmission, or a failure in the control of the parking braking system shall be signalled to the driver.

42-3.6.1.16.4.2 Compensation by the electric control transmission for deterioration or defect within the braking system.

42-3.6.1.16.4.3 Where applicable, a yellow warning signal indicating an electrically detected defect within the vehicle braking equipment, which is not indicated by the red warning signal.

42-3.6.1.16.4.4 A coupling force control failure.

42-3.6.1.16.4.5 With the exception of vehicles of categories N1, power-driven vehicles equipped with an electric control line and/or authorized to tow a trailer equipped with an electric control transmission, a defect within the electric control transmission of the braking equipment of the trailer.

42-3.6.1.16.4.6 Trailers that utilize selective braking as a means to enhance vehicle stability, in the event of a failure within the electric control transmission of the stability system.

42-3.6.1.16.4.7 When the supply voltage to the trailer falls below a value nominated by the manufacturer at which the prescribed service braking performance can no longer be guaranteed.

42-3.6.1.16.4.8 When it is failure to supply energy。

42-3.6.1.16.5 A failure within the electric control transmission, that affects the function and performance of systems addressed in this Regulation, shall be indicated to the driver by the red or yellow warning signal.

42-3.6.1.16.6 When the battery voltage falls below a value nominated by the manufacturer at which the prescribed service braking performance can no longer be guaranteed and/or which precludes at least two independent service braking circuits from each achieving the prescribed secondary or residual braking performance, the red warning signal specified in paragraph 42-3.6.1.16.3.4. shall be activated. After the warning signal has been activated, it shall be possible to apply the service braking control and obtain at least the residual performance prescribed in paragraph 42-3.6.3.5 of this Regulation. It should be understood that sufficient energy is available in the energy transmission of the service

braking system. This requirement shall not be construed as a departure from the requirement concerning secondary braking.

42-3.6.1.17 The braking System of Category O vehicle:

42-3.6.1.17.1 Trailers of category O1 need not be equipped with a service braking system; however, if a trailer of this category is equipped with a service braking system, it must satisfy the same requirements as a trailer of category O2.

42-3.6.1.17.2 Trailers of category O2 must be equipped with a service braking system either of the continuous or semi-continuous or the inertia (overrun) type. The last type shall be permitted only for centre-axle trailers. However, electrical braking systems shall be permitted.

42-3.6.1.17.3 Trailers of categories O3 and O4 must be equipped with a service braking system of the continuous or semi-continuous type.

42-3.6.1.17.4 In the case of a power-driven vehicle to which the coupling of a trailer equipped with a brake controlled by the driver of the towing vehicle is authorized, the service braking system of the towing vehicle must be equipped with a device so designed that in the event of failure of the trailer's braking system, or in the event of an interruption in the air supply pipe (or of such other type of connection as may be adopted) between the towing vehicle and its trailer, it shall still be possible to brake the towing vehicle with the effectiveness prescribed for secondary braking; it is accordingly prescribed, in particular, that this device shall be situated on the towing vehicle.

42-3.6.1.17.5 In the event of a failure (e.g. breakage of or leak) in one of the pneumatic connecting lines, interruption or defect in the electric control line, it shall nevertheless be possible for the driver fully or partially to actuate the brakes of the trailer by means either of the service braking control or of the secondary braking control or of the parking braking control, unless the failure automatically causes the trailer to be braked with the performance prescribed in paragraph 42-3.6.4.3.

42-3.6.1.17.6 Trailers of category O4 intended for use as transport units for dangerous goods（ADR）shall be equipped with category A anti-lock systems.

42-3.6.1.18 Where use is made of energy other than the muscular energy of the driver, there need not be more than one source of such energy, but he means by which the device constituting that source is driven must be as safe as practicable.

42-3.6.1.18.1 Any vehicle fitted with a service brake actuated from an energy reservoir must, where the prescribed secondary braking performance cannot be obtained by means of this brake without the use of the stored energy, be provided with a warning device, giving an optical or acoustic signal when the stored energy, in any part of the system, falls to a value at which without re-charging of the reservoir and irrespective of the load conditions of the vehicle, it is possible to apply the service brake control a fifth time after our full-stroke actuations and obtain the prescribed secondary braking performance (without faults in the service brake transmission device and with the brakes adjusted as closely as possible). This warning device must be directly and permanently connected to the circuit. When the engine is running under normal operating conditions and there are no faults in the braking system, as is the case in type approval tests, the warning device must give no signal except during the time required for charging the energy reservoir(s) after start-up of the engine.

42-3.6.1.19 Trailers of categories O3 and O4 shall satisfy the conditions if it installed automatic braking of the trailer shall comply with stipulations as below：

42-3.6.1.19.1 when the designated brake control of the controls, is fully actuated, the pressure in the supply line must fall to 150

kPa within the following two seconds; in addition, when the brake control is released, the supply line shall be re-pressurised.

42-3.6.1.19.2 when the supply line is evacuated at the rate of at least 100 kPa per second the automatic braking of the trailer must start to operate before the pressure in the supply line falls to 200 kPa.

42-3.6.1.20 Generation of a signal to illuminate stop lamps.

42-3.6.1.20.1 Activation of the service braking system by the driver shall generate a signal that will be used to illuminate the stop lamps.

42-3.6.1.20.2 Requirements for vehicles that utilize electronic signalling to control initial application of the service braking system, and equipped with endurance braking and/or regenerative braking system of Category A:

Deceleration by the endurance braking and/or regenerative braking system	
$\leq 1.3\ m/s^2$	$> 1.3\ m/s^2$
May generate the signal	Shall generate the signal

42-3.6.1.20.2.1 In the case of vehicles equipped with a braking system of a specification different to that defined in paragraph above,42-3.6.1.20.2 the operation of the endurance braking system and/or regenerative braking system of Category A may generate the signal irrespective of the deceleration produced.

42-3.6.1.20.2.2 The signal shall not be generated when retardation is produced by the natural braking effect of the engine alone.

42-3.6.1.20.3 Activation of the service braking system by "automatically commanded braking" shall generate the signal. In the case of trailers equipped with an electric control line the message "illuminate stop lamps" shall be transmitted by the trailer via the electric control line when the trailer braking system is activated during "automatically commanded braking" initiated by the trailer. However, when the retardation generated is less than 0.7 m/s2, the signal may be suppressed.

42-3.6.1.20.4 Activation of part of the service braking system by "selective braking" shall not generate the signal.

（During a "selective braking" event, the function may change to "automatically commanded braking".）

42-3.6.1.20.5 In the case of vehicles equipped with an electric control line the signal shall be generated by the motor vehicle when a message "illuminate stop lamps" is received via the electric control line from the trailer. In the case of trailers equipped with an electric control line the message "illuminate stop lamps" shall not be transmitted by the trailer via the electrical control line during "selective braking" initiated by the trailer.

（This requirement shall not apply until the ISO 11992 Standard has been amended to include a message "illuminate stop lamps" and introduced into this Regulation.）

42-3.6.1.21 When a vehicle is equipped with the means to indicate emergency braking, activation and de-activation of the emergency braking signal shall only be generated by the application of the service braking system when the following conditions are fulfilled:

42-3.6.1.21.1 The signal shall not be activated when the vehicle deceleration is below the values defined in the following table but it may be generated at any deceleration at or above those values, the actual value being defined by the vehicle

manufacturer:

N1: Shall not be activated below 6 m/s2.

M2, M3, N2 and N3: Shall not be activated below 4 m/s2.

The signal shall be de-activated for all vehicles at the latest when the deceleration has fallen below 2.5 m/s2.

42-3.6.1.21.2 Signal may also be generated in the following conditions:

(a) The signal may be generated from a prediction of the vehicle deceleration resulting from the braking demand respecting the activation and de-activation thresholds defined in paragraph 42-3.6.1.21.1 above;or

(b) The signal may be activated when the service braking system is applied at a speed above 50 km/h and the antilock system is fully cycling (as defined in paragraph 42-3.2.11).

The signal shall be deactivated when the antilock system is no longer fully cycling.

42-3.6.1.22 In the case of N1 category vehicles with electric regenerative braking systems of category B, the braking input from other sources of braking, may be suitably phased to allow the electric regenerative braking system alone to be applied, provided that both the following conditions are met:

42-3.6.1.22.1 intrinsic variations in the torque output of the electrical regenerative braking system (e.g. as a result of changes in the electric state of charge in the traction batteries) are automatically compensated by appropriate variation in the phasing relationship as long as the requirements of one of the following annexes to this Regulation are satisfied:

paragraph 42-3.6.2.1.11.2 of this regulation, or

paragraph 43.6.3 of Anti-lock braking system (ABS). (including the case with the electric motor engaged), and

42-3.6.1.22.2 wherever necessary, to ensure that braking rate remains related to the driver's braking demand, having regard to the available tyre/road adhesion, braking shall automatically be caused to act on all wheels of the vehicle.

42-3.6.1.23 The service, secondary and parking braking systems shall act on braking surfaces connected to the wheels through components of adequate strength.

Where braking torque for a particular axle or axles is provided by both a friction braking system and an electrical regenerative braking system of category B, disconnection of the latter source is permitted, providing that the friction braking source remains permanently connected and able to provide the compensation referred to in paragraph 42-3.6.1.22.1.

However in the case of short disconnection transients, incomplete compensation is accepted, but within 1 s, this compensation shall have attained at least 75 per cent of its final value.

Nevertheless, in all cases the permanently connected friction braking source shall ensure that both the service and secondary braking systems continue to operate with the prescribed degree of effectiveness.

Disconnection of the braking surfaces of the parking braking system shall be permitted only on condition that the disconnection is controlled exclusively by the driver from his driving seat, by a system incapable of being brought into action by a leak.

42-3.6.1.24 Additional requirements for vehicles of categories M2, N1 and category N2 < 5 tonnes equipped with an electric regenerative braking system of category A:

42-3.6.1.24.1 The electric regenerative braking shall only be actuated by the accelerator control and/ or the gear selector neutral position for vehicles of category N1.

42-3.6.1.24.2 In addition, for vehicles of categories M2 and N2 (< 5 tonnes), the electric regenerative braking control can be a separate switch or lever.

42-3.6.1.24.3 The requirements of paragraphs 42-3.6.1.25.6 and 42-3.6.1.25.7. also apply to Category A regenerative braking systems.

42-3.6.1.25 Additional requirements for vehicles of Categories M2, N1, and N2 < 5 tonnes fitted with an electric regenerative braking system of category B:

42-3.6.1.25.1 It shall not be possible to disconnect, partially or totally, one part of the service braking system other than by automatic means. This should not be construed as a departure from the requirements of paragraph 42-3.6.1.23.

42-3.6.1.25.2 The service braking system shall have only one control device.

42-3.6.1.25.3 For vehicles fitted with electric regenerative braking systems of both categories, all the relevant prescriptions shall apply except paragraph 42-3.6.1.24.1.

In this case, the electric regenerative braking may be actuated by the accelerator control and/or the gear selector neutral position for vehicles of category N1.

Additionally, the action on the service braking control shall not reduce the above braking effect generated by the release of accelerator control.

42-3.6.1.25.4 The service braking system shall not be adversely affected by the disengagement of the motor(s) or by the gear ratio used.

42-3.6.1.25.5 If the operation of the electric component of braking is ensured by a relation established between the information coming from the control of the service brake and the braking force at the respective wheels, a failure of this relation leading to the modification of the braking distribution among the axles (paragraph 43.6.2.10 and 43.6.6 of Anti-lock braking system (ABS), whichever is applicable) shall be signalled to the driver by an optical warning signal at the latest at the moment when the control is actuated and this signal shall remain lit as long as this defect exists and that the vehicle control switch (key) is in the "ON" position.

42-3.6.1.25.6 The operation of the electric regenerative braking shall not be adversely affected by magnetic or electric fields.

42-3.6.1.25.7 For vehicles equipped with an anti-lock device, the anti-lock device shall control the electric regenerative braking system.

42-3.6.1.26 Category B: In the case of a vehicle contribution of the electric regenerative braking system to the braking force generated, when the state of charge of the batteries is in one of the following conditions, shall not exceed that minimum level guaranteed by the system design:

42-3.6.1.26.1 at the maximum charge level as recommended by the manufacturer in the vehicle specification, or

42-3.6.1.26.2 at a level not less than 95% of the full charge level, where the manufacturer has made no specific recommendation, or

42-3.6.1.26.3 at the maximum level which results from automatic charge control on the vehicle.

42-3.6.2 Braking Test

42-3.6.2.1 General:

42-3.6.2.1.1 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.

42-3.6.2.1.1.1 Stopping Distance: means 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.

42-3.6.2.1.1.2 The mean fully developed deceleration (dm): shall be calculated as the deceleration averaged with respect to distance over the interval Vb to Ve, according to the following formula:

$$d_m = \frac{v_b^2 - v_e^2}{25.92(s_e - s_b)}$$

where:

v_0= initial vehicle speed (km/h); not less than 98% of the prescribed speed for the test in question.

v_b=vehicle speed at 0.8 v_0 (km／hr)

v_e= vehicle speed at 0.1 v_0 (km／hr)

s_b= distance traveled between v_0 and v_b (m)

s_e= distance traveled between v_0 and v_e (m)

42-3.6.2.1.2 the vehicle's condition as regards mass must be as prescribed for each type of test and be specified in the test report

42-3.6.2.1.3 The tests must be performed when there is no wind liable to affect the results; The road must have a surface affording good adhesion, unless specified otherwise in the relevant regulation.

42-3.6.2.1.4 If the maximum design speed of a vehicle is lower than the speed prescribed for a test, the test shall be performed at the vehicle's maximum speed.

42-3.6.2.1.5 The prescribed performance must be obtained without locking of the wheels (at speeds exceeding 15km/h), without deviation of the vehicle from its course, and without abnormal vibrations.

42-3.6.2.1.6 If systems or functions, which use the braking system as the means of achieving a higher level objective, are provided, they must not be deactivated during type approval testing of the braking system.

42-3.6.2.1.7 For vehicles powered completely or partially by an electric motor (or motors), permanently connected to the wheels, all tests shall be carried out with the motor(s) connected.

42-3.6.2.1.8 For vehicles as described in paragraph 42-3.6.2.1.7, fitted with an electric regenerative braking system of category A, behaviour tests defined in paragraph 42-3.6.2.2.3 shall be carried out on a track with a low adhesion coefficient (as defined in paragraph paragraph 42-3.6.2.1 of Anti-lock braking system (ABS)). However, the maximum test speed shall not exceed the maximum test speed specified in paragraph 42-3.6.3.2. for a low adhesion surface and the relevant vehicle category.

42-3.6.2.1.8.1 Moreover, for vehicles fitted with an electric regenerative braking system of category A, transient conditions as gear changes or accelerator control release shall not affect the behaviour of the vehicle under test condition described in paragraph 42-3.6.2.1.8.

42-3.6.2.1.9 During the tests specified in paragraphs 42-3.6.2.1.8 and 42-3.6.2.1.8.1, wheel locking is not allowed. However, steering correction is permitted if the angular rotation of the steering control is within 120 degrees during the initial 2

seconds and not more than 240 degrees in total.

42-3.6.2.1.10 For a vehicle with electrically actuated service brakes powered from traction batteries (or an auxiliary battery) which receive(s) energy only from an independent external charging system, these batteries shall, during braking performance testing, be at an average of not more than 5 per cent above that state of charge at which the brake failure warning prescribed in paragraph 42-3.6.1.16.6. is required to be given. If this warning is given, the batteries may receive some recharge during the tests, to keep them in the required state of charge range.

42-3.6.2.1.11 Behaviour of the vehicle during braking

42-3.6.2.1.11.1 In braking tests, and in particular in those at high speed, the general behaviour of the vehicle during braking shall be checked.

42-3.6.2.1.11.2 Behaviour of the vehicle during braking on a road on which adhesion is reduced. The behaviour of vehicles of categories M2, M3, N1, N2, N3, O2, O3 and O4 on a road on which adhesion is reduced, shall meet the relevant paragraphs of 42-3.6.2.10 and 42-3.6.6 and/or relevant requirements of “43 Anti-lock braking system (ABS) “.

42-3.6.2.1.11.2.1 In the case of a braking system according to paragraph 42-3.6.1.22., where the braking for a particular axle (or axles) is comprised of more than one source of braking torque, and any individual source can be varied with respect to the other(s), the vehicle shall satisfy the paragraphs of 42-3.6.2.10 and 42-3.6.6, or alternatively, “43 Anti-lock braking system (ABS)” under all relationships permitted by its control strategy.

42-3.6.2.2 Type-0 Test: ordinary performance test with brakes cold

42-3.6.2.2.1 General:

42-3.6.2.2.1.1 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℃) respectively on both laden and unladen conditions.

42-3.6.2.2.1.1.1 Laden: means a vehicle so laden as to attain its "maximum mass.

42-3.6.2.2.1.1.2 Unladen: means a vehicle with the testing instruments, a driver and a recording operator.

42-3.6.2.2.1.1.3 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 must be such that the load on each axle is proportional to the maximum permissible load for each axle; In the case of tractors 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).

42-3.6.2.2.1.1.4 In the case of a tractor for a semi-trailer, the unladen tests will be conducted with the vehicle in its solo condition, including a mass representing the fifth wheel.

42-3.6.2.2.1.1.5 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.

42-3.6.2.2.1.2 In the case of a vehicle equipped with an electric regenerative braking system:

42-3.6.2.2.1.2.1 Category A: Any separate electric regenerative braking control which is provided, shall not be

used during the Type-0 tests.

42-3.6.2.2.1.2.2 Category B: In the case of a vehicle contribution of the electric regenerative braking system to the braking force generated, when the state of charge of the batteries is in one of the following conditions to paragraph 42-3.6.1.26 , any separate electric regenerative braking control which is provided shall not exceed that minimum level guaranteed by the system design.

42-3.6.2.2.2 Type-0 Test with engine disconnected (Neutral Gear) is conducted at the vehicle speed specified in table 1.

42-3.6.2.2.3 Type-0 Test with engine connected (Driving Gear) is conducted at the speed limitation specified in table 1.

42-3.6.2.2.3.1 Tests must also be carried out 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.

42-3.6.2.2.3.2 In the case of vehicles equipped with a speed limiter, this limiter speed shall be taken as the maximum speed of the vehicle.

42-3.6.2.2.3.3 Tractors for semi-trailers, artificially loaded to simulate the effects of a laden semi-trailer shall not be tested beyond 80 km/h.

Table 1 Type-0 Test Vs. Category-Speed (km/hr)

	Category	M_2	M_3	N_1	N_2	N_3
	Type of test	0-I	0-I-II或 IIA	0-I	0-I	0-I-II
Type-0 Test (Neutral Gear)	v	60	60	80	60	60
Type-0 Test, Engine Connected	v=0.80v_{max} but not exceeding	100	90	120	100	90

42-3.6.2.2.4 Type-0 test for vehicles of category O, equipped with compressed-air brakes:

42-3.6.2.2.4.1 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 must 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.

42-3.6.2.2.4.2 With the exception of cases according to paragraphs 42-3.6.2.2.4.3 and 42-3.6.2.2.4.4 below, 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 braking rate of the trailer is calculated according to the following formula:

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

where:

Z_R = braking rate of trailer,

Z_{R+M} = braking rate of the towing vehicle plus the trailer,

D = thrust on the coupling,
(tractive force： +D)，
(compressive force： -D)

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

42-3.6.2.2.4.3 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 is calculated according to the following formula:

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

where:

R =Rolling Resistance = 0.01

P_M = total normal static reaction between road surface and wheels of towing vehicles for trailers

42-3.6.2.2.4.4 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.

42-3.6.2.3 Type-I Test: Fade Test

42-3.6.2.3.1 In the case of vehicles equipped with automatic brake adjustment devices the adjustment of the brakes shall, prior to the Type-I test above, be set according to the following procedures as appropriate:

42-3.6.2.3.1.1 In the case of vehicles equipped with air operated brakes the adjustment of the brakes shall be such as to enable the automatic brake adjustment device to function.

42-3.6.2.3.1.2 In the case of vehicles equipped with hydraulically operated disc brakes no setting requirements are deemed necessary.

42-3.6.2.3.1.3 In the case of vehicles equipped with hydraulically operated drum brakes the adjustment of the brakes shall be as specified by the manufacturer.

42-3.6.2.3.2 Heating Procedure

42-3.6.2.3.2.1 The service brakes of all power-driven vehicles must be tested by successively applying and releasing the brakes a number of times, the vehicle being laden, in the conditions shown in the table below:

Category	Condition			
	v_1	v_2	Δt (秒)	n
M_2	80% v_{MAX} □100	1/2 v_1	55	15

N_1	80% v_{MAX} □120	1/2 v_1	55	15
M_3 , N_2 , N_3	80% v_{MAX} □60	1/2 v_1	60	20

where:

v_1 = initial speed, at beginning of braking (km/hr)
v2 = speed at end of braking (km/hr)
vMAX = maximum speed of vehicle (km/hr)
n = number of brake applications
Δt = duration of a braking cycle：time elapsing between the initiation of one brake application and the initiation of the next.

42-3.6.2.3.2.2 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 stabilizing the speed v1.

42-3.6.2.3.2.3 In these tests, the force applied to the control must be so adjusted as to attain the mean fully developed deceleration of 3 m/s2 at the first brake application; this force must remain constant throughout the succeeding brake applications.

42-3.6.2.3.2.4 During brake applications, the highest gear ratio (excluding overdrive, etc.) must be continuously engaged.

42-3.6.2.3.2.5 For vehicles not having sufficient autonomy to carry out the cycles of heating of the brakes, the tests shall be carried out by achieving the prescribed speed before the first braking application and thereafter by using the maximum acceleration available to regain speed and then braking successively at the speed reached at the end of each time cycle duration as specified, for the appropriate vehicle category, in paragraph 42-3 6.2.3.2.1 . above.

42-3.6.2.3.2.6 For vehicles equipped with an electric regenerative braking system of category B, the condition of the vehicle batteries at the start of the test, shall be at one of the state of charge conditions listed in paragraph 42-3.6.1.26.2 such that the braking force contribution provided by the electric regenerative braking system does not exceed the minimum guaranteed by the system design.

42-3.6.2.3.3 Continuous Braking:

42-3.6.2.3.3.1 The service brakes of trailers of categories O2 and O3 (when the O3 trailer has not passed alternatively the Type-III test according to paragraph 42-3.6.2.5) 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.

42-3.6.2.3.3.2 The test may be carried out on a level road, the trailer being drawn by a towing 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 maximum total 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 table below:

Speed (km/h)	Distance (m)
40	1700
30	1950
20	2500
15	3100

42-3.6.2.3.4 Hot Performance Test:

42-3.6.2.3.4.1 At the end of the Type-I test, the hot performance of the service braking system must be measured in 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).

42-3.6.2.3.4.2 For vehicles fitted with an electric regenerative braking system of category A, during brake applications, the highest gear shall be continuously engaged and the separate electric regenerative braking control, if any, shall not be used.

42-3.6.2.3.4.3 In the case of vehicles equipped with an electric regenerative braking system of category B, having carried out the heating cycles according to paragraph 42-3.6.2.3.2.5, the hot performance test shall be carried out at the maximum speed which can be reached by the vehicle at the end of the brake heating cycles, unless the speed specified in paragraph 42-3.6.2.2.2 can be reached.

For comparison, the Type-0 test with cold brakes shall be repeated from this same speed and with a similar electric regenerative braking contribution, as set by an appropriate state of battery charge, as was available during the hot performance test. Reconditioning of the linings shall be permitted before the test is made to compare this second Type-0 cold performance with that achieved in the hot test, against the criteria of paragraphs 42-3.6.3.6.1.1. and 42-3.6.3.6.1.2.

42-3.6.2.3.5 Free Running Test:

In the case of motor vehicles equipped with automatic brake adjustment devices, the brakes after completing the tests defined in paragraph 42-3.6.2.3.4 above will be allowed to cool to a temperature representative of a cold brake and it shall be verified that the vehicle is capable of free running by fulfilling one of the following conditions:

42-3.6.2.3.5.1 Wheels are running freely (i.e. may be rotated by hand)

42-3.6.2.3.5.2 When the vehicle is driven at a constant speed of v = 60 km/h with the brakes released the asymptotic temperatures and the residual brake moments shall be checked.

42-3.6.2.4 Type-II Test (Downhill Behavior Test):

42-3.6.2.4.1 Laden power-driven vehicles must 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 endurance braking system, if the vehicle is equipped with one, being used. The gear engaged must be such that the speed of the engine (min-1) does not exceed the maximum value prescribed by the manufacturer.

42-3.6.2.4.2 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 stabilized 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.

42-3.6.2.4.3 At the end of the test, the hot performance of the service braking system must be measured in the same conditions as for the Type-0 test with the engine disconnected (the temperature conditions may be different).

42-3.6.2.5 Type-III Test (Fade Test for laden Vehicles of Category O4 or alternatively of category O3)

42-3.6.2.5.1 Track Test

42-3.6.2.5.1.1 The adjustment of the brakes shall, prior to the Type-III test below, be set according to the following procedures as appropriate:

42-3.6.2.5.1.1.1 In the case of trailers equipped with air operated brakes the adjustment of the brakes shall be such as to enable the automatic brake adjustment device to function.

42-3.6.2.5.1.1.2 In the case of trailers equipped with hydraulically operated disc brakes no setting requirements are deemed necessary.

42-3.6.2.5.1.1.3 In the case of trailers equipped with hydraulically operated drum brakes the adjustment of the brakes shall be as specified by the manufacturer.

42-3.6.2.5.1.2 For the road test the conditions shall be as follows:

42-3.6.2.5.1.2.1 20 times of brake application with each braking cycle duration of 60 seconds.

42-3.6.2.5.1.2.2 The Initial speed at the beginning of braking is 60 km/h; In these tests, the force applied to the control must be so adjusted as to attain the mean fully developed deceleration of 3 m/s^2 in respect to the trailer mass (PR) at the first brake application; this force must remain constant throughout the succeeding brake applications.

42-3.6.2.5.1.3 The braking rate of a trailer is calculated according to the formula given in paragraph 42-3.6.2.2.4.3.

42-3.6.2.5.1.4 The speed at the end of braking:

$$v_2 = v_1 \cdot \sqrt{\frac{P_M + P_1 + P_2 / 4}{P_M + P_1 + P_2}}$$

where:

Z_R = braking rate of the trailer

Z_{R+M} = braking rate of the vehicle combination (motor vehicle and trailer)

R = Rolling Resistance = 0.01

P_M = total normal static reaction between the road surface and the wheels of towing vehicle for trailer (kg)

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

42-3.6.2.5.2 Hot Performance Test:

At the end of the test according to paragraph 42-3.6.2.5.1, the hot performance of the service braking system must 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.

42-3.6.2.5.3 Free Running Test:

After completing the tests defined in paragraph 42-3.6.2.5.2, above, the brakes will be allowed to cool to a temperature representative of a cold brake and it shall be verified that the trailer is capable of free running by fulfilling one of the following conditions:

42-3.6.2.5.3.1 Wheels are running freely (i.e. may be rotated by hand)

42-3.6.2.5.3.2 When the vehicle is driven at a constant speed of v = 60 km/h with the brakes released the asymptotic temperatures and the residual brake moments shall be checked.

42-3.6.2.6 Type-IIA Test (Endurance braking performance)

42-3.6.2.6.1 Vehicles of the following categories shall be subject to the Type-IIA test:

42-3.6.2.6.1.1 The passenger vehicles of maximum mass exceeding 5 tonnes：

42-3.6.2.6.1.1.1 No area available for standing passengers; or

42-3.6.2.6.1.1.2 The passenger vehicles having a capacity exceeding 22 passengers in addition to the driver, vehicles constructed principally for the carriage of seated passengers, and designed to allow the carriage of standing passengers in the gangway and/or in an area which does not exceed the space provided for two double seats.

42-3.6.2.6.1.2 Vehicles of category N3 which are authorized to tow a trailer of category O4

42-3.6.2.6.1.3 The power-driven vehicle and trailers with endurance braking system intended for use as transport units for dangerous goods（ADR）.

42-3.6.2.6.2 Test Conditions：

42-3.6.2.6.2.1 The performance of the endurance braking system shall be tested at the maximum mass of the vehicle or of the vehicle combination.

42-3.6.2.6.2.2 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 must not be engaged. The gear engaged must be such that the speed of the engine does not exceed the maximum value prescribed by the manufacturer. An integrated endurance braking system 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 its brakes remain cold.

42-3.6.2.6.2.3 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 stabilized at a value

closest to 30 km/h on a 7% down-gradient shall be engaged.

42-3.6.2.7 Secondary Braking System :

42-3.6.2.7.1 The performance of the secondary braking system must be checked by the Type-0 test with engine disconnected from the following initial speeds:

	M2	M3	N1	N2	N3
Speed(km/h)	60	60	70	50	40

42-3.6.2.7.2 The secondary braking effectiveness test shall be conducted by simulating the actual failure conditions in the service braking system.

42-3.6.2.7.3 For vehicles employing electric regenerative braking systems, the braking performance shall additionally be checked under the two following failure conditions:

42-3.6.2.7.3.1 For a total failure of the electric component of the service braking output.

42-3.6.2.7.3.2 In the case where the failure condition causes the electric component to deliver its maximum braking force.

42-3.6.2.8 Test for Parking Braking System:

42-3.6.2.8.1 The parking braking system must, with the vehicle laden, be tested on an 18% up or down-gradient.

42-3.6.2.8.2 On vehicles to which the coupling of a trailer is authorized, the parking braking system of the towing vehicle must be, with the combination of vehicles, tested on a 12% up or down-gradient.

42-3.6.2.8.3 To check compliance with the requirement specified in paragraph 42-3.6.1.6, a Type-0 test must be carried out with the engine disconnected at an initial test speed of 30 km/h. The test shall be carried out with the laden vehicle.

42-3.6.2.9 The residual braking after transmission failure:

42-3.6.2.9.1 The residual performance of the service braking system, in the event of failure in a part of its transmission, must be checked by the Type-0 test with the engine disconnected from the initial speeds prescribed in paragraph 42-3.6.2.7.1.

42-3.6.2.9.2 The residual braking effectiveness test shall be conducted by simulating the actual failure conditions in the service braking system.

42-3.6.2.10 Distribution of Braking among the Axles of vehicles and The Compatibility between Towing Vehicles and Trailers:

42-3.6.2.10.1 Adhesion Utilization Curve:

42-3.6.2.10.1.1 The manufacturer shall provide the adhesion utilization curves for the front and rear axles calculated by the formulae:

$$f_1 = \frac{T_1}{N_1} = \frac{T_1}{P_1 + z \cdot \frac{h}{E} \cdot P \cdot g}$$

$$f_2 = \frac{T_2}{N_2} = \frac{T_2}{P_2 - z \cdot \frac{h}{E} \cdot P \cdot g}$$

where :

f_i = Adhesion utilized by axle i

T_i = Force exerted by the brakes on axle i under normal braking conditions on the road.

N_i = Normal reaction of road surface on axle i under braking

P_i = Normal reaction of road surface on axle i under static conditions

g = Acceleration due to gravity

z = Braking rate of vehicle

P = Mass of vehicle

h = height above ground of centre of gravity specified by the manufacturer and agreed by the authorities.

E =Wheelbase

42-3.6.2.10.1.2 The curves shall be plotted for both the following load conditions:

42-3.6.2.10.1.2.1 Unlden: in running order with the driver on board; 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.

42-3.6.2.10.1.2.2 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 considered.

42-3.6.2.10.2 If it is not possible, for vehicles with (permanent) all-wheel drive, to carry out the mathematical verification pursuant to paragraph 42-3.6.2.10.1 above, the manufacturer may instead verify by means of a wheel lock sequence test:

42-3.6.2.10.2.1 The wheel lock sequence test shall be conducted on road surfaces with a coefficient of adhesion of not more than 0.3 and of about 0.8 (dry road).

42-3.6.2.10.2.2 Test Speed

42-3.6.2.10.2.2.1 60 km/h, but not exceeding 0.8 v_{max} for decelerations on low coefficient of friction road surfaces;

42-3.6.2.10.2.2.2 80 km/h, but not exceeding v_{max} for decelerations on high coefficient of friction road surfaces.

42-3.6.2.10.2.3 Pedal force is applied and increased such that the second wheel on the vehicle will reach lockup between 0.5 and 1 second after initiating the brake application, until lockup of both wheels on one axle occurs.

42-3.6.2.10.2.4 The tests shall be carried out twice on each road surface. If the result of one test fails, a third, hence decisive test shall be carried out.

42-3.6.3 The Performance Requirements of Vehicles of Categories M2, M3 and N:

42-3.6.3.1 Service Braking System:

42-3.6.3.1.1 The stopping distance and average deceleration can be designated as below table:

	Category	M_2	M_3	N_1	N_2	N_3
	Type of Test	0-I	0-I-II or IIA	0-I	0-I	0-I-II
Type-0 Test with Engine diconnected	s≤ d_m≥	$0.15v+\frac{v^2}{130}$ 5.0m/s²				
Type-0 Test With Engine Connected	s≤ d_m≥	$0.15v+\frac{v^2}{103}\cdot 5$ 4.0m/s²				
	F≤	700N				

where:

v = test speed, in km/h

s= stopping distance, in meter

d_m=mean fully developed deceleration, in m/s²

F= force applied to foot control, in N

42-3.6.3.1.2 In the case of a power-driven vehicle authorized to tow an unbraked trailer, the minimum performance prescribed for the corresponding power-driven vehicle category (for the Type-0 test with engine disconnected) must be attained with the unbraked trailer coupled to the power-driven vehicle and with the unbraked trailer laden to the maximum mass declared by the power-driven vehicle manufacturer.

42-3.6.3.1.3 The combination performance shall be verified by calculations referring to the maximum braking performance actually achieved by the power-driven vehicle alone (laden) during the Type-0 test with the engine disconnected, using the following formula:

$$d_{M+R}=d_M\cdot\frac{PM}{PM+PR}$$

where:

d_{M+R} = calculated mean fully developed deceleration of the power-driven vehicle when coupled to an unbraked trailer,

d_M= maximum mean fully developed deceleration of the power-driven vehicle alone achieved during the

Type-0 test with engine disconnected,

PM= mass of power-driven vehicle (laden)

PR= maximum mass of an unbraked trailer which may be coupled, as declared by the power-driven vehicle manufacturer.

42-3.6.3.2 Secondary Braking System:

42-3.6.3.2.1 The secondary braking system, even if the control which actuates it is also used for other braking functions, must give a stopping distance not exceeding the following values and a mean fully developed deceleration not less than the following values:

42-3.6.3.2.1.1 M2 and M3 Category Vehicle: $0.15v + (2v^2/130)$; the second term corresponds to a mean fully developed deceleration: 2.5 m/s2

42-3.6.3.2.1.2 N Category Vehicle: $0.15v + (2v^2/115)$; the second term corresponds to a mean fully developed deceleration: 2.2 m/s^2

42-3.6.3.3 Parking Braking System:

42-3.6.3.3.1 The parking braking system must be capable of holding the laden vehicle stationary on a 18% up or down gradient.

42-3.6.3.3.2 On vehicles to which the coupling of a trailer is authorized, the parking braking system of the towing vehicle must be capable of holding the combination of vehicles stationary on a 12% up or down gradient.

42-3.6.3.3.3 A parking braking system which has to be actuated several times before it attains the prescribed performance is admissible.

42-3.6.3.3.4 The mean fully developed deceleration on application of the control of the parking brake system and the deceleration immediately before the vehicle stops shall not be less than 1.5 m/s2; the force exerted on the braking control device shall comply with the paragraph 42-3.6.3.4 below.

42-3.6.3.3.5 The following requirements shall be fulfilled in the event of an electrical failure as specified:

42-3.6.3.3.5.1 Vehicles of categories M2, M3, N2 and N3: In the case of an electrical failure in the control or a break in the wiring within the electric control transmission external to the electronic control unit(s), excluding the energy supply, it shall remain possible to apply the parking braking system from the driver's seat. Alternatively, in this case, an automatic actuation of the parking brake is allowed when the vehicle is stationary, provided that the above performance is achieved and, once applied, the parking brake remains engaged independently of the status of the ignition (start) switch. In this alternative, the parking brake shall be automatically released as soon as the driver starts to set the vehicle in motion again. It shall also be possible to release the parking braking system, if necessary by the use of tools and/or an auxiliary device carried/fitted on the vehicle.

42-3.6.3.3.5.2 Vehicles of category N1: In the case of an electrical failure in the control or a break in the wiring within the electric control transmission between the control and the ECU directly connected with it, excluding the energy supply, it shall remain possible to apply the parking braking system from the driver's seat. Alternatively, in this case, an automatic actuation of the parking brake is allowed when the vehicle is stationary, provided that the above performance is achieved and, once applied, the parking brake remains engaged independently of the status of the ignition (start) switch. In this alternative, the parking brake shall be automatically released as soon as the

driver starts to set the vehicle in motion again. The engine/manual transmission or the automatic transmission (park position) may be used to achieve or assist in achieving the above performance.

42-3.6.3.3.5.3 A break in the wiring within the electric transmission, or an electric failure in the control of the parking braking system shall be signalled to the driver by the yellow warning signal specified in paragraph 42-3 6.1.16. When caused by a break in the wiring within the electric control transmission of the parking braking system, this yellow warning signal shall be signalled as soon as the break occurs. In addition, such an electric failure in the control or break in the wiring external to the electronic control unit(s) and excluding the energy supply shall be signalled to the driver by flashing the red warning signal specified in paragraph 42-3 6.1.16 as long as the ignition (start) switch is in the "on" (run) position including a period of not less than 10 seconds thereafter and the control is in the "on" (activated) position. Where actuation of the parking brake is normally indicated by a separate red warning signal, satisfying all the requirements of 42-3 6.1.16.1 this signal shall be used to satisfy the above requirement for a red signal.

42-3.6.3.4 The exerted force of Secondary Braking System and Parking Braking System:

42-3.6.3.4.1 If the control is manual, the force applied to it must not exceed 600N.

42-3.6.3.4.2 If it is a foot control, the force exerted on the control must not exceed 700N.

42-3.6.3.5 The residual braking after transmission failure:

42-3.6.3.5.1 The residual performance of the service braking system, in the event of failure in a part of its transmission, must give a stopping distance not exceeding the following values and a mean fully developed deceleration not less than the following values:

Category	Laden		Unladen	
	s(m)	d_m (m/s^2)	s(m)	d_m (m/s^2)
M2	$0.15v + (100/30)\cdot(v^2/130)$	1.5	$0.15v + (100/25)\cdot(v^2/130)$	1.3
M3	$0.15v + (100/30)\cdot(v^2/130)$	1.5	$0.15v + (100/30)\cdot(v^2/130)$	1.5
N1	$0.15v + (100/30)\cdot(v^2/115)$	1.3	$0.15v + (100/25)\cdot(v^2/115)$	1.1
N2	$0.15v + (100/30)\cdot(v^2/115)$	1.3	$0.15v + (100/25)\cdot(v^2/115)$	1.1
N3	$0.15v + (100/30)\cdot(v^2/115)$	1.3	$0.15v + (100/25)\cdot(v^2/115)$	1.3

42-3.6.3.5.2 Use a control force not exceeding 700N.

42-3.6.3.6 Hot Performance:

42-3.6.3.6.1 Type-I Test:

42-3.6.3.6.1.1 For power-driven vehicles this hot performance must 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.

42-3.6.3.6.1.2 In the case of a power-driven vehicle which satisfies the 60% requirement specified in paragraph above, but which cannot comply with the 80% requirement of paragraph above, a further hot performance test may be carried out using a control force not exceeding that specified in paragraph 42-3.6.3.1.1. The results of both tests shall be entered in the report.

42-3.6.3.6.2 Type-II Test: a stopping distance not exceeding the following values and a mean fully developed deceleration not less than the following values,

42-3.6.3.6.2.1 M3 Category Vehicle: $0.15v + (1.33v^2 / 130)$ (the second term corresponds to a mean fully developed deceleration dm = 3.75 m/s2)

42-3.6.3.6.2.2 N3 Category Vehicle: $0.15v + (1.33v^2 / 115)$ (the second term corresponds to a mean fully developed deceleration dm = 3.3 m/s^2)

42-3.6.3.6.3 Type-III Test: The hot brake-force at the periphery of the wheels must then 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.

42-3.6.3.7 Type IIA Test:

42-3.6.3.7.1 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℃.

42-3.6.3.7.2 If the performance of the braking action of the engine alone is determined by measuring the deceleration, it shall be sufficient if the mean deceleration measured is at least 0.6 m/s^2.

42-3.6.4 Performance of Braking Systems of Vehicle of Category O:

42-3.6.4.1 Service Braking System:

42-3.6.4.1.1 If the service braking system is of the continuous or semi-continuous type, the sum of the forces exerted on the periphery of the braked wheels shall be at least x% of the maximum stationary wheel load, x having the following values:

Category	Load	x (%)
Full Trailer/Central-Axle Trailer	Laden & Unladen	50
Semi-trailer	Laden & Unladen	45

42-3.6.4.1.2 If the trailer is fitted with a compressed-air braking system, the pressure in the supply line shall not exceed 7 bar during the brake test (test speed 60 km/h) and the signal value in the control line shall not exceed the following values:

42-3.6.4.1.2.1 6.5 bar in the pneumatic control line.

42-3.6.4.1.2.2 a digital demand value corresponding to 6.5 bar in the electric control line.

42-3.6.4.1.3 Vehicles equipped with the inertia braking system, it shall comply with the following regulations:

42-3.6.4.1.3.1 Declararion of conformance of design: applicant shall ensure and announce comply with this regulation.

42-3.6.4.1.3.1.1 In hydraulic-transmission inertia braking systems a check shall be made to verify that the

travel of the master cylinder is not less than the maximum displacement of coupling head.

42-3.6.4.1.3.1.2 $G_A \leq G'_A$ trailer's "maximum mass" capable of being braked by the control device, as declared by the manufacturer（G_A :Technically permissible maximum mass）.

42-3.6.4.1.3.2 Testing requires:

42-3.6.4.1.3.2.1 Inertia braking devices must be so arranged that in the case when the coupling head travels to its fullest extent, no part of the transmission seizes, undergoes permanent distortion, or breaks.

42-3.6.4.1.3.2.2 When it is exercised with the practical braking operation, the self-actuation or unexpected control cannot occur in the braking mechanism of trailer.

42-3.6.4.1.3.2.3 The inertia braking system must allow the trailer to be reversed with the towing vehicle without imposing a sustained drag force exceeding $0.08 \cdot g \cdot G_A$ (G_A : technically permissible maximum mass). Devices used for this purpose must act automatically and disengage automatically when the trailer moves forward. Any special device incorporated for this purpose shall be such that the parking performance when facing up a gradient shall not be adversely affected.

42-3.6.4.1.4 The vehicles of category O1(if equipped with service braking system), O2 and O3 must be conducted with type-I test or alternatively a Type-III test in the case of an O3 trailer. In the Type-I or the Type-III test of a semi-trailer, the mass braked by the latter's axle(s) must correspond to the maximum axle load(s) (not including the king pin load).

42-3.6.4.1.5 The vehicles of category O4 must undergo the Type- test. In the Type- III test of a semi-trailer, the mass braked by the latter's axle(s) must correspond to the maximum axle load(s).

42-3.6.4.1.6 However, in the case of trailers, the hot brake force at the periphery of the wheels when tested at 40 km/h must not be less than 36□of the maximum stationary wheel load, nor less than 60□of the figure recorded in the Type-0 test at the same speed.

42-3.6.4.1.7 The hot brake-force at the periphery of the wheels must then 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.

42-3.6.4.2 Parking Braking System: The parking braking system with which the trailer is equipped must be capable of holding the laden trailer stationary, when separated from the towing vehicle, on an 18% up or down-gradient. The force applied to the control device must not exceed 600 N.

42-3.6.4.3 Automatic Braking System: The automatic braking performance, when testing the laden vehicle from a speed of 40 km/h, shall not be less than 13.5% of the maximum stationary wheel load. Wheel-locking at performance levels above 13.5% is permitted.

42-3.6.5 Response Time: Where a vehicle is equipped with a service braking system 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 in an emergency manoeuvre:

42-3.6.5.1 The time elapsing between the moment when the control device 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.

42-3.6.5.2 In the case of vehicles fitted with compressed-air braking systems, it is considered to be satisfied if the vehicle complies with the following provisions:

42-3.6.5.2.1 Vehicles of Categories M and N:

42-3.6.5.2.1.1 For an actuating time of 0.2 seconds, the time elapsing from the initiation of the braking system control actuation to the moment when the pressure in the brake cylinder reaches 75% of its asymptotic value shall not exceed 0.6 seconds.

42-3.6.5.2.1.2 The time elapsing from the initiation of brake-pedal actuation to the moment when:

42-3.6.5.2.1.2.1 the pressure measured at the coupling head of the pneumatic control line,

42-3.6.5.2.1.2.2 the digital demand value in the electric control line. reaches x% of its asymptotic, respectively final, value shall not exceed the times shown in the table below:

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

42-3.6.5.2.1.3 In the case of power-driven vehicles authorized to tow trailers of categories O3 or O4, the following test conducted and verified:

42-3.6.5.2.1.3.1 by measuring the pressure at the extremity of a pipe 2.5 m long with an internal diameter of 13 mm which shall be joined to the coupling head of the supply line;

42-3.6.5.2.1.3.2 by simulating a failure of the control line at the coupling head;

42-3.6.5.2.1.3.3 by actuating the service braking control device in 0.2 seconds.

42-3.6.5.2.2 For the vehicles of category O with a pneumatic control line the time elapsing between the moment when the pressure produced in the control line by the simulator reaches 650 kPa and the moment when the pressure in the brake actuator of the trailer reaches 75% of its asymptotic value must not exceed 0.4 seconds.

42-3.6.5.2.3 For the vehicles of category O with an electric control line the time elapsing between the moment when the signal produced by the simulator exceeds the equivalent of 650 kPa and the moment when the pressure in the brake actuator of the trailer reaches 75% of its asymptotic value must not exceed 0.4 seconds.

42-3.6.5.3 In the case of vehicles fitted with hydraulic braking systems, the requirements of paragraph 42-3.6.5.1 above are considered to be satisfied if, in an emergency manoeuvre, the deceleration of the vehicle or the pressure at the least favourable brake cylinder, reaches a level corresponding to the prescribed performance within 0.6 seconds.

42-3.6.6 Distribution of braking among the axles of vehicles and requirements for compatibility between towing vehicles and trailers: Vehicles which are not equipped with an anti-lock system shall meet all the requirements of this regulation，if vehicle install endurable braking that generate retardatory strength shouldn't consideration。

42-3.6.6.1 Two-Axled Vehicle

42-3.6.6.1.1 For all categories of vehicles for k values between 0.2 and 0.8: $z \geq 0.1 + 0.85(k - 0.2)$

42-3.6.6.1.2 Adhesion Utilization Curve: For all states of load of the vehicle, the adhesion utilization curve of the rear axle shall not be situated above that for the front axle:

42-3.6.6.1.2.1 For all braking rates between 0.15 and 0.80 in the case of vehicles of category M1 and vehicles of category

N1 with a laden/unladen rear axle loading ratio not exceeding 1.5 or having a maximum mass of less than 2 t. However, for vehicles of this category in the range of z values between 0.30 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);

42-3.6.6.1.2.2 For all braking rates between 0.15 and 0.50 in the case of vehicles of category N1. This condition is also considered satisfied if, for braking rates between 0.15 and 0.30, the adhesion utilization curves for each axle are situated between two lines parallel to the line of ideal adhesion utilization given by the equation k = z +/- 0.08 as shown in diagram 1B where the adhesion utilization curve for the rear axle may cross the line k = z - 0.08; and complies for a braking rate between 0.30 and 0.50, with the relation z > k - 0.08; and between 0.50 and 0.61 with the relation z > 0.5k + 0.21.

42-3.6.6.1.2.3 For all braking rates between 0.15 and 0.30 in the case of vehicles of other categories. This condition is also considered satisfied if, for braking rates between 0.15 and 0.30, the adhesion utilization curves for each axle are situated between two lines parallel to the line of ideal adhesion utilization given by the equation k = z +/- 0.08 as shown in diagram 1C and the adhesion utilization curve for the rear axle for braking rates z □ 0.3 complies with the relation z □ 0.3 + 0.74 (k - 0.38).

42-3.6.6.1.3 In the case of a power-driven vehicle authorized to tow trailers of category O3 or O4 fitted with compressed-air braking systems:

42-3.6.6.1.3.1 When tested with the energy source stopped, the supply line blocked off, a reservoir of 0.5 litre capacity connected to the pneumatic control line, and the system at cut-in and cut-out pressures, the pressure at full application of the braking control shall be between 650 kPa and 850 kPa at the coupling heads of the supply line and the pneumatic control line, irrespective of the load condition of the vehicle.

42-3.6.6.1.3.2 For vehicles equipped with an electric control line; a full application of the control of the service braking system shall provide a digital demand value corresponding to a pressure between 650 kPa and 850 kPa.

42-3.6.6.1.3.3 These values shall be demonstrably present in the power-driven vehicle when uncoupled from the trailer. The compatibility bands in the diagrams 2, 3 and 4, should not be extended beyond 750 kPa and/or the corresponding digital demand value.

42-3.6.6.1.3.4 It must be ensured that at the coupling head of the supply line a pressure of at least 700 kPa is available when the system is at cut-in pressure. This pressure shall be demonstrated without applying the service brakes.

42-3.6.6.1.4 Wheel Lock Sequence Test:

42-3.6.6.1.4.1 For all braking rates between 0.15 and 0.8, lockup of the front wheels occurs either simultaneously with or before the lockup of the rear wheels.

42-3.6.6.1.4.2 A simultaneous lockup of the front and rear wheels refers to the condition when the time interval between the lockup of the last (second) wheel on the rear axle and the last (second) wheel on the front axle is < 0.1 seconds for vehicle speeds > 30 km/h.

42-3.6.6.1.4.3 Pedal Force: It may exceed the foresaid paragraph 42-3.6.3.1.1.

42-3.6.6.1.5 Towing vehicles other than tractors for semi-trailers : In the case of a power-driven vehicle authorized to tow trailers of category O3 or O4 fitted with a compressed air braking system, the permissible relationship between the braking rate T_M / P_M and the pressure p_m shall lie within the areas shown on diagram 2 for all pressures between 20 and 750 kPa.

42-3.6.6.1.6 Tractors for Semi-Trailers:

42-3.6.6.1.6.1 Tractors with unladen semi-trailer:

42-3.6.6.1.6.1.1 An unladen combination is understood to be a tractor in running order, with the driver on board, coupled to an unladen semi-trailer.

42-3.6.6.1.6.1.2 The dynamic load of the semi-trailer on the tractor shall be represented by a static mass P_s mounted at the fifth wheel coupling equal to 15% of the maximum mass on the coupling. The braking forces must continue to be regulated between the state of the "tractor with unladen semi-trailer" and that of the "tractor alone"; the braking forces relating to the "tractor alone" shall be verified.

42-3.6.6.1.6.2 Tractors with laden semi-trailer:

42-3.6.6.1.6.2.1 A laden combination is understood to be a tractor in running order, with the driver on board, coupled to a laden semi-trailer.

42-3.6.6.1.6.2.2 The dynamic load of the semi-trailer on the tractor shall be represented by a static mass P_s mounted at the fifth wheel coupling equal to: $P_s = P_{s0}(1 + 0.45z)$

where, P_{s0} represents the difference between the maximum laden mass of the tractor and its unladen mass.For h the following value shall be taken:

$$h = \frac{h_0 \cdot P_0 + h_s \cdot P_s}{P}$$

where,

h_0 = the height of the center of gravity of the tractor;

h_s = the height of the coupling on which the semi-trailer rests;

P_0 = the unladen mass of the tractor alone.

$$P = P_0 + P_s = \frac{P_1 + P_2}{g}$$

42-3.6.6.1.6.2.3 In the case of a vehicle fitted with a compressed air braking system, the permissible relationship between the braking rate T_M / P_M and the pressure p_m shall be within the areas shown on diagram 3 for all pressures between 20 and 750 kPa.

42-3.6.6.2 Vehicles with more than two axles: The requirements of paragraph 42-3.6.6.1 shall apply to vehicles with more than two

axles. The requirements of paragraph 42-3.6.6.1.4 with respect to wheel lock sequence shall be considered to be met if, in the case of braking rates between 0.15 and 0.30, the adhesion utilized by at least one of the front axles is greater than that utilized by at least one of the rear axles.

42-3.6.6.3 For semi-trailers fitted with compressed-air braking systems:

42-3.6.6.3.1 The permissible relationship between the braking rate T_R / P_R and the pressure p_m shall lie within two areas derived from diagrams 4A and 4B for all pressures between 20 and 750 kPa, in both the laden and unladen states of load.

42-3.6.6.3.2 If the requirements of paragraph 42-3.6.6.3.1 above cannot be satisfied in conjunction with the requirements of paragraph 42-3.6.4.1.1 for semi-trailers with a K_c factor less than 0.80, then the semi-trailer must meet the minimum braking performance specified in paragraph 42-3.6.4.1.1 and be fitted with an approved anti-lock system.

42-3.6.6.4 Requirements for Full and Centre-Axle Trailers:

42-3.6.6.4.1 For full trailers fitted with compressed-air braking systems:

42-3.6.6.4.1.1 The requirements set out in paragraph 42-3.6.6.1 shall apply to twin-axle trailers (except where the axle spread is less than 2 m).

42-3.6.6.4.1.2 Full trailers with more than two axles shall be subject to the requirements of paragraph 42-3.6.6.2.

42-3.6.6.4.1.3 The permissible relationship between the braking rate T_R / P_R and the pressure p_m shall lie within the designated areas in diagram 2 for all pressures between 20 and 750 kPa, in both the laden and unladen states of load.

42-3.6.6.4.2 For centre-axle trailers fitted with compressed-air braking systems:

42-3.6.6.4.2.1 The permissible relationship between the braking rate T_R / P_R and the pressure p_m shall lie within two areas derived from diagram 2, by multiplying the vertical scale by 0.95. This requirement shall be met at all pressures between 20 and 750 kPa, in both the laden and unladen states of load.

42-3.6.6.4.2.2 If the requirements of paragraph 42-3.6.4.1.1 to this Regulation cannot be satisfied due to lack of adhesion, then the centre-axle trailer must be fitted with an antilock system.

42-3.6.6.5 Requirements to be met in case of failure of the braking distribution system:

42-3.6.6.5.1 It shall be possible, in the event of the failure of its control, to stop the vehicle under the conditions specified for secondary braking in the case of power-driven vehicles;

42-3.6.6.5.2 For those power-driven vehicles authorized to tow a trailer fitted with compressed-air braking systems, it must be possible to achieve a pressure at the coupling head of the control line within the range specified in paragraph 42-3.6.6.1.3.

42-3.6.6.5.3 In the event of failure of the control of the device on trailers, a service braking performance of at least 30% of that prescribed for the vehicle in question shall be attained.

42-3.6.6.6 Validation of the development of braking force.

42-3.6.6.6.1 At the time of type approval it shall be checked that the development of braking on an axle of each independent axle group shall

be within the following pressure ranges:

42-3.6.6.6.1.1 Laden vehicles: At least one axle shall commence to develop a braking force when the pressure at the coupling head is within the pressure range 20 to 100 kPa. At least one axle of every other axle group shall commence to develop a braking force when the pressure at the coupling head is at a pressure < 120 kPa。

42-3.6.6.6.1.2 Unladen vehicles: At least one axle shall commence to develop a braking force when the pressure at the coupling head is within the pressure range 20 to 100 kPa.

42-3.6.6.6.2 With the wheel(s) of the axle(s) raised off the ground and free to rotate, apply an increasing brake demand and measure the coupling head pressure corresponding to when the wheel(s) can no longer be rotated by hand. This condition is defined as the development of the braking force.

42-3.6.7 Braking system with stored energy

42-3.6.7.1 In the event of failure in any part of the transmission of a braking system, the feed to the part not affected by the failure must continue to be ensured if required for the purpose of halting the vehicle with the degree of effectiveness prescribed for residual and/or 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.

42-3.6.7.2 Furthermore, storage devices located down-circuit of this device must be such that in the case of a failure in the energy supply after four full-stroke actuations of the service brake control, it is still possible to halt the vehicle at the fifth application, with the degree of effectiveness prescribed for secondary braking.

42-3.6.7.3 Vehicles equipped with a hydraulic braking system with stored energy which cannot meet the requirements of paragraph 42-3.6.7.1 of this Regulation shall be deemed to satisfy that paragraph if the following requirements are met: After any single transmission failure it shall still be possible after eight full-stroke actuations of the service brake control to achieve, at the ninth application, at least the performance prescribed for the secondary braking system.

42-3.6.8 Procedure for monitoring the state of battery charge: This procedure is applicable to vehicle batteries used for traction and regenerative braking. The procedure requires the use of a bi-directional DC Watt-hour meter or applicant offer properly state of battery charge of measuring method for processing.

42-3.6.8.1 Procedure

42-3.6.8.1.1 If the batteries are new or have been subject to extended storage, they shall be cycled as recommended by the manufacturer. A minimum 8-hour soak period at ambient temperature shall be allowed after completion of cycling.

42-3.6.8.1.2 A full charge shall be established using the manufacturer's recommended charging procedure.

42-3.6.8.1.3 When the braking tests of paragraphs 42-3.6.2.1.10, 42-3.6.1.26, 42-3.6.2.3.2.6 and 42-3.6.2.3.4.3 are conducted the watt-hours consumed by the traction motors and supplied by the regenerative braking system shall be recorded as a running total which shall then be used to determine the state of charge existing at the beginning or end of a particular test.

42-3.6.8.1.4 To replicate a level of state of charge in the batteries for comparative tests, such as those of paragraph 42-3.6.2.3.4.3, the batteries shall be either recharged to that level or charged to above that level and discharged into a fixed load at approximately constant power until the required state of charge is reached. Alternatively, for vehicles with battery powered electric traction only, the state of charge may be adjusted by running the vehicle. Tests conducted with a battery partially charged at their start shall be commenced as soon as possible after the desired state of charge has been reached.

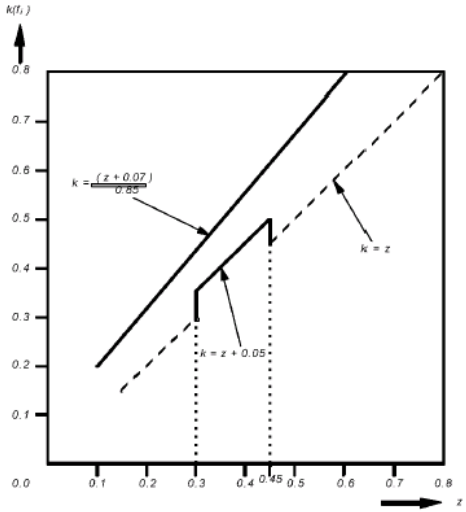


Diagram 1A. Certain vehicles of category N1 （stipulated in paragraph 42-3 6.6.1.2.1）

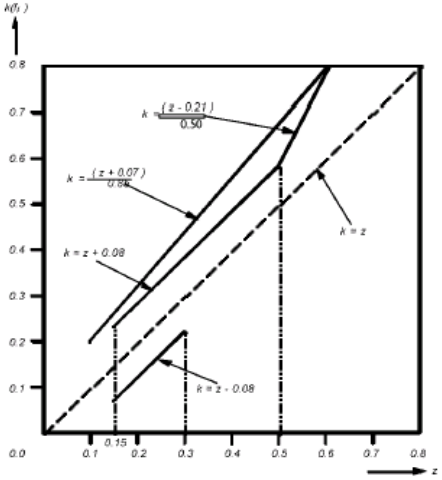


Diagram 1B. N1 Category (Except specific N1 Category Vehicle)
Remark：The lower limitation of k=z-0.08 is not applicable to the adhesion application of rear axle.

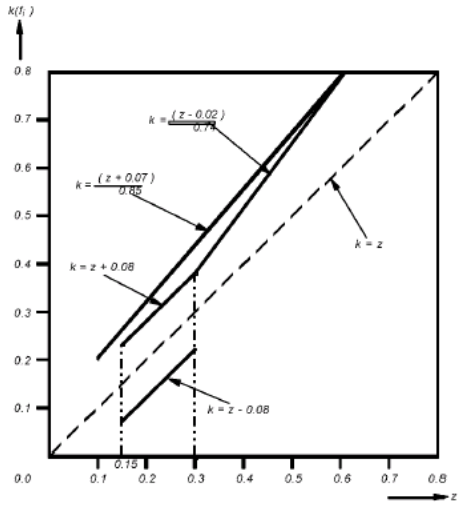


Diagram 1C. The Power-Driven Vehicle except N1 Category Vehicle and full Trailer
Remark：The lower limitation of k=z-0.08 is not applicable for the adhesion utilization of rear axle.

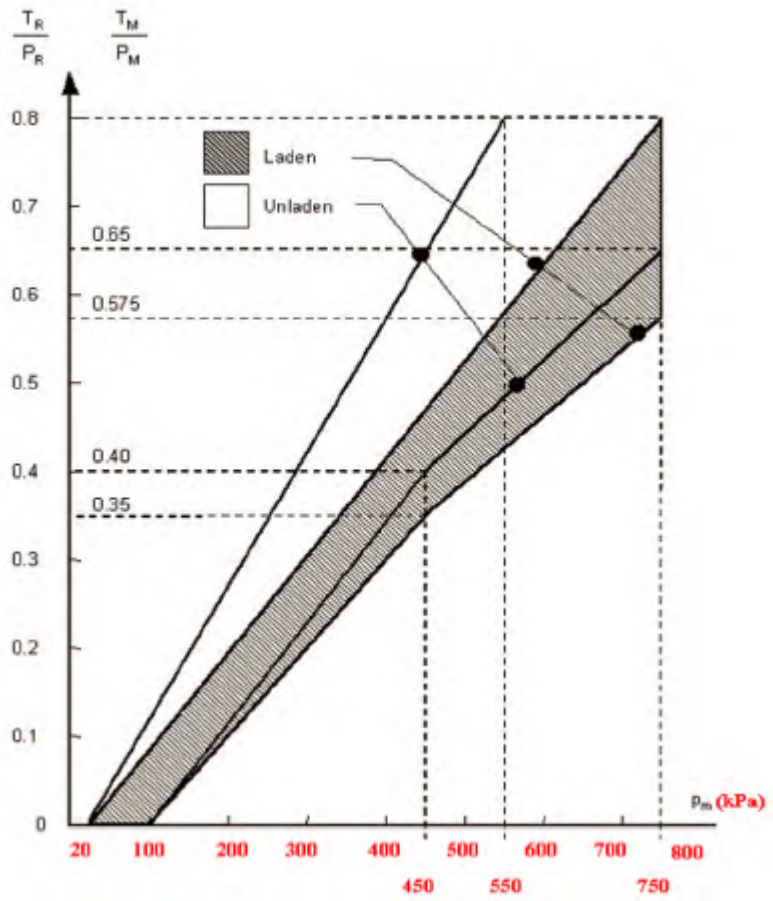


Diagram 2 Towing vehicles & Trailer (except tractors for semi-trailers &semi- trailers)

Remark：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.

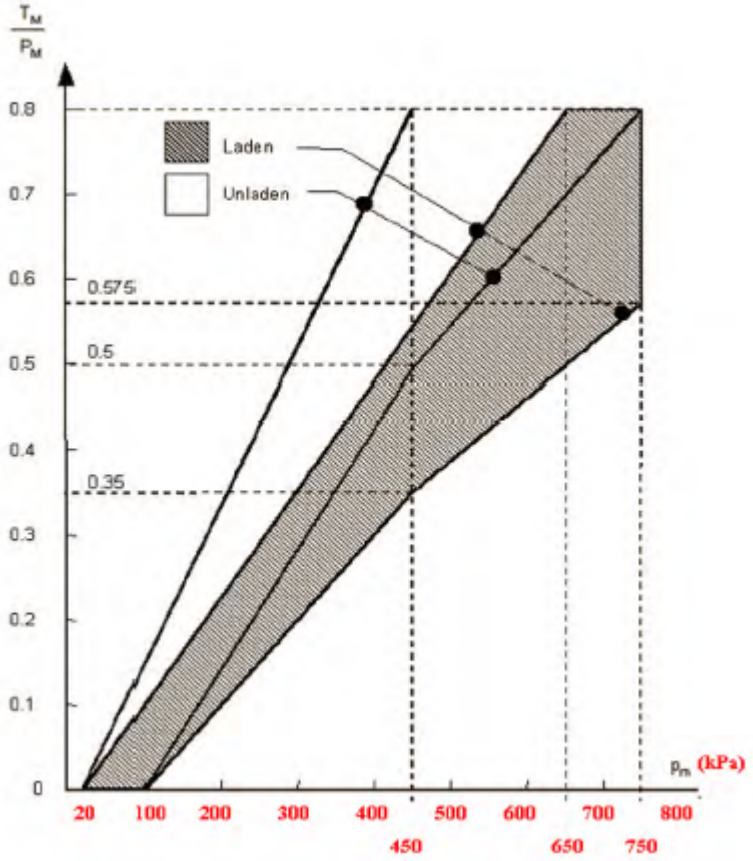


Diagram 3 Tractors for semi trailers

Remark : 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.

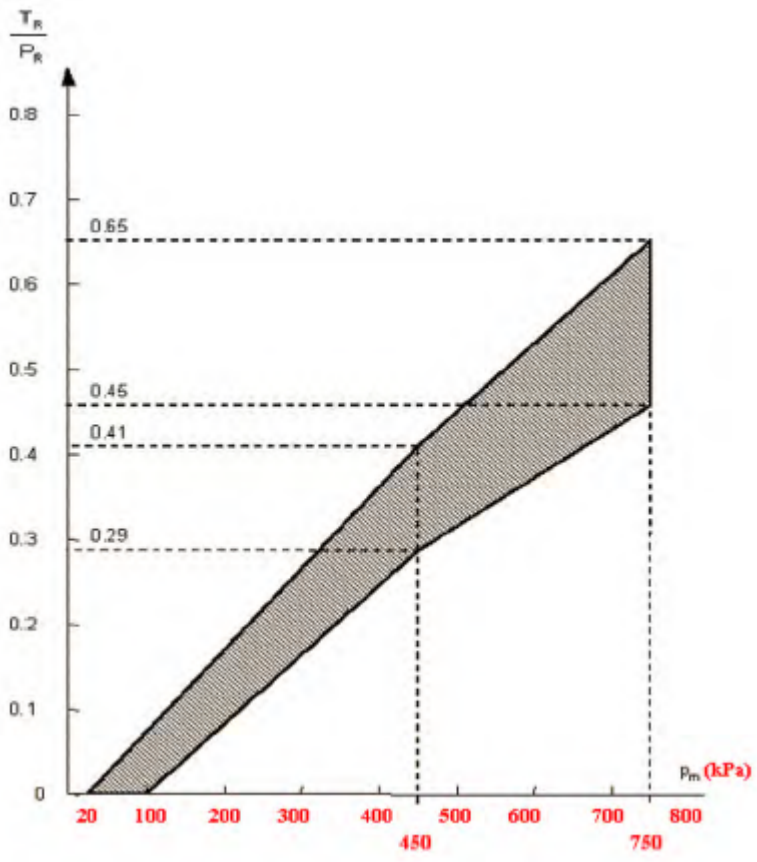


Diagram 4A Semi-Trailers

Remark：The relation between the braking rate T_R/P_R and the control line pressure for the laden and unladen conditions is determined as follows：

The factors Kc (laden), Kv (unladen) are obtained by reference to diagram 4B. To determine the areas corresponding to the laden and unladen conditions, the values of the ordinates of the upper and lower limits of the hatched area in diagram 4A are multiplied by the factors Kc and Kv respectively.

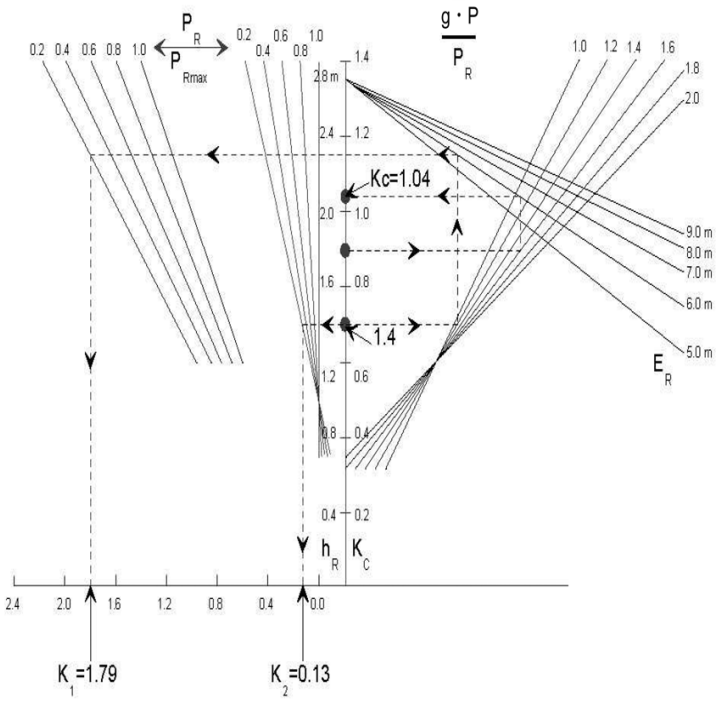


Diagram 4B （see the 4th paragraph of F(III) and diagram 4A）

Formula from which diagram 4B is derived：

$$K = \left[1.7 - \frac{0.7P_R}{P_{R_{max}}}\right]\left[1.35 - \frac{0.96\left(1.0 + (h_R - 1.0)\frac{g \cdot P}{P_R}\right)}{E_R}\right]\left[1.0 - \frac{P_R}{P_{R_{max}}}\right]\left[\frac{h_R - 1.0}{2.5}\right]$$

42-3.6.9 Special requirements for vehicles equipped with a vehicle stability function (apply for vehicles of category symbol M2,M3,N2,O3 and O4 and the vehicles of category symbol M1 N1 with a mass in running order more than 1,735 kg that manufacturer choosing comply with this requirement.)

42-3.6.9.1 General

42-3.6.9.1.1 Power-driven vehicles

42-3.6.9.1.1.1 Where a vehicle is equipped with a vehicle stability function as defined in paragraph 42-3 2.1.22. of this Regulation, the following shall apply:

In the case of directional control the function shall have the ability to automatically control individually the speed of the left and right wheels on each axle or an axle of each axle group 1/ by selective braking based on the evaluation of actual vehicle behaviour in comparison with a determination of vehicle behaviour demanded by the driver.

In the case of roll-over control the function shall have the ability to automatically control the wheel speeds on at least two wheels of each axle or axle group 1/ by selective braking or automatically commanded braking based on the evaluation of actual vehicle behaviour that may lead to vehicle roll-over.

In both cases, the function is not required:

(a) When the vehicle speed is below 20 km/h;

(b) Until the initial start-up self test and plausibility checks have been completed;

(c) When the vehicle is being driven in reverse.

42-3.6.9.1.2 To realise the functionality defined above a vehicle stability function shall include, in addition to selective braking and/or automatically commanded braking, at least the following:

(1) The ability to control engine power output.

(2) In the case of directional control: The determination of actual vehicle behaviour from values of yaw rate, lateral acceleration, wheel speeds, and from the driver's control inputs to the braking and steering systems and to the engine. Only onboard generated information shall be used. If these values are not directly measured, the evidence of the appropriate correlation with directly measured values under all driving conditions (e.g. including driving in a tunnel) shall be shown to the technical service at the time of type approval.

(3) In the case of roll-over control: The determination of actual vehicle behaviour from values of the vertical force on the tyre(s) (or at least lateral acceleration and wheel speeds) and from the driver's control inputs to the braking system and to the engine. Only on-board generated information shall be used. If these values are not directly measured, the evidence of the appropriate correlation with directly measured values under all driving conditions (e.g. including driving in a tunnel) shall be shown to the technical service at the time of type approval.

(4) In the case of a towing vehicle equipped according to paragraph 42-3 4.1.4 of this Regulation: The ability to apply the service brakes of the trailer via the respective control line(s) independently of the driver.

42-3.6.9.1.3 The vehicle stability function shall be demonstrated to the Technical Service by dynamic manoeuvres on one vehicle. This may be realized by a comparison of results obtained with the vehicle stability function enabled and disabled for a given load condition. As an alternative to carrying-out dynamic manoeuvres for other vehicles and other load conditions, fitted with the same vehicle stability system, the results from actual vehicle tests or computer simulations may be submitted.

The use of the simulator is defined in paragraph 42-3 6.9.3.

The specification and validation of the simulator is defined in paragraph 42-3 6.9.4.

Until unified test procedures are agreed, the method by which this demonstration is carried out shall be agreed between the vehicle manufacturer and the Technical Service and shall include the critical conditions of directional control and roll-over control as appropriate to the vehicle stability function installed on the vehicle with the method of demonstration and results being appended to the type approval report. This may be carried-out other than at the time of type approval.

As a means of demonstrating the vehicle stability function any of the following dynamic manoeuvres shall be used

Directional Control	Roll-Over Control

Reducing radius test	Steady state circular test
Step steer input test	J-turn
Sine with dwell	
J-turn	
mu-split single lane change	
Double lane change	
Reversed steering test or "fish hook" test	
Asymmetrical one period sine steer or pulse steer input test	

To demonstrate repeatability the vehicle will be subject to a second demonstration using the selected manoeuvre(s).

Note: Should the use of any of the above defined manoeuvres not result in loss of directional control or roll-over as appropriate an alternative manoeuvre may be used in agreement with the Technical Service.

42-3.6.9.1.4 Interventions of the vehicle stability function shall be indicated to the driver by a specific optical warning signal. The indication shall be present as long as the vehicle stability function is in an intervention mode. The warning signals specified in paragraph 42-3.5.1.9. and 42-3.6.1.16. of this Regulation shall not be used for this purpose.

Interventions of the vehicle stability function used in any learning process to determine the vehicle operational characteristics shall not generate the above signal.

The signal shall be visible to the driver, even in daylight, such that the driver can easily verify the satisfactory condition of the signal without leaving the driver's seat.

42-3.6.9.1.5 A vehicle stability function failure or defect shall be detected and indicated to the driver by the specific optical warning signal referred to in paragraph 42-3.5.1.9. and 42-3.6.1.16. of this Regulation.

The warning signal shall be constant and remain displayed as long as the failure or defect persists and the ignition (start) switch is in the 'on' (run) position.

42-3.6.9.1.6 In the case of a power-driven vehicle equipped with an electric control line and electrically connected to a trailer with an electric control line the driver shall be warned by a specific optical warning signal whenever the trailer provides the information "VDC Active" via the data communications part of the electric control line. The optical signal defined in paragraph 42-3 6.9.1.4. above may be used for this purpose.

42-3.6.9.2 Trailers

42-3.6.9.2.1 Where a trailer is equipped with a vehicle stability function as defined in paragraph 42-3 2.1.22. of this Regulation,

the following shall apply:

In the case of directional control the function shall have the ability to automatically control individually the speed of the left and right wheels on each axle or an axle of each axle group by selective braking based on the evaluation of actual trailer behaviour in comparison with a determination of the relative behaviour of the towing vehicle.

In the case of roll-over control the function shall have the ability to automatically control the wheel speeds on at least two wheels of each axle or axle group by selective braking or automatically commanded braking based on the evaluation of actual trailer behaviour that may lead to roll-over.

Note:

(1) In the case of multiple axles, where the spread between one axle and its adjacent axle is greater than 2 m, each individual axle shall be considered as an independent axle group.

(2) Additional interaction with other vehicle systems or components is allowed. Where these systems or components are subject to special Regulations, such interaction shall comply with the requirements of those Regulations, e.g. interaction with the steering system shall comply with the requirements set out in Regulation No. 47 Steering equipment for corrective steering.

42-3.6.9.2.2 To realise the functionality defined above a vehicle stability function shall include, in addition to automatically commanded braking and where appropriate selective braking, at least the following:

(1) The determination of actual trailer behaviour from values of the vertical force on the tyre(s), or at least lateral acceleration and wheel speeds. Only on-board generated information shall be used. If these values are not directly measured, the evidence of the appropriate correlation with directly measured values under all driving conditions (e.g. including driving in a tunnel) shall be shown to the technical service at the time of type approval.

42-3.6.9.2.3 The vehicle stability function shall be demonstrated to the Technical Service by dynamic manoeuvres on one vehicle. This may be done by a comparison of results obtained with the vehicle stability function enabled and disabled for a given load condition. As an alternative to carrying-out dynamic manoeuvres for other vehicles and other load conditions, fitted with the same vehicle stability system, the results from actual vehicle tests or computer simulations may be submitted.

The use of the simulator is defined in paragraph 42-3 6.9.3.

The specification and validation of the simulator is defined in paragraph 42-3 6.9.4.

Until unified test procedures are agreed, the method by which this demonstration is carried out shall be agreed between the trailer manufacturer and the Technical Service and shall include the critical conditions of roll-over control and directional control as appropriate to the vehicle stability function installed on the trailer with the method of demonstration and results being appended to the type approval report. This may be carried-out other than at the time of type approval.

As a means of demonstrating the vehicle stability function any of the following dynamic manoeuvres shall be used:

Directional Control	Roll-Over Control
Reducing radius test	Steady state circular

	test
Step steer input test	J-turn
Sine with dwell	
J-turn	
mu-split single lane change	
Double lane changev	
Reversed steering test or "fish hook" test	
Asymmetrical one period sine steer or pulse steer input test	

To demonstrate repeatability the vehicle will be subject to a second demonstration using the selected manoeuvre(s).

Note: Should the use of any of the above defined manoeuvres not result in loss of directional control or roll-over as appropriate an alternative manoeuvre may be used in agreement with the technical service.

42-3.6.9.2.4 Trailers equipped with an electric control line, when electrically connected to a towing vehicle with an electric control line, shall provide the information "VDC active" via the data communications part of the electric control line when the vehicle stability function is in an intervention mode. Interventions of the vehicle stability function used in any learning process to determine the trailer operational characteristics shall not generate the above information.

42-3.6.9.2.5 To maximise the performance of trailers that utilise "select-low" such trailers are permitted to change control mode to "select-high" during an intervention of the "Vehicle Stability Function".

42-3.6.9.3 Use of the dynamic stability simulation

The effectiveness of the directional and/or roll-over stability control function of power-driven vehicles and trailers of categories M, N and O, may be determined by computer simulation.(refer to 42-3 6.9.1.3. or 42-3 6.9.2.3.)

42-3.6.9.3.1 Use of the simulation

42-3.6.9.3.1.1 The vehicle stability function shall be demonstrated by the vehicle manufacturer to the Type Approval

Authority or Technical Service with the same dynamic manoeuvre(s) as for the practical demonstration in paragraph 42-3 6.9.1.3. or 42-3 6.9.2.3.

42-3.6.9.3.1.2 The simulation shall be a means whereby the vehicle stability performance may be demonstrated with the vehicle stability function enabled or disabled, and in the laden and unladen conditions.

42-3.6.9.3.1.3 The simulations shall be carried out with a validated modelling and simulation tool. The verification shall be carried out using the same manoeuvre(s) as defined in paragraph 42-3 6.9.3.1.

42-3.6.9.4 Dynamic stability simulation tool and its validation

42-3.6.9.4.1 Specification of the simulation tool

42-3.6.9.4.1.1 The simulation method shall take into account the main factors which influence the directional and roll motion of the vehicle. A typical model may include the following vehicle parameters in an explicit or implicit form:

(a) Axle/wheel
(b) Suspension
(c) Tyre
(d) Chassis/vehicle body
(e) Power train/driveline, if applicable
(f) Brake system
(g) Pay load

42-3.6.9.4.1.2 The Vehicle Stability Function shall be added to the simulation model by means of:

(a) a subsystem (software model) of the simulation tool, or
(b) the electronic control box in a hardware-in-the-loop configuration.

42-3.6.9.4.1.3 In the case of a trailer, the simulation shall be carried out with the trailer coupled to a representative towing vehicle.

42-3.6.9.4.1.4 Vehicle loading condition

42-3.6.9.4.1.1.1 The simulator shall be able to take into account the laden and unladen conditions.

42-3.6.9.4.1.1.2 The load shall be considered to be a fixed load with properties (mass, mass distribution and maximum recommended height of the centre of gravity) specified by the manufacturer.

42-3.6.9.4.2 Validation of the simulation tool

42-3.6.9.4.2.1 The validity of the applied modelling and simulation tool shall be verified by means of comparisons with a practical vehicle test(s). The test(s) utilised for the validation shall be those which, without control action, would result in loss of directional control (understeer and over-steer) or roll-over control as appropriate to the functionality of the stability control function installed on a representative vehicle.

During the test(s) the following motion variables, as appropriate, shall be recorded or calculated in accordance with ISO 15037 Part 1:2005: General conditions for passenger cars or Part 2:2002: General conditions for heavy vehicles and buses (depending on the vehicle category):

(1) yaw velocity;
(2) lateral acceleration;

(3) wheel load or wheel lift;
(4) forward velocity;
(5) driver input.

42-3.6.9.4.2.2 The objective is to show that the simulated vehicle behaviour and operation of the vehicle stability function is comparable with that seen in practical vehicle tests.

42-3.6.9.4.2.3 The simulator shall be deemed to be validated when its output is comparable to the practical test results produced by a given vehicle type during the selected manoeuvre(s) from those defined with paragraph 42-3 6.9.1.3. or 42-3 6.9.2.3., as appropriate.

In the case of the steady state circular test the under-steer gradient shall be the means of making the comparison.

In the case of a dynamic manoeuvre, the relationship of activation and sequence of the vehicle stability function in the simulation and in the practical vehicle test shall be the means of making the comparison.

42-3.6.9.4.2.4 The physical parameters that are different between the reference vehicle and simulated vehicle configurations shall be modified accordingly in the simulation.

42-3.6.9.4.2.5 A simulator test report shall be produced, a model and a copy attached to the vehicle approval report.

42-3.7 Dynamic Braking for vehicles of category symbols L：

42-3.7.1 Declaration of design compliance: applicant shall be ensure and declared comply with the paragraph 42-3.7.1..

42-3.7.1.1 General Specifications:

42-3.7.1.1.1 Service brake system control operation Vehicles shall have configurations that enable a rider to actuate the service brake system control while seated in the normal driving position and with both hands on the steering control.

42-3.7.1.1.2 Secondary brake system control operation Vehicles shall have configurations that enable a rider to actuate the secondary brake system control while seated in the normal driving position and with at least one hand on the steering control.

42-3.7.1.1.3 Characteristic of braking equipment

42-3.7.1.1.3.1 Two-wheeled vehicles of categories L1 and L3 shall be equipped with either two separate service brake systems, or a split service brake system, with at least one brake operating on the front wheel and at least one brake operating on the rear wheel.

42-3.7.1.1.3.2 Three-wheeled vehicles of category L2 shall be equipped with a parking brake system plus one of the following service brake systems:

42-3.7.1.1.3.2.1 Two separate service brake systems, except CBS, which, when applied together, operate the brakes on all wheels; or

42-3.7.1.1.3.2.2 A split service brake system; or

42-3.7.1.1.3.2.3 A CBS that operates the brakes on all wheels and a secondary brake system which may be the parking brake system.

42-3.7.1.1.3.3 Category L5 vehicles shall be equipped with:

42-3.7.1.1.3.3.1 A parking brake system; and

42-3.7.1.1.3.3.2 A foot-actuated service brake system which operates on the brakes on all wheels.

42-3.7.1.1.3.3.2.1 A split service brake system; or

42-3.7.1.1.3.3.2.2 A CBS that operates the brakes on all wheels and a secondary brake system, which may be the parking brake system.

42-3.7.1.1.3.3.3 For vehicles of category L5 which designed for disabled person use, then its controlled service braking device specified in 42-3.7.1.1.3.3.2 may be hand controlled.

42-3.7.1.1.4 In cases where two separate service brake systems are installed, the systems may share a common brake, if a failure in one system does not affect the performance of the other.

42-3.7.1.1.5 For vehicles that use hydraulic fluid for brake force transmission, the master cylinder shall:

42-3.7.1.1.5.1 Have a sealed, covered, separate reservoir for each brake system;

42-3.7.1.1.5.2 Have a minimum reservoir capacity equivalent to 1.5 times the total fluid displacement required to satisfy the new to fully worn lining condition with the worst case brake adjustment condition; and

42-3.7.1.1.5.3 Have a reservoir where the fluid level is visible for checking without removal of the cover.

42-3.7.1.1.6 All warning lamps shall be mounted in the rider's view.

42-3.7.1.1.7 Vehicles that are equipped with a split service brake system shall be fitted with a red warning lamp, which shall be activated:

42-3.7.1.1.7.1 When there is a hydraulic failure on the application of a force of < 90 N on the control; or

42-3.7.1.1.7.2 Without actuation of the brake control, when the brake fluid level in the master cylinder reservoir falls below the greater of:

42-3.7.1.1.7.2.1 That which is specified by the manufacturer; and

42-3.7.1.1.7.2.2 That which is less than or equal to half of the fluid reservoir capacity. To permit function checking, the warning lamp shall be illuminated by the activation of the ignition switch and shall be extinguished when the check has been completed. The warning lamp shall remain on while a failure condition exists whenever the ignition switch is in the "on" position.

42-3.7.1.1.8 Vehicles that are equipped with an ABS system shall be fitted with a yellow warning lamp. The lamp shall be activated whenever there is a malfunction that affects the generation or transmission of signals in the vehicle's ABS system. To permit function checking, the warning lamp shall be illuminated by the activation of the ignition switch and extinguished when the check has been completed. The warning lamp shall remain on while a failure condition exists whenever the ignition switch is in the "on" position.

42-3.7.1.1.9 Parking Braking system:

42-3.7.1.1.9.1 Have a control which is separate from the service brake system controls.

42-3.7.1.1.9.2 Be held in the locked position by solely mechanical means.

42-3.7.1.1.9.3 Vehicles shall have configurations that enable a rider to be able to actuate the parking brake system while seated in the normal driving position.

42-3.7.1.2 Durability

42-3.7.1.2.1 Wear of the brakes shall be compensated for by means of a system of automatic or manual adjustment.

42-3.7.1.2.2 The friction material thickness shall either be visible without disassembly, or where the friction material is not visible,

wear shall be assessed by means of a device designed for that purpose.

42-3.7.1.2.3 During all the tests in this Regulation and on their completion, there shall be no friction material detachment and no leakage of brake fluid.

42-3.7.1.3 Brake lining materials: Brake linings shall not contain asbestos.

42-3.7.2 Measurement of dynamic performance

There are three ways in which the service brake system performance may be measured:

42-3.7.2.1 MFDD (Mean Fully Developed Deceleration):

Calculation of MFDD:

$$d_m = \frac{V_b^2 - V_e^2}{25.92 \cdot (S_e - S_b)} \quad \text{in m/s}^2$$

where:

dm = mean fully developed deceleration

V1 = vehicle speed when rider actuates the control

Vb = vehicle speed at 0.8 V1 in km/h

Ve = vehicle speed at 0.1 V1 in km/h

Sb = distance travelled between V1 and Vb in metres

Se = distance travelled between V1 and Ve in metres

42-3.7.2.2 Stopping distance:

Based on the basic equations of motion:

$$S = 0.1 \cdot V + (X) \cdot V^2$$

where:

S = stopping distance in metres

V = vehicle speed in km/h

X = a variable based on the requirement for each test

To calculate the corrected stopping distance using the actual vehicle test speed, the following formula is used:

$$Ss = 0.1 \cdot Vs + (Sa - 0.1 \cdot Va) \cdot Vs^2/Va^2$$

where:

Ss = corrected stopping distance in metres

Vs = specified vehicle test speed in km/h

Sa = actual stopping distance in metres

Va = actual vehicle test speed in km/h

Note: This equation is only valid when the actual test speed (Va) is within +/- 5 km/h of the specified test speed (Vs).

42-3.7.2.3 Continuous deceleration recording:

For the burnishing procedure and tests such as the wet brake and heat fade – heating procedure, there is a continuous recording of the vehicle's instantaneous deceleration from the moment a force is applied to the brake control until the end of the stop.

42-3.7.3 Test conditions procedures an performance requirements

42-3.7.3.1 Test surfaces

42-3.7.3.1.1 High friction surface

42-3.7.3.1.1.1 Applicable to all dynamic brake tests excluding the ABS tests where a low-friction surface is specified;

42-3.7.3.1.1.2 The test area is a clean and level surface, with a gradient□1 per cent;

42-3.7.3.1.1.3 The surface has a nominal peak braking coefficient (PBC) of 0.9, unless otherwise specified.

42-3.7.3.1.2 Low friction surface:

42-3.7.3.1.2.1 Applicable to all dynamic brake tests where a low-friction surface is specified;

42-3.7.3.1.2.2 The test area is a clean and level surface, with a gradient□1 per cent;

42-3.7.3.1.2.3 The surface has a PBC of □ 0.45.

42-3.7.3.1.3 Measurement of PBC:

The PBC is measured as determined by the approval authority using either:

42-3.7.3.1.3.1 The American Society for Testing and Materials (ASTM) E1136-93 (Reapproved 2003) standard reference test tyre, in accordance with ASTM Method E1337-90 (Reapproved 2002), at a speed of 40 mph; or

42-3.7.3.1.3.2 The method specified in the paragraph 43-1 8.1.2 of “43-1 Anti-lock braking system (ABS)”.

42-3.7.3.1.4 Test lane width:

For vehicle categories L1 and L3 the test lane width is 2.5 m.

For vehicle categories L2 and L5 the test lane width is 2.5 m plus the vehicle width.

42-3.7.3.1.5 Parking brake system tests: The specified test slope has a clean and dry surface that does not deform under the mass of the vehicle.

42-3.7.3.2 Ambient temperature

The ambient temperature is between 4 degrees C and 45 degrees C.

42-3.7.3.3 Wind speed

The wind speed is not more than 5 m/s.

42-3.7.3.4 Test speed tolerance

The test speed tolerance is +/- 5 km/h. In the event of the actual test speed deviating from the specified test speed, the actual stopping distance is corrected using the formula in paragraph 42-3 7.3.2 of this Regulation.

42-3.7.3.5 Automatic transmission

Vehicles with automatic transmission shall complete all tests - whether they are for "engine connected" or "engine disconnected".

If an automatic transmission has a neutral position, the neutral position is selected for tests where "engine disconnected" is specified.

42-3.7.3.6 Vehicle position and wheel lock

42-3.7.3.6.1 The vehicle is positioned in the centre of the test lane for the beginning of each stop;

42-3.7.3.6.2 Stops are made without the vehicle wheels passing outside the applicable test lane and without wheel lock.

42-3.7.3.7 Test sequence

Test order
1. Dry stop-single brake control actuated
2. Dry stop-all service brake controls actuated
3. High speed
4. Wet brake
5. Heat fade（Heat fade is always the last test to be carried out）
6. If fitted:
6.1 Parking brake system
6.2. ABS (the ABS shall comply with 43-1 “ABS” in the Directions.)
6.3. Partial failure, for spilt service brake systems
6.4. power-assisted braking system failure

42-3.7.4 Preparation

42-3.7.4.1 Engine idle speed

The engine idle speed is set to the manufacturer's specification.

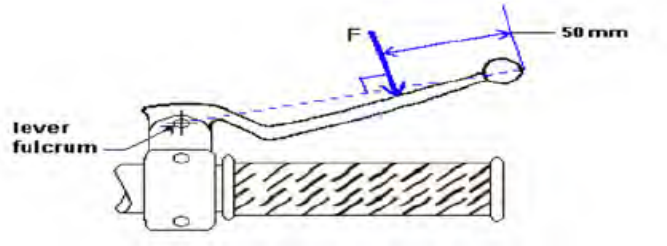
42-3.7.4.2 Tyre pressures

The tyres are inflated to the manufacturer's specification for the vehicle loading condition for the test.

42-3.7.4.3 Control application points and direction

For a hand control lever, the input force (F) is applied on the control lever's forward surface perpendicular to the axis of the lever fulcrum and its outermost point on the plane along which the control lever rotates (see figure below).

The input force is applied to a point located 50 mm from the outermost point of the control lever, measured along the axis between the central axis of the fulcrum of the lever and its outermost point.



For a foot control pedal, the input force is applied to the centre of, and at right angles to, the control pedal.

42-3.7.4.4 Brake temperature measurement

As determined by the approval authority, the brake temperature is measured on the approximate centre of the braking path of the disc or drum using:

42-3.7.4.4.1 A rubbing thermocouple that is in contact with the surface of the disc or drum; or

42-3.7.4.4.2 A thermocouple that is embedded in the friction material.

42-3.7.4.5 Burnishing procedure

The vehicle brakes are burnished prior to evaluating performance. This procedure may be completed by the manufacturer:

42-3.7.4.5.1 Vehicle lightly loaded;

42-3.7.4.5.2 Engine disconnected;

42-3.7.4.5.3 Test speed:

42-3.7.4.5.3.1 Initial speed: 50 km/h or 0.8 Vmax, whichever is lower;

42-3.7.4.5.3.2 Final speed = 5 to 10 km/h;

42-3.7.4.5.4 Brake application: Each service brake system control actuated separately;

42-3.7.4.5.5 Vehicle deceleration:

42-3.7.4.5.5.1 Single front brake system only:

3.0-3.5 m/s2 for vehicle categories L3;

1.5-2.0 m/s2 for vehicle categories L1 and L2;

42-3.7.4.5.5.2 Single rear brake system only: 1.5-2.0 m/s2;

42-3.7.4.5.5.3 CBS or split service brake system: 3.5-4.0 m/s2;

42-3.7.4.5.6 Number of decelerations: 100 per brake system;

42-3.7.4.5.7 Initial brake temperature before each brake application $\leqq$ 100 degrees C;

42-3.7.4.5.8 For the first stop, accelerate the vehicle to the initial speed and then actuate the brake control under the conditions specified until the final speed is reached. Then reaccelerate to the initial speed and maintain that speed until the brake temperature falls to the specified initial value. When these conditions are met, reapply the brake as specified. Repeat this procedure for the number of specified decelerations. After burnishing, adjust the brakes in accordance with the manufacturer's recommendations.

42-3.7.5 Dry stop test - single brake control actuated

42-3.7.5.1 Vehicle condition:

42-3.7.5.1.1 The test is applicable to all vehicle categories;

42-3.7.5.1.2 Laden:

For vehicles fitted with CBS and split service brake systems: the vehicle is tested in the lightly loaded condition in addition to the laden condition;

42-3.7.5.1.3 Engine disconnected.

42-3.7.5.2 Test conditions and procedure:

42-3.7.5.2.1 Initial brake temperature: □55 degrees C and □ 100 degrees C;

42-3.7.5.2.2 Test speed:

42-3.7.5.2.2.1 Vehicle categories L1 and L2: 40 km/h or 0.9 Vmax, whichever is lower;

42-3.7.5.2.2.2 Vehicle categories L3 and L5: 60 km/h or 0.9 Vmax, whichever is lower;

42-3.7.5.2.3 Brake application: Each service brake system control actuated separately;

42-3.7.5.2.4 Brake actuation force:

42-3.7.5.2.4.1 Hand control: □200 N;

42-3.7.5.2.4.2 Foot control:

□350 N for vehicle categories L1, L2 and L3;

□ 500 N for vehicle categories L5.

42-3.7.5.2.5 Number of stops: until the vehicle meets the performance requirements, with a maximum of 6 stops;

42-3.7.5.2.6 For each stop, accelerate the vehicle to the test speed and then actuate the brake control under the conditions specified in this paragraph.

42-3.7.5.3 Performance requirements

The stopping distance shall be as specified in column 2 or the MFDD shall be as specified in column 3 of the following table:

Column 1	Column 2	Column 3
Vehicle Category	Stopping distance（s）（Where V is the specified test speed in km/h and S is the required stopping distance in meters）	MFDD
Single brake system, front wheel（s）braking only:		
L1	S□0.1V＋0.0111V2	□3.4m/s2
L2	S□0.1V＋0.0143V^2	□2.7m/s^2
L3	S□0.1V＋0.008V2	□4.4m/s2
Single brake system, rear wheel（s）braking only:		
L1	S□0.1V＋0.0143V2	□2.7m/s2
L2	S□0.1V＋0.0143V^2	□2.7m/s^2
L3	S□0.1V＋0.0133V2	□2.9m/s2
Vehicles with CBS or split service brake systems: for laden and lightly loaded conditions:		
L1 and L2	S□0.1V＋0.0087V2	□4.4m/s2
L3	S□0.1V＋0.0076V2	□5.1m/s2
L5	S□0.1V＋0.0077V^2	□5.0m/s^2

Vehicles with CBS – secondary service brake systems		
ALL	S□0.1V＋0.0154V2	□2.5m/s2

42-3.7.6 Dry stop test - all service brake controls actuated

42-3.7.6.1 Vehicle condition:

42-3.7.6.1.1 The test is applicable to vehicle categories L3 and L5;

42-3.7.6.1.2 Lightly loaded;

42-3.7.6.1.3 Engine disconnected.

42-3.7.6.2 Test conditions and procedure:

42-3.7.6.2.1 Initial brake temperature:□55 degrees C and□100 degrees C;

42-3.7.6.2.2 Test speed: 100 km/h or 0.9 Vmax, whichever is lower;

42-3.7.6.2.3 Brake application: Simultaneous actuation of both service brake system controls, if so equipped, or of the single service brake system control in the case of a service brake system that operates on all wheels;

42-3.7.6.2.4 Brake actuation force:

42-3.7.6.2.4.1 Hand control:□ 250 N;

42-3.7.6.2.4.2 Foot control:

□ 400 N for vehicle categories L3;

□ 500 N for vehicle categories L5.

42-3.7.6.2.5 Number of stops: until the vehicle meets the performance requirements, with a maximum of 6 stops;

42-3.7.6.2.6 For each stop, accelerate the vehicle to the test speed and then actuate the brake controls under the conditions specified in this paragraph.

42-3.7.6.3 Performance requirements

The stopping distance (S) shall be S □ 0.0060 V2 (where V is the specified test speed in km/h and S is the required stopping distance in metres).

42-3.7.7 High speed test

42-3.7.7.1 Vehicle condition:

42-3.7.7.1.1 The test is applicable to vehicle categories L3 and L5;

42-3.7.7.1.2 Test is not required for vehicles with Vmax □ 125 km/h;

42-3.7.7.1.3 Lightly loaded;

42-3.7.7.1.4 Engine connected with the transmission in the highest gear.

42-3.7.7.2 Test conditions and procedure:

42-3.7.7.2.1 Initial brake temperature: □ 55 degrees C and □ 100 degrees C;

42-3.7.7.2.2 Test speed:

0.8 Vmax for vehicles with Vmax > 125 km/h and < 200 km/h;

160 km/h for vehicles with Vmax □ 200 km/h;

42-3.7.7.2.3 Brake application:

Simultaneous actuation of both service brake system controls, if so equipped, or of the single service brake system control in the case of a service brake system that operates on all wheels;

42-3.7.7.2.4 Brake actuation force:

42-3.7.7.2.4.1 Hand control: □ 200 N;

42-3.7.7.2.4.2 Foot control:

□350 N for vehicle categories L3;

□500 N for vehicle categories L5.

42-3.7.7.2.5 Number of stops: until the vehicle meets the performance requirements, with a maximum of 6 stops;

42-3.7.7.2.6 For each stop, accelerate the vehicle to the test speed and then actuate the brake control(s) under the conditions specified in this paragraph.

42-3.7.7.3 Performance requirements:

(a) The stopping distance (S) shall be □ 0.1 V + 0.0067 V2 (where V is the specified test speed in km/h and S is the required stopping distance in metres); or(b)The MFDD shall be □ 5.8 m/s2.

42-3.7.8 Wet brake test

42-3.7.8.1 General:

42-3.7.8.1.1 The test is comprised of two parts that are carried out consecutively for each brake system:

42-3.7.8.1.1.1 A baseline test based on the dry stop test - single brake control actuated.

42-3.7.8.1.1.2 A single wet brake stop using the same test parameters as in (i), but with the brake(s) being continuously sprayed with water while the test is conducted in order to measure the brakes' performance in wet conditions;

42-3.7.8.1.2 The test is not applicable to a parking brake system, unless it is the secondary brake;

42-3.7.8.1.3 Drum brakes or fully enclosed disc brakes are exempt from this test unless ventilation or open inspection ports are present;

42-3.7.8.1.4 This test requires the vehicle to be fitted with instrumentation that gives a continuous recording of brake control force and vehicle deceleration. The MFDD and the stopping distance measurements are not appropriate in this case.

42-3.7.8.2 Vehicle condition:

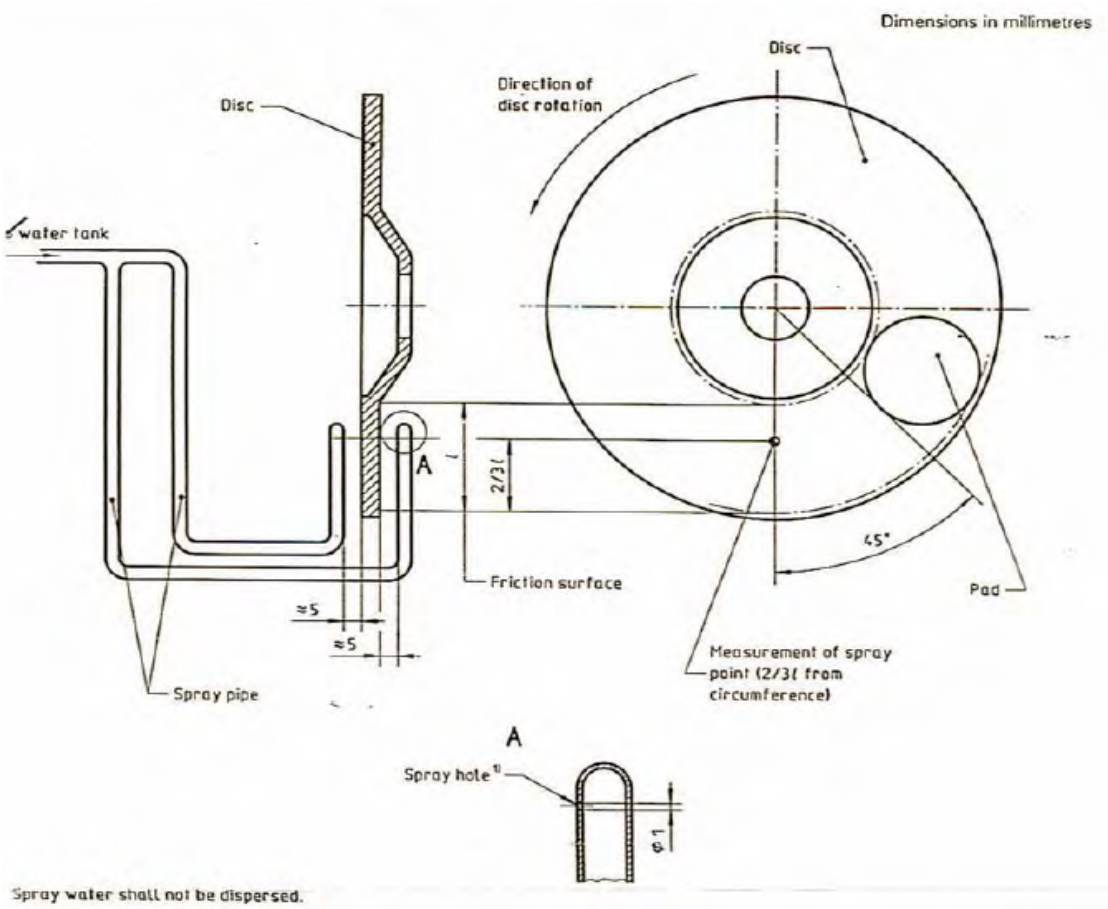
42-3.7.8.2.1 The test is applicable to all vehicle categories;

42-3.7.8.2.2 Laden: For vehicles fitted with CBS and split service brake systems: the vehicle is tested in the lightly loaded condition in addition to the laden condition;

42-3.7.8.2.3 Engine disconnected;

42-3.7.8.2.4 Each brake is fitted with water spray equipment:

42-3.7.8.2.4.1 Disc brakes: Sketch of water spray equipment:



The disc brake water spray equipment is installed as follows:

42-3.7.8.2.4.1.1 Water is sprayed onto each brake with a flow rate of 15 litres/hr. The water is equally distributed on each side of the rotor;

42-3.7.8.2.4.1.2 If the surface of the rotor has any shielding, the spray is applied 45 degrees prior to the shield;

42-3.7.8.2.4.1.3 If it is not possible to locate the spray in the position shown on the sketch, or if the spray coincides with a brake ventilation hole or similar, the spray nozzle may be advanced by an additional 90 degrees maximum from the edge of the pad, using the same radius;

42-3.7.8.2.4.2 Drum brakes with ventilation and open inspection ports:

The water spray equipment is installed as follows:

42-3.7.8.2.4.2.1 Water is sprayed equally onto both sides of the drum brake assembly (on the stationary back plate and on the rotating drum) with a flow rate of 15 litres/hr;

42-3.7.8.2.4.2.2 The spray nozzles are positioned two thirds of the distance from the outer circumference of the rotating drum to the wheel hub centre;

42-3.7.8.2.4.2.3 The nozzle position is > 15 degrees from the edge of any opening in the drum back plate.

42-3.7.8.3 Baseline test

42-3.7.8.3.1 Test conditions and procedure:

42-3.7.8.3.1.1 The test in paragraph 42-3.7.7 (dry stop test - single brake control actuated) is carried out for each brake system but with the brake control force that results in a vehicle deceleration of 2.5 - 3.0 m/s2, and the following is determined:

42-3.7.8.3.1.1.1 The average brake control force measured when the vehicle is travelling between 80 per cent and 10 per cent of the specified test speed;

42-3.7.8.3.1.1.2 The average vehicle deceleration in the period 0.5 to 1.0 seconds after the point of actuation of the brake control;

42-3.7.8.3.1.1.3 The maximum vehicle deceleration during the complete stop but excluding the final 0.5 seconds;

42-3.7.8.3.1.2 Conduct 3 baseline stops and average the values obtained in paragraph 42-3 7.8.3.1.1.1 to 42-3 7.8.1.1.3.

42-3.7.8.4 Wet brake stop

42-3.7.8.4.1 Test conditions and procedure:

42-3.7.8.4.1.1 The vehicle is ridden at the test speed used in the baseline test set out in paragraph 6.3. with the water spray equipment operating on the brake(s) to be tested and with no application of the brake system;

42-3.7.8.4.1.2 After a distance of □ 500 m, apply the averaged brake control force determined in the baseline test for the brake system being tested;

42-3.7.8.4.1.3 Measure the average vehicle deceleration in the period 0.5 to 1.0 seconds after the point of actuation of the brake control;

42-3.7.8.4.1.4 Measure the maximum vehicle deceleration during the complete stop but excluding the final 0.5 seconds.

42-3.7.8.5 Performance requirements

When the brakes are tested in accordance with the test procedure set out in paragraph 42-3 7.10.4.1, the wet brake deceleration performance shall be:

42-3.7.8.5.1 The value measured in paragraph 42-3 7.10.4.1.3□60 per cent of the averaged deceleration values recorded in the baseline test in paragraph 42-3 7.10.3.1.1.2, i.e. in the period 0.5 to 1.0 seconds after the point of application of the brake control; and

42-3.7.8.5.2 The value measured in 42-3 7.10.4.1.4□120 per cent of the averaged deceleration values recorded in the baseline test 42-3 7.10.3.1.1.3, i.e. during the complete stop but excluding the final 0.5 seconds.

42-3.7.9 Heat fade test

42-3.7.9.1 General:

42-3.7.9.1.1 The test comprises three parts that are carried out consecutively for each brake system:
42-3.7.9.1.1.1 A baseline test using the dry stop test - single brake control actuated);
42-3.7.9.1.1.2 A heating procedure which consists of a series of repeated stops in order to heat the brake(s);
42-3.7.9.1.1.3 A hot brake stop using the dry stop test - single brake control actuated, to measure the brake's performance after the heating procedure;
42-3.7.9.1.2 The test is applicable to vehicle categories L3 and L5;
42-3.7.9.1.3 The test is not applicable to parking brake systems and secondary service brake systems;
42-3.7.9.1.4 All stops are carried out with the vehicle laden;
42-3.7.9.1.5 The heating procedure requires the vehicle to be fitted with instrumentation that gives a continuous recording of brake control force and vehicle deceleration. The MFDD and stopping distance measurements are not appropriate for the heating procedure. The baseline test and the hot brake stop require the measurement of either MFDD or the stopping distance.
42-3.7.9.2 Baseline test
42-3.7.9.2.1 Vehicle condition:
42-3.7.9.2.1.1 Engine disconnected.
42-3.7.9.2.2 Test conditions and procedure:
42-3.7.9.2.2.1 Initial brake temperature: □55 degrees C and□100 degrees C;
42-3.7.9.2.2.2 Test speed: 60 km/h or 0.9 Vmax, whichever is lower;
42-3.7.9.2.2.3 Brake application: Each service brake system control actuated separately;
42-3.7.9.2.2.4 Brake actuation force:
42-3.7.9.2.2.4.1 Hand control: □ 200 N;
42-3.7.9.2.2.4.2 Foot control:
□350 N for vehicle categories L3;
□500 N for vehicle categories L5.
42-3.7.9.2.2.5 Accelerate the vehicle to the test speed, actuate the brake control under the conditions specified and record the control force required to achieve the vehicle braking performance specified in the table to paragraph 42-3 7.7.3.
42-3.7.9.3 Heating procedure
42-3.7.9.3.1 Vehicle condition:
42-3.7.9.3.1.1 Engine transmission:
42-3.7.9.3.1.1.1 From the specified test speed to 50 per cent specified test speed: connected, with the highest appropriate gear selected such that the engine speed remains above the manufacturer's specified idle speed;
42-3.7.9.3.1.1.2 From 50 per cent specified test speed to standstill: disconnected.
42-3.7.9.3.2 Test conditions and procedure:
42-3.7.9.3.2.1 Initial brake temperature prior to first stop only:□55 degrees C and□100 degrees C;
42-3.7.9.3.2.2 Test speed:

Single brake system, front wheel braking only: 100 km/h or 0.7V max, whichever is lower;
Single brake system, rear wheel braking only: 80 km/h or 0.7V max, whichever is lower;
CBS or split service brake system: 100 km/h or 0.7V max, whichever is lower;

42-3.7.9.3.2.3 Brake application: Each service brake system control actuated separately;

42-3.7.9.3.2.4 Brake actuation force:

42-3.7.9.3.2.4.1 For the first stop:

The constant control force that achieves a vehicle deceleration rate of 3.0 - 3.5 m/ s2 while the vehicle is decelerating between 80 per cent and 10 per cent of the specified speed;

If the vehicle is unable to achieve the specified vehicle deceleration rate, this stop is carried out to meet the deceleration requirements in the table in paragraph 42-3 7.7.3;

42-3.7.9.3.2.4.2 For the remaining stops:

42-3.7.9.3.2.4.2.1 The same constant brake control force as used for the first stop;

42-3.7.9.3.2.4.2.2 Number of stops: 10;

42-3.7.9.3.2.4.2.3 Interval between stops: 1000 m;

42-3.7.9.3.2.5 Carry out a stop to the conditions specified in this paragraph and then immediately use maximum acceleration to reach the specified speed and maintain that speed until the next stop is made.

42-3.7.9.4 Hot brake stop

42-3.7.9.4.1 Test conditions and procedure:

Perform a single stop under the conditions used in the baseline test (paragraph 42-3 7.9.3) for the brake system that has been heated during the procedure in accordance with paragraph 42-3 7.9.2. This stop is carried out within one minute of the completion of the procedure set out in paragraph 42-3 7.9.3. with a brake control application force less than or equal to the force used during the test set out in paragraph 42-3 7.9.2.

42-3.7.9.5 Performance requirements

When the brakes are tested in accordance with the test procedure set out in paragraph 42-3 7.9.4.1.

42-3.7.9.5.1 The stopping distance: S2 □ 1.67 S1 - 0.67 x 0.1V where:

S1 = corrected stopping distance in metres achieved in the baseline test set out in paragraph 42-3 7.9.2.

S2 = corrected stopping distance in metres achieved in the hot brake stop set out in paragraph 42-3 7.9.4.1.

V = specified test speed in km/h; or

42-3.7.9.5.2 The MFDD□60 per cent of the MFDD recorded in the test set out in paragraph 42-3 7.9.2.

42-3.7.10 Partial failure test - for split service brake systems

42-3.7.10.1 General information:

42-3.7.10.1.1 The test is only applicable to vehicles that are equipped with split service brake systems;

42-3.7.10.1.2 The test is to confirm the performance of the remaining subsystem in the event of a hydraulic system leakage failure.

42-3.7.10.2 Vehicle condition:

42-3.7.10.2.1 The test is applicable to vehicle categories L3 and L5;

42-3.7.10.2.2 Lightly loaded;
42-3.7.10.2.3 Engine disconnected.
42-3.7.10.3 Test conditions and procedure:
42-3.7.10.3.1 Initial brake temperature: □55 degrees C and□100 degrees C;
42-3.7.10.3.2 Test speeds: 50 km/h and 100 km/h or 0.8 Vmax, whichever is lower;
42-3.7.10.3.3 Brake actuation force:
42-3.7.10.3.3.1 Hand control:□250 N;
42-3.7.10.3.3.2 Foot control:□400 N;
42-3.7.10.3.4 Number of stops: until the vehicle meets the performance requirements, with a maximum of 6 stops for each test speed;
42-3.7.10.3.5 Alter the service brake system to induce a complete loss of braking in any one subsystem. Then, for each stop, accelerate the vehicle to the test speed and then actuate the brake control under the conditions specified in this paragraph;
42-3.7.10.3.6 Repeat the test for each subsystem.
42-3.7.10.4 Performance requirements:
When the brakes are tested in accordance with the test procedure;
42-3.7.10.4.1 The system shall comply with the failure warning requirements set out in paragraph 42-3 7.1.1.6; and
42-3.7.10.4.2 The stopping distance (S) shall be□0.1 V + 0.0117 V^2 (where V is the specified test speed in km/h and S is the required stopping distance in metres) or the MFDD shall be□3.3 m/s2.
42-3.7.11 Power-assisted braking system failure test
42-3.7.11.1 General information:
42-3.7.11.1.1 The test is not conducted when the vehicle is equipped with another separate service brake system;
42-3.7.11.1.2 The test is to confirm the performance of the service brake system in the event of failure of the power assistance.
42-3.7.11.2 Test conditions and procedure:
Dry stop test - single brake control actuated for each service brake system with the power assistance disabled.
42-3.7.11.3 Performance requirements
When the brakes are tested in accordance with the test procedure, the stopping distance shall be as specified in column 2 or the MFDD shall be as specified in column 3 of the following table:

Column 1	Column 2	Column 3
Vehicle Category	Stopping distance（s） （Where V is the specified test speed in km/h and S is the required stopping distance in meters）	MFDD
Single brake system		
L1	S□0.1V＋0.0143V2	□2.7m/s2

L2	S□0.1V＋0.0143V^2	□2.7m/s^2
L3	S□0.1V＋0.0133V2	□2.9m/s2
Vehicle with CBS or SSBS		
ALL	S□0.1V＋0.0154V2	□2.5m/s2

42-3.7.12 Measurement method of PBC

42-3.7.12.1 General:

(a) The test is to establish a PBC for the vehicle type when being braked on the test surfaces described in Annex 3, paragraphs 42-3.7.3.1.1. and 42-3.7.3.1.2.

(b) The test comprises a number of stops with varying brake control forces. Both wheels shall be braked simultaneously up to the point reached before wheel lock, in order to achieve the maximum vehicle deceleration rate on the given test surface.

(c) The maximum vehicle deceleration rate is the highest value recorded during all the test stops.

(d) The Peak Braking Coefficient (PBC) is calculated from the test stop that generates the maximum vehicle deceleration rate, as follows:

$$PBC = \frac{0.566}{t}$$

where:

t = time taken for the vehicle speed to reduce from 40 km/h to 20 km/h in seconds.

Note: For vehicles unable to achieve a test speed of 50 km/h, PBC shall be measured as follows:

$$PBC = \frac{0.566}{t}$$

where:

t = time taken, in seconds, for the speed of the vehicle to reduce from 0.8 Vmax to (0.8 Vmax - 20), where Vmax is measured in km/h.

(e) The value of PBC shall be rounded to three decimal places.

42-3.7.12.2 Vehicle condition:

(a) The test is applicable to vehicle categories L1 and L3.

(b) The anti-lock system shall be either disconnected or inoperative, between 40 km/h and 20 km/h.

(c) Lightly loaded.

(d) Engine disconnected.

42-3.7.12.3 Test conditions and procedure:

(a) Initial brake temperature: ≧ 55 degrees C and ≦ 100 degrees C.

(b) Test speed: 60 km/h or 0.9 Vmax, whichever is lower.

(c) Brake application: Simultaneous actuation of both service brake system controls, if so equipped, or of the single service brake system control in the case of a service brake system that operates on all wheels. For vehicles equipped with a single service brake system control, it may be necessary to modify the brake system if one of the wheels is not approaching maximum deceleration.

(d) Brake actuation force:

The control force that achieves the maximum vehicle deceleration rate as defined in paragraph 42-3.7.12.1.(c). The application of the control force must be constant during braking.

(e) Number of stops: until the vehicle meets its maximum deceleration rate.

(f) For each stop, accelerate the vehicle to the test speed and then actuate the brake control(s) under the conditions specified in this paragraph.

42-3.7.13 Parking braking system test - for vehicles equipped with parking brakes

42-3.7.13.1 Vehicle condition:

42-3.7.13.1.1 The test is applicable to vehicle categories L2 and L5.

42-3.7.13.1.2 Test surface gradient = 18 per cent;

42-3.7.13.1.3 Engine disconnected.

42-3.7.13.2 Test conditions and procedure:

42-3.7.13.2.1 Initial brake temperature: ≦ 100 degrees C;

42-3.7.13.2.2 Test surface gradient = 18 per cent;

42-3.7.13.2.3 Brake actuation force:

42-3.7.13.2.3.1 Hand control: ≦ 400 N;

42-3.7.13.2.3.2 Foot control: ≦ 500 N;

42-3.7.13.2.4 For the first part of the test, park the vehicle on the test surface gradient facing up the slope by applying the parking brake system under the conditions specified in this paragraph.

42-3.7.13.2.5 On completion of the test with vehicle facing up the gradient, repeat the same test procedure with the vehicle facing down the gradient.

42-3.7.13.3 Performance requirements: When tested in accordance with the test procedure set out in paragraph 42-3.7.13.2., the parking braking system shall hold the vehicle stationary for 5 minutes when the vehicle is both facing up and facing down the gradient.