



COMMONWEALTH OF AUSTRALIA

AUSTRALIAN DESIGN RULE 31 FOR HYDRAULIC BRAKING SYSTEMS

As Endorsed by the
Australian Transport Advisory Council

The intention of this Australian Design Rule is to ensure safe braking under normal and emergency conditions for vehicles equipped with hydraulic service brakes.

The Australian Transport Advisory Council has recommended to Commonwealth, State and Territory Governments that all motor vehicles specified below shall comply with Australian Design Rule 31 - Hydraulic Braking Systems.

VEHICLE CATEGORY	RULE AMENDMENT		
	MANUFACTURED ON OR AFTER		
	31		
Passenger Cars			
Forward Control Passenger Vehicles up to 8 seats	N/A		
9 seats	N/A		
Other Passenger Cars	1 Jan 1977		
Passenger Car Derivatives	N/A		
Multi-Purpose Passenger Cars	N/A		
Omnibuses up to 3.5 tonnes GVM			
up to 12 seats	N/A		
over 12 seats	N/A		
up to 4.5 tonnes GVM	N/A		
over 4.5 tonnes GVM	N/A		
Motorcycles	N/A		
Mopeds	N/A		
Specially Constructed Vehicles	N/A		
Other Vehicles not listed above			
up to 4.5 tonnes GVM	N/A		
over 4.5 tonnes GVM	N/A		

N/A - Not Applicable

GROSS VEHICLE MASS - Abbreviated to 'GVM'

The Australian Transport Advisory Council has also recommended to Commonwealth, State and Territory Governments that sub-clauses 31.2.3.2 and 31.2.3.3 shall only become effective on 1 January 1982.

Issued By: Department of Transport
PO Box 594
CIVIC SQUARE ACT 2608
AUSTRALIA

Issued: February 1984

AUSTRALIAN DESIGN RULE NO. 31 - HYDRAULIC BRAKING SYSTEMS

31.1 Definitions

- 31.1.1 'Antilock System' - means a portion of a service brake system that automatically controls the degree of rotational wheel slip relative to the road at one or more road wheels of the vehicle during braking.
- 31.1.2 'Average Deceleration' - means the number determined by dividing the square of the initial vehicle speed by twice the stopping distance expressed in compatible units.
- 31.1.3 'Brake Power Assist Unit' - means a device installed in a hydraulic brake system that reduces the operator effort required to actuate the system and that if inoperative does not prevent the operator from braking the vehicle by a continued application of muscular force on the service brake control.
- 31.1.4 'Brake Power Unit' - means a device installed in a brake system that provides the energy required to actuate the brakes, either directly or indirectly through an auxiliary device, with the operator action consisting only of modulating the energy application level.
- 31.1.5 'Friction Element' - means a part of the system designed for replacement and which contacts another part of the system in such a way that vehicle kinetic energy is dissipated or the vehicle is prevented from moving.
- 31.1.6 'Hydraulic Brake System' - means a system that uses hydraulic fluid as medium for transmitting force in any part of the system from the control to the friction elements and that may incorporate a brake power assist unit, or a brake power unit.
- 31.1.7 'Lightly Loaded Test Mass' - means the mass of the unladen vehicle with a full capacity of lubricating oil and coolant and not less than 75 percent of full fuel capacity but without goods, occupants or options except those options which are essential for the test procedures specified, plus additional loading distributed in the seating position adjacent to the driver's seating position so that the mass of such loading plus the mass of the driver and instrumentation mounted in the vehicle is $155 \pm 30\text{kg}$.
- 31.1.8 'Maximum Loaded Test Mass' - means the value specified by the vehicle manufacturer as the loaded mass of the vehicle, provided such mass is not less than the mass of unladen vehicle together with the heaviest factory installed options if the mass of such individual options exceeds 2.3 kg, with a full capacity of lubricating oil and coolant and at least 75 percent capacity of fuel plus additional mass equivalent to 68 kg located in each unoccupied seating position.

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- 31.1.9 'Normal Loaded Vehicle Mass' - of a passenger car means the mass of the unladen vehicle with a full capacity of lubricating oil, coolant and fuel together with the heaviest factory installed options if such individual options weigh 2.3kg or more, plus 68 kg for each of two front seat occupants, plus if the prescribed seating capacity is 5 or more, 68 kg for a rear seat passenger.
- 31.1.10 'Maximum Vehicle Speed' - means the speed attainable, established by calculation or on the basis of a test, under maximum vehicle acceleration from a standing start for 1.6km at normal loaded vehicle mass.
- 31.1.11 'Pedal Effort' - means the force applied to the service brake control.
- 31.1.12 'Spike Stop' - means a stop resulting from the application of a force on the service brake control of at least 885N attained within 400ms of the commencement of application of such force.
- 31.1.13 'Split Service Brake System' - means a brake system consisting of two or more sub-systems actuated by a single control designed so that a leakage-type failure of a pressure component in a single sub-system (except structural failure of a housing that is common to all sub-systems) shall not impair the operation of any other sub-systems.
- 31.1.14 'Stopping Distance' - means the distance travelled by a vehicle from the point of application of force to the brake control to the point at which the vehicle is brought to rest.
- 31.1.15 'Variable Proportioning Brake System' - means a system that automatically adjusts the braking force at the axles to compensate for vehicle static axle loading and/or dynamic weight transfer between axles during deceleration.
- 31.1.16 'Parking Mechanism' - means a component or sub-system of the drive train that locks the drive train when the transmission control is placed in a parking or other gear position and the ignition key is removed.
- 31.2 Design Requirements
- 31.2.1 Service Brake System
- 31.2.1.1 The vehicle shall be equipped with a service brake system.
- 31.2.2 Parking Brake System
- 31.2.2.1 The vehicle shall be equipped with a parking brake system such that in the applied position retention is effected by mechanical means, and the braking effect of which is effected by:

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- (i) the frictional force developed between two friction surfaces, or
- (ii) the frictional force developed between two friction surfaces and a parking mechanism incorporated in the transmission or transmission control, so designed that engagement of such mechanism must be effected before the ignition key can be removed from the ignition switch.

31.2.3 Service Brake Failure Indicator Lamp

31.2.3.1 Each vehicle shall have one or more service brake failure indicator lamps. The indicator lamp shall be activated whenever any of the following conditions occur whilst the ignition switch is in the 'engine on' position:

- for a vehicle having a split service brake system, any of conditions (i) and (iv), or optionally any of conditions (iii) and (iv).
 - for a vehicle not having a split service brake system, any of conditions (ii) and (iv), or optionally any of conditions (iii) and (iv).
- (i) When a pressure failure occurs in any part of the service brake system except for pressure failure caused by either:
- a structural failure of a housing that is common to two or more sub-systems, or
 - failure of a vacuum component of a vacuum brake power assist unit.

In the event of such failures, for the purpose of this Clause the lamp activation requirement will be deemed to be satisfied if the lamp is activated before or upon application of:

- (a) a differential line pressure of not more than 1.55 MPa between the active and failed brake systems, or
- (b) a pedal effort of 225N in the case of unassisted service brake systems, or
- (c) a pedal effort of 115N in the case of service brake systems with a brake power assist unit, or
- (d) when the supply pressure in a brake power unit drops to less than one half of the operating pressure.

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For the purposes of this Clause, differential line pressure shall be measured either at a master cylinder outlet, or at a slave cylinder outlet if the master cylinder controls a slave cylinder at a booster unit.

- (ii) When the supply pressure in any brake power unit drops to less than half of the operating pressure.
- (iii) When a drop in the level of brake fluid occurs in any master cylinder reservoir either to less than the manufacturer's designated minimum level or to less than 25% of the reservoir fluid capacity whichever is the greater volume remaining.
- (iv) A total electrical failure in an antilock or brake proportioning system.

31.2.3.2 In the case where the master cylinder reservoir also contains fluid for the use of a system other than the brake system, the indicator system and the reservoir shall be so designed that the indicator lamp will not be activated when there are any variations in the fluid level in that part of the reservoir provided exclusively for the use of the system other than the brake system.

31.2.3.3 As a check of lamp function the indicator lamp shall be so designed that it is activated

- (i) when the ignition switch is turned from the 'engine off' position to the 'engine on' position and the engine is not operating, and unless a failure of the type described in Clause 31.2.3.1 exists in the brake system, it shall be deactivated when the engine is operating, or
- (ii) when the ignition switch is in the 'engine start' position, and unless a failure of the type described in Clause 31.2.3.1 exists in the brake system, it shall be deactivated upon return of the ignition switch to the 'engine on' position, or
- (iii) when the ignition switch is in a position between the 'engine on' position and the 'engine start' position, that is designated by the manufacturer as a check position, and unless a failure of the type described in Clause 31.2.3.1 exists in the brake system, it shall be de-activated upon return of the ignition switch to the 'engine on' position.

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For the purpose of this Clause, for vehicles equipped with an automatic transmission the activation as a check of lamp function is not required when the transmission control lever is in a forward or reverse drive position.

31.2.3.4 The indicator lamp system shall be so designed that once having been activated to signal a brake failure it shall be activated whenever the ignition switch is in the 'engine on' position and the fault remains uncorrected, and;

- (i) in the case of a vehicle having a split service brake system the activated lamp may be steady burning or flashing. At the option of the manufacturer the lamp shall be labelled with at least the word "BRAKE" or, the symbol for "BRAKE FAILURE" specified as No. 4.31 in International Standard ISO 2575-1982(E) - Road vehicles - Symbols for controls, indicators and tell-tales, placed either directly on the lens or adjacent to it in such a way that the label is illuminated by the same light source as the lens. The letters of the label shall be not less than 3 mm high and shall be of a contrasting colour to their background. If the label is directly on the lens the colour of either label or lens shall be red and if the label is not on the lens the colour of the lens shall be red. *
- (ii) in the case of a vehicle not having a split service brake system a device shall be fitted which activates both a continuous or short period intermittent audible signal and a flashing indicator lamp. At the option of the manufacturer the lamp shall be labelled with at least the words "STOP - BRAKE FAILURE" or the symbol for "BRAKE FAILURE" specified as No. 4.31 in International Standard ISO 2575-1982(E) - Road Vehicles - Symbols for controls, indicators, and tell-tales, placed either directly on the lens or adjacent to it in such a way that the label is illuminated by the same light source as the lens. The letters of the label shall be not less than 6mm high and shall be of a contrasting colour to their background. If the label is directly on the lens the colour of either label or lens shall be red and if the label is not on the lens the colour of the lens shall be red. *
- (iii) In the case of a vehicle having an anti-lock braking system where the lamp or lens display is used exclusively for the anti-lock system and where there is a failure of the anti-lock system the vehicle can still meet the performance requirements of clause 31.3, the activated lamp may be steady burning or flashing. The lamp shall be labelled with the word "ANTILOCK" or equivalent placed either directly on the lens or adjacent to it in *

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such a way that the label is illuminated by the same light source as the lens. The letters of the label shall be not less than 3 mm high and the lens and the letters shall be of contrasting colours, one of which is red or yellow. If the label is directly on the lens the colour of either the label or lens shall be red or yellow and if the label is not on the lens the colour of the lens shall be red or yellow.

31.2.4 Parking Brake Indicator Lamp

- 31.2.4.1 Each vehicle shall be provided with a lamp, which at the option of the manufacturer, may be common with or distinct and separate from any service brake failure indicator lamp. The parking brake indicator lamp will be activated whenever the ignition switch is in the 'engine-on' position and the parking brake is engaged. In the case of a common lamp, the lamp shall be labelled with the word "BRAKE" or, the symbol for "BRAKE FAILURE" specified as No. 4.31 in International Standard ISO 2575-1982(E) - Road Vehicles - Symbols for controls, indicators and tell-tales, and in the case of a distinct and separate lamp, the lamp shall be labelled with at least the words "PARK BRAKE" or "PARKING BRAKE" or, the symbol for "PARKING BRAKE" specified as No. 4.32 in International Standard ISO 2575-1982(E) - Road Vehicles - Symbols for controls, indicators and tell-tales, placed either directly on the lens or adjacent to it in such a way that the label is illuminated by the same light source as the lens. The letters of the label shall be not less than 3mm high and shall be of a contrasting colour to their background. If the label is directly on the lens the colour of either label or lens shall be red and if the label is not on the lens the colour of the lens shall be red.

31.2.5 Reservoirs

- 31.2.5.1 In the case where the service brake system incorporates a master cylinder, any service brake sub-system serviced by the master cylinder shall have either:
- (i) a reservoir which contains fluid exclusively for the use of that service brake sub-system, or
 - (ii) a reservoir which contains fluid for the use of two or more service brake sub-systems in which case that part of the reservoir capacity provided exclusively for the use of each service brake sub-system shall be not less than the volume displaced by the master cylinder piston servicing the sub-system, during a full stroke of the piston.

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- 31.2.5.2 The capacity of each reservoir shall be not less than the fluid displacement resulting when all the wheel cylinders or caliper pistons serviced by the reservoir move from a new-lining, fully-retracted position, as adjusted according to the manufacturer's recommendations to a fully-worn, fully-applied position. For the purposes of this Clause, fully-worn means that the lining is worn to whichever of the following conditions allows the greatest shoe or pad movement:
- (i) rivet or bolt heads on riveted or bolted linings; or
 - (ii) within 0.8 mm of shoe or pad mounting surface on bonded linings; or
 - (iii) the limit recommended by the manufacturer.
- 31.2.5.3 Each brake power unit shall have a reservoir of capacity not less than the total capacity of the reservoirs required under the requirements of Clause 31.2.5.2 plus the fluid displacement necessary to charge the piston(s) or accumulator(s) provided for the purpose of storing energy.
- 31.2.5.4 A statement specifying the type of fluid to be used in the brake system and displaying at least the words 'WARNING. Clean filler cap before removing' shall be permanently affixed, stamped, engraved or embossed with letters not less than 3mm high, either on or partially within 150mm of one brake fluid reservoir filler plug or cap and totally within 300mm of all reservoir filler plugs or caps. If not stamped, engraved or embossed, the lettering shall be of a contrasting colour to that of the background.
- 31.2.6 Protection of System Using Stored Energy
- 31.2.6.1 Any device for storing energy for the operation or to assist in the operation of the braking system, shall be so protected that failure of the power unit supplying the energy does not result in depletion of the stored energy.
- 31.2.6.2 In cases where the generating power unit of a brake power unit supplies energy to other units, the design shall be such that the brake power unit is preferentially charged.
- 31.2.6.3 In the case of a service brake system with a single brake power unit, the design shall be such that the device for storing energy shall preferentially service the braking system if such device also services other systems. In the case of a service brake system with two or more independent brake power units, the design shall be such that at least one device for storing energy shall preferentially service the brake system.

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31.3 Performance Requirements

31.3.1 The vehicle shall be capable of meeting the range of performance tests set out in the table of Clause 31.3.2 subject to the general test conditions of Clause 31.4 and the particular test conditions of Clause 31.5. The sequence of testing shall be in the order set out in the table except that the parking brake test may be conducted at any time within the sequence and items 4-24 may follow items 25-26.

31.3.2

Item No.	Series of Tests and Procedures	Initial Vehicle Speed# km/h	Minimum Average Deceleration m/s ²	Vehicle Mass	Gear Selector Position
1	Pre Test Instrumentation Check	65 (max)	N.A.	N.A.	N.A.
2	First Effectiveness Test	45-55 95-105	5.00 5.45	M M	Neutral "
3	First Burnishing Procedure	55-65	N.A.	M	Drive
4	Second Effectiveness Test	45-55 95-105 125-135	5.45 5.75 5.45	M M M	Neutral " "
5	First Reburnishing Procedure	55-65	N.A.	M	Drive
6	Parking Brake Test	N.A.	N.A.	M&L	See text
7	Third Effectiveness Test	95-105	6.00 5.75 if max. vehicle speed 55 km/h or less	L	Neutral
8	Partial Failure	95-105	2.55	M&L	Drive

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31.3.2 (cont.)

Item No.	Series of Tests and Procedures	Initial Vehicle Speed# km/h	Minimum Average Deceleration m/s ²	Vehicle Mass	Gear Selector Position
9	Inoperative Brake Power Assist Unit or Brake Power Unit	95-105	See text	M	Drive
10	First Base Line Check Procedure	45-55	See text	M	Drive
11	First Fade Test	95-105	See text	M	Drive
12	First Fade Recovery Procedure	45-55	See text	M	Drive
13	First Fade Recovery Test	45-55	See text	M	Drive
14	Second Reburnishing Procedure	55-65	N.A.	M	Drive
15	Second Base Line Check Procedure	45-55	See text	M	Drive
16	Second Fade Test	95-105	See text	M	Drive
17	Second Fade Recovery Procedure	45-55	See text	M	Drive
18	Second Fade Recovery Test	45-55	See text	M	Drive
19	Third Reburnishing Procedure	55-65	N.A.	M	Drive

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31.3.2 (cont.)

Item No.	Series of Tests and Procedures	Initial Vehicle Speed# km/h	Minimum Average Deceleration m/s ²	Vehicle Mass	Gear Selector Position
20	Fourth Effectiveness Test	45-55	5.00	M	Neutral
		95-105	5.45	M	"
		125-135	5.00	M	"
		or 160 km/h (Refer Clause 31.5.21)	4.75	M	"
21	Third Base Line Check Procedure	45-55	See text	M	Drive
22	Water Conditioning Procedure	5-10	N.A.	M	Drive
23	Water Recovery	45-55	See text	M	Drive
24	Water Recovery Test	45-55	See text	M	Drive
25	Spike Stops	45-55	N.A.	M	Neutral
26	Final Effectiveness Test	95-105	5.45	M	Neutral

N.A. means no condition applicable

Item number also corresponds to sub-clause number of Clause 31.5, e.g. item 2 is described in Clause 31.5.2

'M' means Maximum Loaded Test Mass

'L' means Lightly Loaded Test Mass

The initial vehicle speed shall not be outside the range specified.

31.3.3 A vehicle shall be deemed to meet the range of performance tests if it meets the requirements of each particular test and completes the range without component failure. For the purpose of this Design Rule, component failure means:

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- (i) the lining surface area of any single friction element is reduced by more than ten percent as a result of friction element tearout or detachment;
- (ii) detachment or malfunctioning of any mechanical component of the braking system;
- (iii) there is visible evidence of brake fluid on the friction surface of the brake or at wheel cylinders or fluid line junctions.

31.4 General Test Conditions

- 31.4.1 The ambient temperature at the test site shall be within the range of 0°C to 40°C.
- 31.4.2 The ignition timing, engine idle speed and adjustable speed governor if fitted shall be set to the manufacturer's recommendation.
- 31.4.3 The tyres fitted to the vehicle shall be inflated to the pressure, recommended by the vehicle manufacturer, appropriate to the maximum loaded test mass.
- 31.4.4 Except as required for instrumentation purposes, all vehicle openings other than facia vents of through-flow ventilation systems and quarter vents of vehicles not fitted with such ventilation systems, shall be closed.
- 31.4.5 Deceleration shall be conducted on a test track or roadway that meets the following requirements:
 - (i) in the case of fade tests, the surface shall be substantially level and any effective upward gradient between the start and end of the test shall not exceed 1%;
 - (ii) in the case of all other deceleration tests, the upward gradient shall not exceed 1%.
- 31.4.6 Except when conducting burnishing procedures, decelerations shall be conducted in a direction such that the component of wind velocity opposite to the direction of travel of the vehicle does not exceed 15 km/h.
- 31.4.7 Where a test requires that the gear selector is in 'drive' the transmission selector control shall be in the control position other than overdrive as recommended by the manufacturer appropriate to the speed of the vehicle at the commencement of the deceleration mode, except that where the vehicle is equipped with a manually operated gear box the transmission may be disconnected from the engine output when the vehicle speed is less than 35 km/h.

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- 31.4.8 If the vehicle is not capable of attaining the initial speed requirement specified for a particular deceleration test, then, unless otherwise specified, the initial speed shall be a speed within 15 km/h of the maximum speed of the vehicle.
- 31.4.9 For all effectiveness and partial failure tests no part of the vehicle shall move outside a straight lane 3.7m in width, the vehicle being positioned at the centre of the lane at the commencement of the deceleration.
- 31.4.10 Except in the case of the parking brake test, the water recovery procedure and the water recovery test, each test procedure may be preceded by a series of 10 stops from not more than 65 km/h with a sustained deceleration not exceeding 3.5m/s².
- 31.4.11 Pedal efforts for any deceleration mode unless otherwise specified shall not exceed 670N.
- 31.4.12 Automatic brake adjusters, if fitted, may be rendered inoperative prior to the commencement of the First Burnishing Procedure specified in Clause 31.5.3. In cases where this option is exercised, adjusters shall remain inoperative for the duration of the test program.
- 31.5 Particular Test Conditions
- 31.5.1 Pretest Instrumentation Check: The number of decelerations for the purpose of instrumentation checks shall not exceed twenty. Such decelerations shall be conducted from a speed of not more than 65 km/h and the actual deceleration shall not exceed 3.5m/s².
- 31.5.2 First Effectiveness Test: The vehicle shall be deemed to pass if all the parameters for each set of conditions specified in Clause 31.3.1 are met on at least one deceleration mode within a number of deceleration modes which shall not exceed six.
- 31.5.3 First Burnishing Procedure: This shall be conducted by making not more than 200 decelerations under the conditions specified in Clause 31.3.1 such that any instantaneous deceleration shall not exceed 5m/s². The interval from the start of one service brake application to the start of the next shall be not more than 1.6km. The vehicle shall be accelerated to the specified speed after each deceleration mode and maintained at that speed until initiating the next deceleration mode.

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On completion of the First Burnishing Procedure, the brake system may be adjusted in accordance with the manufacturer's recommendation.

- 31.5.4 Second Effectiveness Test: If the Maximum Vehicle Speed is less than 135 km/h, the vehicle shall be deemed to pass the test if all of the first two sets of conditions specified in Clause 31.3.1 for this test are met on at least one deceleration mode within a number of deceleration modes which shall not exceed six. If the Maximum Vehicle Speed is not less than 135 km/h, the vehicle shall be deemed to pass this test if all the parameters specified in Clause 31.3.1 are met on at least one deceleration mode within a number of deceleration modes which shall not exceed six in the case of each of the first two sets of parameters and four in the case of the third set of parameters.
- 31.5.5 First Reburnishing Procedure: The Burnishing Procedure of Clause 31.5.3 shall be repeated except that the maximum number of deceleration modes shall be 35.
- 31.5.6 Parking Brake System Test: Vehicles fitted with parking brake systems as described in Clause 31.2.2.1(i) shall meet the requirements of Clause 31.5.6.1. Vehicles fitted with parking brake systems as described in Clause 31.2.2.1(ii) shall meet the requirements of either Clause 31.5.6.1 or Clause 31.5.6.2.
- 31.5.6.1 The vehicle shall be positioned on a grade of at least 30% where the vertical rise is expressed as a percentage of the horizontal distance travelled to achieve this rise, such that the longitudinal axis of the vehicle is parallel to the direction of the grade. The parking mechanism (if applicable) shall be disengaged. The service brake shall be applied, transmission disengaged and parking brake shall be applied by a single application of the force specified except that a series of applications to achieve the specified force may be made in the case of a parking brake design that does not allow the application of the specified force in a single application. The service brake shall be released, for a period of not less than 5 minutes. The vehicle shall then be parked in the reverse position on the grade, for a period of not less than 5 minutes. These conditions shall be met under both conditions of loading specified. The force for actuation of a hand operated parking brake system shall be not greater than 400N and shall be applied at the centre of the hand grip area or not closer than 35mm to the free end of the actuation lever. The force for actuation of a foot operated parking brake system shall be not greater than 540N.

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The vehicle shall be deemed to pass this test if, for each of the 5 minute periods, it remains stationary on the slope, or in the case where the test is carried out on a clean, dry, smooth portland cement concrete surface, there is no rotation of the wheels to which the parking brake is applied. If the vehicle does not remain stationary, reapplication of the service brake to hold the vehicle stationary, with reapplication of the specified force to the parking brake control (without release of the ratcheting or other holding mechanism of the parking brake) may be used twice to attain a stationary position. In cases where the parking brake system does not utilise the service brake friction elements, the friction elements of the system may be burnished to the manufacturer's recommendation prior to the test.

- 31.5.6.2 The vehicle shall be tested according to the test requirements specified in Clause 31.5.6.1 except that both the parking brake and the parking mechanism shall be engaged. Furthermore the vehicle shall be capable of meeting the same requirements with the parking mechanism disengaged except that in this case the gradient shall be not less than 20%.
- 31.5.7 Third Effectiveness Test: The vehicle shall be deemed to pass if all the parameters specified for each set of conditions specified in Clause 31.3.1 are met on at least one deceleration mode within a number of deceleration modes which shall not exceed six.
- 31.5.7.1 Minimum Pedal Effort Test: In the case where the requirements of Clause 31.5.7 are achieved with a pedal effort of less than 150N, the sustained deceleration resulting when a pedal effort of not less than 65N is applied from an initial vehicle speed of 45 km/h shall not exceed 5.45m/s².
- 31.5.8 Partial Failure: The vehicle shall meet the requirements of Clause 31.5.8.1 if fitted with a split service brake system or Clauses 31.5.8.2 and 31.5.8.3 if not fitted with a split service brake system.
- 31.5.8.1 In the case of a vehicle having a split service braking system the vehicle shall be deemed to satisfy the requirements of this Clause if all the parameters specified in Clause 31.3.1 are met by operation of the service brake control on at least one deceleration mode within a number of deceleration modes which shall not exceed four for each single type of potential failure, including:
- (i) failure of each sub-system of the split system;
 - (ii) inoperative antilock system;
 - (iii) inoperative variable proportioning brake system.

One single failure shall be induced prior to each set of deceleration modes and the vehicle restored at the completion of the set.

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31.5.8.2 In the case of a vehicle not having a split service brake system the vehicle shall be deemed to satisfy the requirements of this Clause if all the parameters specified in Clause 31.3.1 are met by operation of the service brake control on each of 10 consecutive stops for each single type of potential failure, including:

- (i) rupture or leakage of any component of the brake system other than a structural failure of a housing that is common to two or more sub-systems;
- (ii) inoperative antilock system;
- (iii) inoperative variable proportioning brake system.

One single failure shall be induced prior to each set of deceleration modes and the vehicle restored at the completion of the set.

31.5.8.3 In the case of a vehicle not having a split service brake system but having a service brake system using stored energy the pressure and volume of the working fluid in the brake system (including any energy storage devices) shall not exceed the minimum levels specified by the vehicle manufacturer or achievable by adjustment of controls accessible to the driver for initiation of the failure mode prior to the commencement of any partial failure test sequence.

31.5.9 Inoperative Brake Power Assist Unit or Brake Power Unit: The vehicle shall meet the requirements of Clause 31.5.9.1 or alternatively 31.5.9.2 if fitted with one or more brake power assist units, or Clause 31.5.9.3 if fitted with one or more brake power units.

31.5.9.1 The vehicle shall be deemed to satisfy the requirements of this Clause if under the parameters specified in Clause 31.3.1 for this test a minimum average deceleration of 2.55m/s^2 is attained for one deceleration mode within a number of deceleration modes which shall not exceed four when any one brake power assist unit or brake power unit is inoperative and depleted of all reserve capability. One single failure shall be induced prior to each set of deceleration modes and the vehicle restored at the completion of the set.

31.5.9.2 The vehicle shall be deemed to satisfy the requirements of this Clause if, under the parameters specified in Clause 31.3.1 for this test and with any one brake power assist unit inoperative, the following average decelerations are attained on the first six consecutive stops with the inoperative unit not initially depleted of reserve capability, and the average deceleration specified for the final seventh stop is attained with the inoperative unit depleted of reserve capability.

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<u>Stop Number</u>	<u>Average Deceleration</u>
1	4.85 m/s ²
2	3.65 m/s ²
3	3.00 m/s ²
4	2.70 m/s ²
5	2.40 m/s ²
6	2.25 m/s ²
7	2.00 m/s ²

- 31.5.9.3 In the case of a vehicle fitted with a brake power unit incorporating an accumulator-type reserve system, the vehicle shall be deemed to satisfy the requirements of this Clause if, under the parameters specified in Clause 31.3.1 for this test and with any one brake power unit inoperative, the following average decelerations are attained on the first ten consecutive stops with the inoperative unit not initially depleted of reserve capability, and the average deceleration specified for the final eleventh stop is attained with the inoperative unit depleted of reserve capability.

Stop NumberAverage Deceleration

1	4.85 m/s ²
2	3.95 m/s ²
3	3.65 m/s ²
4	3.35 m/s ²
5	3.00 m/s ²
6	2.85 m/s ²
7	2.70 m/s ²
8	2.55 m/s ²
9	2.40 m/s ²
10	2.25 m/s ²
11	2.10 m/s ²

In the case of a vehicle fitted with a brake power unit incorporating a backup type system, the vehicle shall be deemed to satisfy the requirements of this Clause if, under the parameters specified in Clause 31.3.1 for this test and with any one brake power unit inoperative, the average deceleration for each of fifteen consecutive stops is not less than 3.65m/s².

- 31.5.10 First Base Line Check Procedures: Under the conditions specified in Clause 31.3.1, three stops shall be made such that the sustained deceleration of each stop is within $\pm 0.2\text{m/s}^2$ of the sustained deceleration of each of the other two stops and such that the sustained deceleration of all stops is $3 \pm 0.5\text{m/s}^2$. The maximum force applied to the service brake control during each deceleration to 8 km/h shall be recorded. The average of the maximum force applied to the service brake control for the three deceleration modes shall be calculated.

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31.5.11 First Fade Test: Ten deceleration modes shall be conducted such that:

- (i) the sustained deceleration of each of the first five modes is not less than 4.50 m/s^2 , and
- (ii) for each of the remaining five modes, the sustained deceleration is either:
 - (a) not less than 1.50 m/s^2 and is the sustained deceleration achieved with application of a pedal effort not less than 570N nor more than the maximum allowable pedal effort; or
 - (b) not less than 4.50 m/s^2

The average time required to achieve the sustained deceleration shall be not more than 1 second. The control force requirements shall be applicable whilst the vehicle speed is greater than 8 km/h. The vehicle shall be subjected to maximum acceleration immediately after each stop and the distance between successive brake applications shall be not more than 650m. In any case when the specified speed cannot be attained, decelerations shall be conducted at the speed attained under maximum acceleration from the previous stop to a point not less than 620m from the commencement of the previous stop. The vehicle shall be deemed to pass if the required deceleration can be achieved on all stops within the conditions specified.

31.5.12 First Fade Recovery Procedure: Immediately upon completion of the First Fade Test, the vehicle shall be driven at $50 \pm 5 \text{ km/h}$ for not more than 1.6 km. Immediately after the 1.6 km conditioning, four stops shall be effected at a sustained deceleration of $3 \pm 0.5 \text{ m/s}^2$ under the conditions specified. The distance between successive brake applications shall be not more than 1.6 km.

31.5.13 First Fade Recovery Test: Immediately upon completion of the First Fade Recovery Procedure, the vehicle shall be accelerated to the specified speed and within 1.6 km. From the start of the test the vehicle shall be decelerated in the same manner as for the First Base Line Check Procedure of Clause 31.5.10 such that the sustained deceleration is within $\pm 0.2 \text{ m/s}^2$ of the arithmetic mean of the actual sustained decelerations

recorded for the three deceleration modes of the First Base Line Check Procedure. The vehicle shall be deemed to pass this test if the maximum force applied to the service brake control during the deceleration to 8 km/h is within $\pm 90\text{N}$ and either -50N or -40% , whichever gives the wider range, of the average control force determined for the First Base Line Check Procedure (Clause 31.5.10).

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- 31.5.14 Second Reburnishing Procedure: This shall be a repeat of the First Reburnishing Procedure - Clause 31.5.5.
- 31.5.15 Second Base Line Check Procedure: This shall be a repeat of the First Base Line Check Procedure - Clause 31.5.10.
- 31.5.16 Second Fade Test: This shall be a repeat of the First Fade Test (Clause 31.5.11) except that fifteen deceleration modes shall be conducted such that:
- (i) the sustained deceleration of each of the first ten modes is not less than 4.50m/s^2 , and
 - (ii) for each of the remaining five modes, the sustained deceleration is either:
 - (a) not less than 1.50m/s^2 and is the sustained deceleration achieved with application of a pedal effort not less than 570N nor more than the maximum allowable pedal effort; or
 - (b) not less than 4.50m/s^2 .
- 31.5.17 Second Fade Recovery Procedure: This shall be a repeat of the First Fade Recovery Procedure (Clause 31.5.12) except that it shall be appropriate to the Second Fade Test.
- 31.5.18 Second Fade Recovery Test: This shall be a repeat of the First Fade Recovery Test (Clause 31.5.13) except that it shall be appropriate to the Second Fade Recovery Procedure and the Second Base Line Check Procedure.
- 31.5.19 Third Reburnishing Procedure: This shall be a repeat of First Reburnishing Procedure - Clause 31.5.5.
- 31.5.20 Fourth Effectiveness Test: The vehicle shall be deemed to pass this test:
- (i) if all of the parameters for each of the first sets of conditions specified in Clause 31.3.1 for this test are met on at least one deceleration mode within a number of deceleration modes which shall not exceed six; and

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- (ii) if all of the parameters for the third set of conditions specified in Clause 31.3.1 for this test are met on at least one deceleration mode within a number of deceleration modes which shall not exceed four in the case where the Maximum Vehicle Speed is greater than or equal to 135 km/h but less than 160 km/h; or
- (iii) if all the parameters for the fourth set of conditions specified in Clause 31.3.1 for this test are met on at least one deceleration mode within a number of deceleration modes which shall not exceed four in the case where the Maximum Vehicle Speed is not less than 160 km/h.

- 31.5.21 Third Base Line Check Procedure: This shall be a repeat of First Base Line Check Procedure - Clause 31.5.10.
- 31.5.22 Water Conditioning Procedure: The vehicle shall be driven with the brakes released, through water of depth not less than 150mm for a period of two minutes. During such period, the vehicle speed shall not exceed 10 km/h and for at least one minute, shall be not less than 5 km/h. For the purpose of this Clause changes from drive to reverse and reverse to drive shall be considered as continuous driving.
- 31.5.23 Water Recovery Procedure: Immediately upon completion of the Water Conditioning Procedure, the First Fade Recovery Procedure (Clause 31.5.12) shall be repeated with the additional requirement that the brakes must not be applied except for the deceleration specified.
- 31.5.24 Water Recovery Test: This shall be a repeat of the First Fade Recovery Test (Clause 31.5.13) except that it shall be appropriate to the Water Recovery Procedure and the Third Base Line Check Procedure, and further, the vehicle shall be deemed to pass this test if the maximum force applied to the service brake control during the deceleration to 8 km/h is within +200N and either -50N or -40%, whichever gives the wider range, of the average control force determined for the Third Base Line Check Procedure, but in no case shall it exceed 400N.
- 31.5.25 Spike Stops
- 31.5.25.1 Ten spike stops shall be conducted under the conditions specified. A pedal effort of not less than 885N shall be achieved within 400 ms of pedal application and shall be maintained until the vehicle is stationary.

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31.5.26 Final Effectiveness Test

- 31.5.26.1 The vehicle shall be deemed to pass this test if all the parameters specified for each set of conditions listed in Clause 31.3.1 are met on at least one deceleration mode within a number of deceleration modes which shall not exceed six.