



AUSTRALIAN DESIGN RULE NO. 35 - COMMERCIAL VEHICLE BRAKING SYSTEMS

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35.1 Definitions

35.1.1 '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.

35.1.2 'Audible Indicator' means a device incorporated in a brake power unit system which indicates to the operator by an intermittent or continuous audible signal that the supply pressure of the working fluid in the system has fallen below a predetermined level.

35.1.3 'Average Deceleration' means the number determined by dividing the square of the actual initial vehicle speed by twice the stopping distance expressed in compatible units.

35.1.4 'Average Operating Pressure' means the arithmetic average of the vehicle manufacturer's specified maximum and minimum pressures in the operating pressure range.

35.1.5 'Brake Power Assist Unit' means a device installed in a 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.

35.1.6 'Brake Power Unit' means a device installed in a brake system that stores the energy required to actuate the brakes and provides the energy either directly or indirectly through an auxiliary device, with the operator action consisting only of modulating the energy application level.

35.1.7 'Control' means a component actuated directly by the operator to transmit the force required to activate a system.

35.1.8 'Friction Element' means a part of the system designed for replacement and which contacts another part of the system in such a way that either vehicle kinetic energy is dissipated or the vehicle is restrained from moving.

35.1.9 'Gross Vehicle Mass Rating (GVMR)' means the manufacturer's specified maximum loaded vehicle mass for which compliance with current and appropriate Australian Design Rules has been or can be established.

35.1.10 'Hydraulic Brake System' means a system that uses liquid as the medium for transmitting force in any part of the system from the control to the friction elements, and may incorporate either a brake power assist unit or a brake power unit.

35.1.11 'Initial Brake Control Location' means the location of the brake control within the first 3mm of travel of the centre of the brake pedal pad.

35.1.12 '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 positions 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+30kg. In the case of a vehicle in 'cab-and-chassis' condition an additional load not exceeding 7.5 percent of the GVWR shall be located with its centre of mass within 200mm of the manufacturer's designated load centre, measured in a horizontal plane.

35.1.13 'Lock Actuator' means a device which ensures braking operation of the parking brake by mechanically locking the brake piston rod.

35.1.14 'Maximum Laden Vehicle Speed' means the speed attainable at 1.6 km from a standing start under maximum acceleration with the vehicle at maximum loaded test mass, established by either test or calculation.

35.1.15 'Maximum Loaded Test Mass' means the mass of the laden vehicle loaded to Gross Vehicle Mass Rating with the load so distributed over the load bearing area of the vehicle as not to exceed the vehicle manufacturer's nominated individual axle loads.

35.1.16 'Parking Brake System' means a system that, through the medium of a control independent of the service brake control, applies a restraining force to two or more road wheels of the vehicle to either prevent or restrict rotation of the braked wheels.

35.1.17 'Parking Mechanism' for the purposes of this Design Rule means a component or sub-system of the drive train that locks the drive train when the transmission control is placed in the park position.

35.1.18 'Pedal Effort' means the force applied to any foot operated brake control, measured in the direction of pedal movement.

35.1.19 'Secondary Brake System' means either:

- (i) a system which, in the event of failure of any fluid connected component of the Service Brake System, remains operative and capable of imparting a retarding force to the vehicle; or, optionally,
- (ii) one circuit of a split service brake system, except if the vehicle is fitted with only one brake power unit.

35.1.20 'Spike Stop'; for the purpose of this Design Rule means

- (i) in the case of a service brake system fitted with a brake power unit, a stop resulting from the application of a force on the service brake control such as to produce full control travel within 400 ms from the instant at which the control leaves the initial brake control location;
- (ii) in the case of a service brake system without a brake power unit, a stop resulting from the application of a pedal effort of at least 885N on the service brake control attained within 500 ms from the instant at which the control leaves the initial brake control location.

\*Amended February 1978

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- 35.1.21 'Split Service Brake System' means a brake system consisting of two or more sub-systems actuated by a single control and so designed that a leakage-type failure of a pressure component in a single sub-system (except structural failure of a housing that is common to two or more sub-systems) shall not impair the operation of any other sub-systems.
- 35.1.22 'Spring Brake System' means a brake system utilizing one or more springs to store the energy required to actuate a brake.
- 35.1.23 'Stopping Distance' means the distance travelled by a vehicle from its position at the instant the brake control leaves the initial brake control location to the position at which the vehicle is brought to rest.
- 35.1.24 'Stored Energy' means energy stored in a device such as a pressure vessel, a vacuum chamber or a spring.
- 35.1.25 'Variable Proportioning Brake System' means a system that automatically adjusts the braking force at an axle to compensate for vehicle static axle loading and/or dynamic weight transfer between axles during acceleration or deceleration.
- 35.1.26 'Vehicle Category' means classification by mass and function of motor vehicles covered by this Design Rule into the following groups for testing purposes:
- Category P1: Omnibuses having a gross vehicle mass rating not exceeding 5 tonnes, and all multipurpose passenger cars.
  - Category P2: Omnibuses having a gross vehicle mass rating exceeding 5 tonnes.
  - Category T1: Passenger Car derivatives and motor vehicles having a gross vehicle mass rating not exceeding 3.5 tonnes other than multipurpose passenger cars and omnibuses.
  - Category T2: Motor vehicles having a gross vehicle mass rating exceeding 3.5 tonnes but not exceeding 12 tonnes, other than multipurpose passenger cars and omnibuses.
  - Category T3: Motor vehicles having a gross vehicle mass rating exceeding 12 tonnes, other than omnibuses.
- 35.1.27 'Visible Indicator' means a device incorporated in a service brake system which indicates to the operator by a visible signal within his forward field of view (as specified in Clause 35.2.1.2.5) a failure of a critical item or component of the system as specified in Clause 35.2.1.2.1.

35.2 Design Requirements

35.2.1 Service Brake System

35.2.1.1 The vehicle shall be equipped with a service brake system operable on all road wheels through the medium of a single control so placed that it can be actuated by the operator from his normal driving position.

35.2.1.2 The vehicle shall have one or more service brake failure visible indicators.

35.2.1.2.1 The visible indicator shall operate whenever any of the following conditions occur whilst the ignition or electrical control switch is in the 'engine on' position and also whenever any of the following conditions occur whilst the engine is running:

- for a service brake system incorporating an hydraulic brake circuit and no brake power unit in that hydraulic circuit, condition (i) or optionally condition (ii),
- for a service brake system incorporating one or more brake power units in any section of the service brake system, condition (iii).

NOTE: Where the requirements of this Clause necessitate the provision of more than one system failure sensor, the sensors may be interconnected to actuate only one visible indicator.

- (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 subsystems or
  - failure of a component of a brake power assist unit.

In the event of such failure, for the purpose of this Clause the indicator operation requirement shall be deemed to be satisfied if the indicator operates 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.

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 a drop in the level of brake fluid occurs in the reservoir(s), either to less than the manufacturer's designated minimum level or to less than 25% of the reservoir(s) fluid capacity whichever is the greater volume remaining.
- (iii) When the supply pressure in any one unit drops to or below 65% of the average operating pressure.

\* Amended July 1980

35.2.1.2.2 As a check of function the visible indicator shall be so designed that it operates when:

- (i) the ignition or electrical control 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 35.2.1.2.1 exists in the brake system, or in the event of an electrical failure of the antilock system it shall not operate when the engine is running, or
- (ii) the ignition or electrical control switch is in the 'engine start' position, and unless a failure of the type described in Clause 35.2.1.2.1 exists in the brake system, or in the event of an electrical failure of the antilock system it shall not operate after the return of the ignition or electrical control switch to the 'engine on' position, or
- (iii) the ignition or electrical control switch is in a position between the 'engine on' position and the 'engine start' position, which is designated by the manufacturer as a check position, and unless a failure of the type described in Clause 35.2.1.2.1 exists in the brake system, or in the event of an electrical failure of the antilock systems, it shall not operate after the return of the ignition or electrical control switch to the 'engine on' position, or
- (iv) the engine start circuit is energised and unless a failure of the type described in Clause 35.2.1.2.1 exists in the brake system or in the event of an electrical failure of the antilock system it shall not operate when the engine start circuit is not energised.

Where an antilock system is fitted the visible indicator as a check of function, may continue to operate for up to 10 seconds following the activation as a check of function.

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

35.2.1.2.3 The visible indicator system shall be so designed that once having become operative to signal a brake failure it shall operate whenever the ignition or electrical control switch is in the 'engine-on' position and the fault remains uncorrected.

35.2.1.2.4 The visible indicator may take the form of an indicator lamp, or of a mechanical signalling device. Where an indicator lamp is used the lamp shall be labelled with at least the word "BRAKE" placed either directly on the lens or adjacent to it in such a way that the word 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. An illuminated lamp may be either steady-burning or flashing. Where a mechanical signalling device is used, it shall display at least the word "BRAKE" in letters not less than 10mm high when the signal is deployed. Letters and background shall be of contrasting colours, one of which is red.

35.2.1.2.5 The service brake failure visible indicator and its specified label or display shall be totally located forward of a transverse vertical plane through the point representing the intersection of the steering wheel axis of rotation and the plane of the steering wheel, and totally within the space bounded by:

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- (i) the right-hand internal sidewall; and
  - (ii) a vertical plane along the longitudinal centreline of the vehicle; and
  - (iii) a horizontal plane through a point on the lower edge of the instrument panel; and
  - (iv) a horizontal plane 150mm above the highest point on the windshield glass.

35.2.1.3 Where the service brake system incorporates a single brake power unit, an audible indicator shall be provided. Such device shall operate at all times when the service brake failure visible indicator operates as specified in Clause 35.2.1.2.1(iii).

#### 35.2.2 Parking Brake System

35.2.2.1 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 is achieved by either:

- (i) the frictional force developed between two friction surfaces, or
- (ii) the frictional force developed between two friction surfaces, together with a parking mechanism as defined in Clause 35.1.17.

35.2.2.2 The parking brake control shall incorporate a device to retain it in the 'brake-on' position, and shall be designed to minimise the possibility of inadvertent release of the brake. The requirements of this sub-clause shall be deemed to be satisfied if at least two separate and distinct movements are necessary to disengage the parking brake.

#### 35.2.2.3 Parking Brake Indicator Lamp

The vehicle, if not fitted with spring brakes or lock actuators, shall be provided with a lamp, distinct and separate from any service brake failure visible indicator lamp, which indicates that the parking brake is engaged. The lamp shall be labelled with at least the words "PARK BRAKE" or "PARKING BRAKE" placed either directly on the lens or adjacent to it in such a way that the words are 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. The park brake indicator lamp and its specified label shall be located within the space boundaries specified in Clause 35.2.1.2.5.

#### 35.2.3 Secondary Brake System

35.2.3.1 The vehicle shall be equipped with a Secondary Brake System.

35.2.3.2 Hydraulic service brake systems shall be split service brake systems.

35.2.3.3 The vehicle, if equipped with one or more brake power units shall incorporate a Secondary Brake System that is capable of application through the medium of a control.

35.2.3.4 The Secondary brake control shall be capable of releasing and applying the secondary brake after its first application. The control shall be so placed that it can be actuated by the operator from his normal driving position.

35.2.3.5 A Secondary Brake System may utilise elements of the service brake system.

\* Amended July 1980

35.2.3.6 Where the Secondary Brake System is a spring brake system:

- (i) in a single circuit service brake system the energy supply system for maintaining the secondary brake in its released position shall include an energy storage device that does not service any other device or equipment.
- (ii) in the event of failure of the energy supply to any one circuit of a service brake system employing two or more independent circuits, the energy requirements for retaining the secondary brakes in the released position shall be supplied from the energy storage device(s) of the other circuits or optionally from an independent energy storage.
- (iii) with the energy storage device charged to its average operating pressure it shall have sufficient capacity to permit the Secondary Brake System to be applied and released not fewer than 2 times when the brakes are adjusted so that the distance travelled by the device which directly actuates the brake shoe or pad is a maximum or optionally 3 times when the brakes are adjusted to the manufacturer's specifications.

35.2.4 Special Provisions for All Vehicles with Hydraulic Brake Systems

35.2.4.1 In cases where the service brake system incorporates a master cylinder, each 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.

35.2.4.2 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) the limit recommended by the manufacturer; or
- (ii) rivet or bolt heads on riveted or bolted linings; or
- (iii) within 3 mm of the pad mounting surface on bonded pads; or
- (iv) within the following height from the shoe mounting surface on bonded linings:

Nominal Lining thickness	≤ 5mm	> 5mm	> 10mm	> 13mm	> 19mm
		≤ 10mm	≤ 13mm	≤ 19mm	
Worn thickness	0.8mm	3mm	5mm	6mm	7mm

35.2.4.3 Each brake power unit shall be provided with a reservoir of capacity not less than the total capacity of the reservoirs required under the requirements of Clause 35.2.4.2 plus the fluid displacement necessary to charge the piston(s) or accumulator(s) provided for the purpose of storing energy.

\*Amended July 1979



35.2.4.4 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 300 mm 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.

35.2.5 Special Provisions for Systems Using Stored Energy  
(except spring brake systems)

35.2.5.1 Any device storing energy for the operation or to assist in the operation of the braking system, shall be so protected that failure of the device generating the energy does not result in depletion of the stored energy.

35.2.5.2 Where the device generating the energy for a brake power unit supplies energy to other devices, the design shall be such that the brake power unit is preferentially charged.

35.2.5.3 For systems incorporating brake power units, the combined volume of all devices for storing energy at positive pressure shall be not less than twelve times the combined volume of all service brake chambers at maximum travel of the pistons or diaphragms.

35.2.5.4 Any device generating energy at positive pressure for a brake power unit shall be of sufficient capacity to increase the pressure in the energy storage device(s) from 85% of the average operating pressure to the average operating pressure with the vehicle's engine operating at the vehicle manufacturer's recommended maximum engine speed within a time given by the expression:

$$\frac{\text{Actual energy storage capacity}}{\text{Required energy storage capacity}} \times 25 \text{ (secs)}$$

35.2.5.5 For service brake systems incorporating brake power units and operating at positive pressure a gauge(s) shall be fitted to indicate the pressure in each independent storage system. The gauge(s) shall be visible to the operator when seated in the normal driving position and shall be accurate to within plus or minus 7% of the cut-out pressure of the pressure limiting device fitted to the energy source.

35.2.5.6 For systems incorporating brake power assist units, the combined volume of all devices for storing energy shall be such that with no replenishment of stored energy the performance prescribed for the laden secondary brake test in Clause 35.5.7 shall be achieved:

- (i) where the energy source is a pump, on the eighth actuation of the service brake control, after seven actuations with vehicle stationary, either to full stroke or to the application of a pedal effort not less than 685N whichever occurs first;

\*Amended February 1978

- (ii) where the energy source is the engine of the vehicle, on the fourth actuation of the service brake control, after three actuations with vehicle stationary, either to full stroke or to the application of a pedal effort not less than 685N, whichever occurs first. \*

35.2.5.7 An energy generating device producing energy at negative pressure shall be capable of achieving the volume-pressure relationship required to satisfy the conditions specified in Clause 35.2.5.6 within a time not exceeding 3 minutes with

- (i) the engine operating at 65% of speed corresponding to either maximum power output or governed speed where the energy generating device is a vacuum pump.
- (ii) the engine operating at idle speed with the transmission selector in neutral position where the engine itself is the energy generating device.

35.2.5.8 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 it 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 brake power unit shall preferentially service the brake system.

### 35.3 Performance Requirements

35.3.1 The vehicle shall be capable of meeting the range of performance tests set out in the table in Clause 35.3.3, subject to the general test conditions of Clause 35.4 and the particular test conditions of Clause 35.5. The sequence of testing may be in the order set out in the table. Where the sequence of testing is not in the order set out in the table, the sequence shall satisfy the following requirements:

Items 1 & 2, if conducted, must precede all other items  
 Items 3-10 must be in sequence  
 Items 11-13 must be in sequence  
 Items 14-15 must be in sequence  
 Items 16-17 may be conducted at any time  
 between or after the above sequences,

except that in the case where service brake fade testing is carried out in accordance with Clause 35.5.9.2, Item 9 is not subject to the above sequence requirements. \*

35.3.2 The vehicle will be deemed to satisfy the following requirements of this Design Rule if it is covered by a type test certificate in accordance with the "United Nations Agreement Concerning the Adoption of Uniform Conditions of Approval and Reciprocal Recognition of Approval for Motor Vehicle Equipment and Parts, done at Geneva on 20 March 1958. Addendum 12, Regulation No. 13 to be annexed to the Agreement, Revision 1".

Clause	35.2.3.7 (iii)	Spring brake lift off
"	35.2.5.6	Reserve energy storage capacity for service brake systems which operate at negative pressure
"	35.2.5.7	Capacity of energy generating device for service brake systems which operate at negative pressure

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- Clause 35.5.3 Service Brake unladen effectiveness test
  - " 35.5.4 Unladen Secondary Brake test
  - " 35.5.5 Unladen partial failure test
  - " 35.5.6 Service Brake laden effectiveness test
  - " 35.5.7 Laden Secondary Brake test
  - " 35.5.8 Laden partial failure test
  - " 35.5.9 Service Brake fade test
  - " 35.5.10 Service Brake fade effectiveness check
  - " 35.5.16 Parking Brake test

35.3.3 #Item	Tests and Procedures	Vehicle Category	Initial Speed (km/h)	Minimum Average Deceleration (m/s <sup>2</sup> )	Vehicle Mass	Gear Selector	Maximum Control Force (N)
1.	Pre Test Instrumentation Check	All	40 Max	See Text	--	--	--
2.	Service Brake Burnishing Procedure (optional)	All	65 Max	See Text	--	--	--
3.	Service Brake Unladen Effectiveness Test						
3.1	First Mode	P1,P2 T1 T2 T3	30 35 25 20	3.03 ) 2.97 ) 2.62 ) 2.38 )	L	N	685
3.2	Second Mode	P1,P2 T1 T2 T3	60 70 50 40	3.78 ) 3.55 ) 3.29 ) 3.09 )	L	N	685
3.3	Third Mode	P1,P2 T1,T2,T3	100 100	4.19 ) 3.78 )	L	N	685
4.	Unladen Secondary Brake Test	P1,P2 T1 T2 T3	60 70 50 40	2.10 ) 2.0 ) 1.85 ) 1.80 )	L	N	590 (hand) 685 (foot)

*Item No.	Tests and Procedures	Vehicle Category	Initial Speed (km/h)	Minimum Average Deceleration (m/s <sup>2</sup> )	Vehicle Mass	Gear Selector	Maximum Control Force (N)		
5.	Unladen Partial Failure Test	P1,P2	60	2.10 )	L	N	685		
		T1	70	2.0 )					
		T2	50	1.85 )					
		T3	40	1.80 )					
6.	Service Brake Laden Effectiveness Test	First Mode	P1,P2	30	3.03 )	M	N	685	
			T1	35	2.97 )				
			T2	25	2.62 )				
			T3	20	2.38 )				
		Second Mode	P1,P2	60	3.78 )	M	N	685	
			T1	70	3.55 )				
			T2	50	3.29 )				
			T3	40	3.09 )				
		Third Mode	P1,P2	100	4.19 )	M	N	685	
			T1,T2,T3	100	3.78 )				
7.	Laden Secondary Brake Test	P1,P2	60	2.10 )	M	N	590 (hand) 685 (foot)		
		T1	70	2.0 )					
		T2	50	1.85 )					
		T3	40	1.80 )					

# Item No.	Tests and Procedures	Vehicle Category	Initial Speed (km/h)	Minimum Average Deceleration (m/s <sup>2</sup> )	Vehicle Mass	Gear Selector	Maximum Control Force (N)
8.	Laden Partial Failure Test	P1,P2	60	2.10)	M	N	685
		T1	70	2.0)			
		T2	50	1.85)			
		T3	40	1.80)			
9.	Service Brake Fade Test	All	See Text	See Text	M	D	See Text
10.	Service Brake Fade Effectiveness Check	P1,P2	60	3.02)	M	N	685
		T1	70	2.84)			
		T2	50	2.63)			
		T3	40	2.47)			
11.	Service Brake Water Conditioning Procedure	All	See Text	--	M	D & R	--
12.	Service Brake Water Recovery Procedure	All	See Text	--	M	D	685
13.	Service Brake Water Effectiveness Check	P1,P2	60	2.27)	M	N	685
		T1	70	2.13)			
		T2	50	1.97)			
		T3	40	1.85)			
14.	Service Brake Spike Stop Procedure	All	40	--	M	N	Refer Clause 35.1.20

#Item No.	Tests and Procedures	Vehicle Category	Initial Speed (km/h)	Minimum Average Deceleration (m/s <sup>2</sup> )		Vehicle Mass	Gear Selector	Maximum Control Force (N)
				at 100	at 200			
15.	Service Brake Spike Test Effectiveness Check	P1, P2	60	3.02				
		T1	70	2.84				
		T2	50	2.63	M	N		685
		T3	40	2.47				
16.	Parking Brake Test	All	--	--	M	N	590(hand) 685(foot)	
17.	Service Brake Actuating Time Test	See Text	N.A.	N.A.	N.A.	N.A.	See Text	

#-Item No. also corresponds to sub-Clause number of Clause 35.5

'M' means maximum loaded test mass.

'L' means lightly loaded test mass.

'D' means transmission control in drive position appropriate to test speed.

'N' means transmission control in neutral position.

'R' means transmission control in reverse position.

'N.A.' means not applicable

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#### 35.4 General Test Conditions

35.4.1 The ambient temperature at the test site shall be within the range of 0°C to 40°C.

35.4.2 The following adjustments shall be checked before commencing tests, and set to vehicle manufacturer's recommendations

- (i) Injection or ignition timing
- (ii) Engine idle speed
- (iii) Engine governed speed if adjustable governor is fitted
- (iv) All brake adjustments.

35.4.3 The tyres fitted to the vehicle shall be of the size and type specified by the vehicle manufacturer as original equipment for the vehicle, and shall be inflated to pressures not less than those recommended by the vehicle manufacturer.

35.4.4 The friction elements of the vehicle brakes shall be of the make and grade specified by the vehicle manufacturer.

35.4.5 Decelerations shall be conducted on sections of a test track or roadway that meets the following requirements

- (i) in the case of the vehicle service brake fade test, the surface shall be substantially level and any effective upward average gradient between the start and end of each deceleration test section shall not exceed 1%. The requirements of this Clause shall be deemed to be met if it is demonstrated that over the total number of brake applications of the vehicle service brake fade test sequence of Clause 35.5.9.1 the total effective contribution to vehicle retardation of the deceleration test section gradients is not greater than the vehicle retardation which would result from an average upward gradient of not more than 1%;
- (ii) in the case of other deceleration tests, the upward gradient, if any, shall not exceed 1%.

35.4.6 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.

35.4.7 Where a test requires that the gear selector be in 'drive' the transmission selector control shall be in the control position recommended by the manufacturer as appropriate to the speed of the vehicle at the commencement of the deceleration mode.

35.4.8 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 within 10 km/h of the maximum laden vehicle speed. The average deceleration so required shall be determined from the expressions;



$$s = K_1 (0.15V + \frac{V^2}{K_2})$$

$$\text{and } a = \frac{u^2}{2s}$$

Where s=stopping distance m.

V=initial speed km/h.

K1,K2 =constants, dependent on test and category, see chart below

u=initial speed m/s

a=average deceleration, m/s<sup>2</sup>

TEST	CATEGORY	K <sub>1</sub>	K <sub>2</sub>
Service Brake Effectiveness Test	P1 P2	1.0	130
	T1 T2 T3	1.0	115
Secondary Brake Test	P1 P2	1.0	65
	T1 T2 T3	1.67	115
Water Test Effectiveness Check	P1 P2	1.67	130
	T1 T2 T3	1.67	115
Fade and Spike Test Effectiveness Check	P1 P2	1.25	130
	T1 T2 T3	1.25	115

35.4.9 For all effectiveness, secondary brake and partial failure tests, no part of the vehicle shall move outside a straight lane not exceeding 3.7m in width, the vehicle being positioned at the approximate centre of the lane at the commencement of the deceleration. \*

35.4.10 Except in the case of the parking brake test, the service brake water recovery procedure and the service brake water effectiveness test, each test procedure may be preceded by a series of stops or decelerations, provided the temperature measured at the surface of the disc or drum does not exceed 100°C immediately prior to the commencement of the test.

35.4.11 Except as permitted by Clause 35.5.2 brakes shall not be adjusted during testing. Automatic brake adjusters, if fitted, may be rendered inoperative prior to commencement of the optional Service Brakes Burnishing Procedure. In cases where this option is exercised, adjusters shall remain inoperative for the duration of the test programme.

35.4.12 Except where Clause 35.4.8 applies any vehicle speed specified in Clause 35.3.3 shall be achieved within a tolerance of +5, -1 km/h.

\*Amended February 1980

## 35.5 Particular Test Conditions

### 35.5.1 Pre-test 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 40 km/h and any instantaneous deceleration shall not exceed 3 m/s<sup>2</sup>.

### 35.5.2 Service Brake Burnishing Procedure

Burnishing, if conducted, shall consist of any desired number of decelerations at the manufacturers' option.

On completion of the Burnishing Procedure if conducted, the brake system may be adjusted in accordance with the manufacturers' recommendation.

### 35.5.3 Service Brake Unladen Effectiveness Test

A series of test modes shall be conducted in the sequence as described in Clause 35.3.3 (Item 3). The vehicle shall be deemed to satisfy the requirements of a mode if all the parameters of that mode are met on at least one test within a number of tests that shall not exceed six.

### 35.5.4 Unladen Secondary Brake Test

35.5.4.1 Where the secondary brake is not applied by the service brake control, the vehicle shall be decelerated using only the secondary brake system and deemed to satisfy the requirements of this test, if all the parameters specified in Clause 35.3.3 (Item 4) are met in at least one test within a number of tests that shall not exceed six.

35.5.4.2 Where the secondary brake is applied by the service brake control, the vehicle shall be decelerated using the secondary brake system and deemed to satisfy the requirements of this test, if all the parameters specified in Clause 35.3.3 (Item 4) are met in at least one test within a number of tests that shall not exceed six for each single failure of a fluid system, including where appropriate:

- (a) each sub-system of a split system
- (b) failure of energy assistance in a brake power assist unit.

### 35.5.5 Unladen Partial Failure Test

The requirements of this Clause shall only apply to a vehicle fitted with a brake system where the secondary brake is applied by the service brake control. The vehicle shall be deemed to satisfy the requirements of this test if all the parameters specified in Clause 35.3.3 (Item 5) are met on at least one deceleration mode within a number of deceleration modes which shall not exceed six for each single type of partial failure, including:

- (i) inoperative antilock system
- (ii) inoperative variable proportioning brake system.

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

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35.5.6 Service Brake Laden Effectiveness Test

A series of test modes shall be completed in the sequence of Clause 35.3.3 (item G). The vehicle shall be deemed to satisfy the requirements of a mode if all parameters for that mode are met for at least one test within a number of tests that shall not exceed six.

35.5.7 Laden Secondary Brake Test

The test procedure and determination of compliance shall be as specified in Clause 35.5.4, except that the vehicle shall be at maximum loaded test mass.

35.5.8 Laden Partial Failure Test

The test procedure and determination of compliance shall be as specified in Clause 35.5.5, except that the vehicle shall be at maximum loaded test mass.

35.5.9 Service Brake Fade Test

Service Brake fade testing shall be carried out in accordance with the requirements of either Clause 35.5.9.1 or Clause 35.5.9.2.

35.5.9.1 Vehicle Service Brake Fade Test

35.5.9.1.1 Successive deceleration modes shall be conducted in accordance with the following:

Vehicle Category	Initial Speed (km/h)	Final Speed at end of deceleration (km/h)	Minimum Stabilizing time (secs) at initial speed	Maximum Interval between applications (secs)	Minimum Number of Applications
P1 T1	100	50	10	55	15
P2 T2 T3	60	30	10	60	20

35.5.9.1.1.2 Tests may be conducted at initial and final speeds which differ from those specified above, provided that for each deceleration mode it can be shown that

$$(V1^2 - V2^2) \geq 7500$$

for vehicles in categories P1 and T1; and

$$(V1^2 - V2^2) \geq 2700$$

for vehicles in categories P2, T2 and T3

where V1 is the initial speed in km/h and V2 is the final speed in km/h at the end of the deceleration mode.

NOTE: The variables in the foregoing expression are not related to those specified in the formulae of Clause 35.4.8.

35.5.9.1.1.3 If the vehicle is not capable of attaining the initial speed required by Clause 35.5.9.1.1.1 or Clause 35.5.9.1.1.2, then the speed employed in each mode for the initial speed shall be not less than 80% of the maximum laden vehicle speed and the final speed shall not be greater than half the initial speed.

35.5.9.1.2 During all deceleration modes the lowest numerical overall drive ratios as specified in Clause 35.4.7 shall be continuously engaged. Deceleration modes shall be conducted from the initial speed to the final speed. During acceleration periods the drive train shall be employed to regain the initial speed in the shortest possible time. Notwithstanding the foregoing requirement, changes of vehicle direction essential to testing and negotiation of curved sections of track may be undertaken at constant vehicle speed. If the vehicle's performance characteristics are such as to preclude it from maintaining the specified maximum interval between successive brake applications, the time interval may be increased accordingly.

35.5.9.1.3 Vehicles shall attain a sustained deceleration of not less than  $3 \text{ m/s}^2$  during the first deceleration mode. Subsequent deceleration shall be conducted employing a control force not less than that established during the first deceleration mode without regard to the actual deceleration achieved.

35.5.9.1.4 The Service Brake Fade Test shall be followed immediately by the Service Brake Fade Effectiveness Check.

#### 35.5.9.2 Dynamometer Service Brake Fade Test

This test may be applied to brake systems using air at positive pressure and is based on the relevant conditions and procedures of Motor Vehicle Safety Standard 121 - Air Brake Systems issued by the National Highway Traffic Safety Administration of the United States Department of Transportation up to and including amendments shown in Federal Register Vol. 42 No. 126 of 30 June 1977.

Testing shall be carried out in accordance with the conditions and requirements specified in Clause 35.6.

#### 35.5.10 Service Brake Fade Effectiveness Check

This procedure is not applicable to vehicles with brake assemblies which have been tested in accordance with the requirements of Clause 35.5.9.2.

The vehicle shall be accelerated over a distance not exceeding 1.6 km from the final speed attained at the conclusion of the deceleration mode of the Service Brake Fade Test to the initial speed specified in Clause 35.3.3 (item 10) and the test carried out in accordance with that item. The vehicle shall be deemed to satisfy the requirements of this test if the deceleration achieved is not less than that specified in Clause 35.3.3 (item 10).

#### 35.5.11 Service Brake Water Conditioning Procedures

Service brake water conditioning shall be carried out in accordance with the requirements of either Clause 35.5.11.1 or Clause 35.5.11.2.

##### 35.5.11.1 Service Brake Water Conditioning Procedure (Water Immersion)

The vehicle shall be driven with the service brake released, through water of depth of not less than 60% of the static loaded radius of the tyres fitted, for a period of at least two minutes. During such period, the vehicle speed shall not exceed 10 km/h and for at least one minute, shall not be 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.

##### 35.5.11.2 Service Brake Water Conditioning Procedure (Water Spray)

The braking surfaces of all brake assemblies fitted to the vehicle shall be simultaneously and continuously wetted for a period of not less than 5 minutes. The rate of delivery of water to each brake assembly shall not be less than 25 litres per minute. In the case of drum brake assemblies the water flow shall be introduced through an aperture in the brake backing plate.

\*Amended February 1978

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35.5.12 Service Brake Water Recovery Procedure

35.5.12.1 Immediately upon completion of the Service Brake Water Conditioning Procedure the vehicle shall be accelerated and the drive train shall be employed to attain initial speed appropriate to its category as specified in Clause 35.5.10. Continue at this speed until the total distance not exceeding 1.6 km has been travelled and then decelerate at a sustained level of not less than  $2.0 \text{ m/s}^2$  until stationary. This sequence shall be repeated three times without interruption. The brakes shall not be applied except for the deceleration specified.

35.5.12.2 The Service Brake Water Recovery Procedure shall be followed immediately by the Service Brake Water Effectiveness Check.

35.5.13 Service Brake Water Effectiveness Check

This check shall be a repetition of the Service Brake Fade Effectiveness Check as specified in Clause 35.5.10, except that the vehicle shall be deemed to satisfy the requirements of this check if the deceleration achieved is not less than that specified in Clause 35.3.3. (item 13).

35.5.14 Service Brake Spike Stop Procedure

Ten spike stops shall be conducted as specified in Clause 35.3.3 (item 14) and the control force for each stop shall be maintained until the vehicle is stationary.

35.5.15 Service Brake Spike Test Effectiveness Check

The vehicle shall be deemed to pass this check if all the parameters specified for each set of conditions listed in Clause 35.3.3 (item 15) are met on at least one deceleration mode within a number of deceleration modes which shall not exceed six.

35.5.16 Parking Brake Test

This test shall be conducted on a grade of at least 18%, where the vertical rise is expressed as a percentage of the horizontal distance travelled to achieve this rise. The vehicle shall be positioned on the grade such that its longitudinal axis is parallel to the direction of the grade. The parking mechanism (if fitted) 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 not less than 5 minutes with the vehicle in condition described above:

The vehicle shall be deemed to pass this test if

- (i) for each of the 5 minute periods it remains stationary on the slope, and
- (ii) the force required to actuate the parking brake does not exceed 685N in the case of a foot operated parking brake, and does not exceed 590N applied at the centre of the handgrip, or not closer than 35mm from the free end of the actuation lever, in the case of a hand operated parking brake system.

If the vehicle does not remain stationary re-application of the service brake to hold the vehicle stationary, with re-application 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 utilize the service brake friction elements, the friction elements of the system may be burnished to the vehicle manufacturer's recommendation prior to the test.

#### 35.5.17 Service Brake Actuating Time Test:

35.5.17.1 This test is applicable only to vehicles using air at positive pressure as the operating fluid and incorporating one or more brake power units. The test is conducted while the vehicle is stationary.

35.5.17.2 Before commencing the test the energy storage device(s) shall be charged to not more than the average operating pressure.

35.5.17.3 The service brake control shall be operated through a full working stroke by an operator seated in the normal driving position. The vehicle shall be deemed to satisfy the requirements of this test if the pressure at the brake chamber terminating the longest brake pressure line from the service brake control attains a level not less than 65% of the average operating pressure, within a period not exceeding 600 ms measured from the instant the control leaves the initial brake control location.

35.5.17.4 A vehicle equipped to tow a trailer which uses air at positive pressure as the brake operating fluid shall satisfy the test parameters specified in Clause 35.5.17.3, but with the pressure measured at the end of a pressure vessel of not less than 13 mm internal diameter and not less than 2.5 m long connected to the trailer control line coupling point of the towing vehicle.

#### 35.6 Dynamometer Service Brake Fade Test

When tested under the conditions of Clause 35.6.1, brake assemblies shall meet the requirements of Clause 35.6.2.

##### 35.6.1 Dynamometer Test Conditions

35.6.1.1 The dynamometer inertia for each wheel shall be not less than that determined from the expression:

$$I = MR^2$$

where

- I = dynamometer inertia, kg.m<sup>2</sup>
- M = mass supported by the wheel at the maximum loaded test mass, kg.
- R = static loaded radius of the tyre, as specified by the tyre manufacturer, m.

35.6.1.2 The ambient temperature shall be between 23.8°C and 37.8°C.

35.6.1.3 Ambient air shall be directed continuously over the brake drum or disc at a velocity of not more than 11.2 m/s.

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35.6.1.4 The temperature of each brake shall be measured by a single plug-type thermocouple installed in the centre of the lining surface of the most heavily loaded shoe or pad. The thermocouple shall be outside any centre groove.

35.6.1.5 The rate of brake drum or disc rotation on a dynamometer corresponding to the rate of rotation on a vehicle at a given speed shall be calculated by assuming a tyre radius equal to the static loaded radius specified by the tyre manufacturer.

35.6.1.6 Burnishing, if conducted, shall consist of:

- (i) not more than 200 stops such that any instantaneous deceleration does not exceed  $3.1 \text{ m/s}^2$  from a maximum speed of 65 km/h. The initial brake temperature for each stop shall be not less than  $157^\circ\text{C}$  and not more than  $197^\circ\text{C}$ ; and
- (ii) not more than 200 additional stops from a maximum speed of 65 km/h at a deceleration not exceeding  $3.1 \text{ m/s}^2$ . The initial brake temperature for each stop shall be not less than  $232^\circ\text{C}$  and not more than  $288^\circ\text{C}$ .

After burnishing, the brakes shall be adjusted in accordance with the manufacturers' recommendations.

35.6.1.7 Brake temperature shall be increased to the specified level by conducting one or more stops from not more than 65 km/h at a deceleration not exceeding  $3.1 \text{ m/s}^2$ , or decreased to a specified level by rotating the drum or disc at a constant speed not exceeding 50 km/h.

35.6.1.8 Speeds, decelerations and times specified in Clause 35.6.2 shall be achieved within the following tolerance limits:

Speeds:	+5, -1 km/h
Decelerations:	+0.25, -0.25 $\text{m/s}^2$
Times:	+5, -5 seconds.

#### 35.6.2 Dynamometer Test Requirements

35.6.2.1 When mounted on an inertia dynamometer, each brake shall be capable of making 10 consecutive decelerations at an average rate of  $2.75 \text{ m/s}^2$  from 80 km/h to 24 km/h at equal intervals of 72 seconds, and shall be capable of decelerating to a stop from 32 km/h at an average deceleration rate of  $4.25 \text{ m/s}^2$  one minute after the 10th deceleration. The series of decelerations shall be conducted as follows:

35.6.2.1.1 With an initial brake temperature between  $65^\circ\text{C}$  and  $94^\circ\text{C}$  for the first brake application, and the drum or disc rotating at a speed equivalent to 80 km/h, apply the brake and decelerate at an average deceleration rate of  $2.75 \text{ m/s}^2$  to 24 km/h. Upon reaching 24 km/h accelerate to 80 km/h and apply the brake for a second time 72 seconds after the start of the first application. Repeat the cycle until 10 decelerations have been made. The service line air pressure shall not exceed 690 kPa during any deceleration.

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35.6.2.1.2 One minute after the end of the last deceleration required by Clause 35.6.2.1.1 and with the drum or disc rotating at a speed of 32 km/h decelerate to a stop at an average deceleration rate of  $4.25 \text{ m/s}^2$ .

35.6.2.2 Starting 2 minutes after completing the tests required by Clause 35.6.2.1 the brake of a vehicle other than either front axle brake of a truck-tractor shall be capable of making 20 consecutive stops from 48 km/h at an average deceleration rate of  $3.65 \text{ m/s}^2$  at equal intervals of one minute measured from the start of each brake application. The service line air pressure needed to attain a rate of  $3.65 \text{ m/s}^2$  shall be not more than 586 kPa and not less than 137 kPa for a brake not subject to the control of an antilock system, or 82 kPa for a brake subject to the control of an antilock system.

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\*Amended February 1978



