



COMMONWEALTH OF AUSTRALIA
AUSTRALIAN DESIGN RULE 33A
FOR
MOTORCYCLE AND MOPED 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.

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 33A - Motorcycle and Moped Braking System.

VEHICLE CATEGORY	RULE AMENDMENT		
	MANUFACTURED ON OR AFTER		
	33A		
Passenger Cars			
Forward Control Passenger Vehicles up to 8 seats	N/A		
9 seats	N/A		
Other Passenger Cars	N/A		
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	1 Mar 1988		
Mopeds	1 Mar 1988		
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 motor vehicles which comply with the requirements of ADR 33A - Motorcycle and Moped Braking Systems - need not comply with the requirements of ADR 33.

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 PO Box 594
 CIVIC SQUARE ACT 2608
 AUSTRALIA

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- 33A.1 Definitions
- 33A.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.
- 33A.1.2 'Average Deceleration' means the number determined by dividing the square of the initial speed by twice the stopping distance expressed in compatible units.
- 33A.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.
- 33A.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.
- 33A.1.5 'Braking Effort' means the force applied to the service brake control.
- 33A.1.6 'Braking Interval' means the distance measured from one point of application of braking effort to the next point of application of braking effort.
- 33A.1.7 'Laden Motorcycle Mass' means the mass of the unladen motorcycle with a full capacity of lubricating oil, coolant and fuel, plus 90 kg (including driver and instrumentation) distributed in the saddle or carrier if so equipped.
- 33A.1.8 'Maximum Motorcycle Speed' means the speed attainable established by calculation or on the basis of a test, under maximum motorcycle acceleration from a standing start for 1.6 km, at laden motorcycle mass.
- 33A.1.9 'Split Service Brake System' means a hydraulic brake system consisting of two or more subsystems actuated by a single control designed so that a leakage type failure of a pressure component in a single subsystem (except structural failure of a housing that is common to all subsystems) shall not impair the operation of the other subsystem(s).
- 33A.1.10 'Stopping Distance' means the distance travelled by a vehicle from the point of application of braking effort to the point at which the vehicle is brought to rest.
- 33A.1.11 '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.

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- 33A.2 Design Requirements
- 33A.2.1 Service Brake System
- 33A.2.1.1 The vehicle shall be equipped with either a split service brake system or independently actuated service brake systems.
- 33A.2.1.2 Failure of any component in a mechanical service brake system shall not result in a loss of braking ability in the other service brake system.
- 33A.2.1.3 A leakage type failure in a hydraulic service brake system shall not result in a loss of braking ability in the other service brake system. Each vehicle equipped with a hydraulic brake system shall meet the requirements of Clause 33A.2.5.
- 33A.2.1.4 The brake system shall be installed so that the lining thickness of drum brake shoes may be visually inspected, either directly or by the use of a mirror without removing the drums, and so that disc brake friction lining thickness may be visually inspected without removing the pads.
- 33A.2.1.5 Except where the requirements of Clauses 33A.2.2.1 and Clause 33A.5.13 apply, a vehicle used in combination with a sidecar shall be only required to meet the provisions of this Design Rule with the sidecar detached.
- 33A.2.2 Parking Brake System
- 33A.2.2.1 Each motorcycle with sidecar attached shall be equipped with a parking brake system such that in the applied position retention is effected by a mechanical means, and the braking effect of which is effected by the frictional force developed between friction surfaces.
- 33A.2.3 Service Brake Failure Indicator Lamps - Each vehicle equipped with a split service brake system, shall have one or more brake failure indicator lamps mounted in front of and in clear view of the driver.
- 33A.2.3.1 The indicator lamp shall be activated whenever any of the following conditions occur whilst the ignition switch is in the 'engine on' position:
- (a) In the case of a service brake system not incorporating a brake power unit, when a pressure failure occurs in any part of the service brake system except for pressure failure caused by
- a structural failure of a brake master cylinder body in a split integral body type master cylinder system, or
 - a structural failure of a service brake system failure indicator body, or

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- failure of a vacuum component of a vacuum brake power assist unit.

In the event of such failure, for the purpose of this Clause, the lamp activation requirement will be met if the lamp is activated before or upon application of a line pressure of not more than 1.38 MPa measured at a master cylinder outlet or at a slave cylinder outlet if the master cylinder controls a slave cylinder at a booster unit, or before or upon application of a braking effort of not more than 90N.

- (b) In the case of a service brake system with a single brake power unit, when the supply pressure in the unit drops to less than half the operating pressure.
- (c) In the case of a service brake system with two or more independent brake power units when the supply pressure in any one unit is depleted.
- (d) A drop in the level of brake fluid in a master cylinder reservoir, without application of braking effort, to less than the manufacturer's recommended safe level or to less than one half of the fluid reservoir capacity in any reservoir compartment, whichever is the greater.
- (e) A total electrical failure in an antilock or brake proportioning system.

33A.2.3.2

- (a) The indicator lamp shall be so designed that it is activated when the ignition switch is turned
 - (i) from the 'off' to the 'on' position, or
 - (ii) from the 'off' to the 'start' position.
- (b) Unless a failure of the type described in Clause 33A.2.3.1 exists in the service brake system, the indicator lamp shall be deactivated
 - (i) in the case of a lamp designed in accordance with (a)(i) above, when the lamp has been activated for a period of not less than 5 seconds and not more than 10 seconds, or
 - (ii) in the case of a lamp designed in accordance with (a)(ii) above when the ignition switch returns to the 'on' position.

33A.2.3.3

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 'on' position and the fault remains uncorrected. For the purpose of this Clause an activated lamp may be steady burning or flashing.

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- 33A.2.3.4 Each indicator lamp shall have a red lens labelled with the words 'Brake Failure' on or adjacent to it in letters not less than 2.3mm high which when lighted is legible to the seated driver under daylight conditions.
- 33A.2.4 Brake System Audible Indicator - In cases where the vehicle is fitted with a single brake power unit, an audible device shall be provided. Such device shall emit a continuous or short period intermittent signal at all times when the service brake failure indicator lamp is activated by a failure as specified in Clause 33A.2.3.1(b).
- 33A.2.5 Reservoirs
- 33A.2.5.1 Where the service brake system incorporates a master cylinder, a separate reservoir compartment shall be provided for each service brake system serviced by the master cylinder and a loss of brake fluid from one compartment shall not result in a complete loss of fluid from another compartment.
- 33A.2.5.2 The capacity of each sub-system reservoir compartment shall be not less than one and one half times the fluid displacement resulting when all the wheel cylinders or caliper pistons serviced by the reservoir move from a new lining, fully retracted position, to a fully worn, fully applied position. For the purposes of this Clause, fully, worn, fully applied means that the lining is worn to:
- (a) rivet or bolt heads on riveted or bolted linings; or
 - (b) within 0.8mm of shoe or pad mounting surface on bonded linings; or
 - (c) the limit recommended by the manufacturer;
- whichever is lower relative to the total possible shoe or pad movement.
- 33A.2.5.3 A statement specifying the type of fluid to be used in the brake system, and the warning 'Clean filler cap before removing' shall be permanently affixed, stamped, engraved or embossed either on or within 100mm of each brake fluid reservoir filler plug or cap, in lettering at least 2.3mm high. If not stamped, engraved or embossed, the lettering shall be of a contrasting colour to that of the background.
- 33A.2.5.4 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 33A.2.5.2 plus the fluid displacement necessary to charge the piston(s) or accumulator(s) provided for the purpose of storing energy.

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33A.2.6 Protection of System using Stored Energy

33A.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.

33A.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.

33A.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.

33A.3 Performance Requirements

33A.3.1 The vehicle shall be capable of meeting the range of performance tests set out in the following Table, subject to the general test conditions of Clause 33A.4 and the particular test conditions of Clause 33A.5 except where the maximum motorcycle speed is equal to or less than 50 km/h and in the case of mopeds, it shall not be necessary to test in accordance with the requirements of Clauses 33A.5.6, 33A.5.7, 33A.5.8, and 33A.5.9. 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.

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TABLE 1

No.	Series of Tests and Procedures	Initial Vehicle Speed km/h	Minimum Average Deceleration m/s ²
1	Instrumentation check	50 (max.)	N.A.
2	First effectiveness test - All service brake systems	Max. Motorcycle Speed $\bar{0}$	5.45
or Max. Moped Speed		45-50	5.45
95-100		5.45	
3	Effectiveness test - independently actuated service brake systems	Max. Motorcycle Speed $\bar{0}$	2.40
or Max. Moped Speed		45-50	2.40
95-100		2.40	
4	First burnish procedure	Max. Motorcycle Speed $\bar{0}$	N.A.
or Max. Moped Speed		45-50	N.A.
5	Second effectiveness test - All service brake systems	Max. Motorcycle Speed $\bar{0}$	6.85
or Max. Moped Speed		45-50	6.85
95-100		6.35	
125-130		6.05	
See Text		5.45	
6	First base line check	45-50	See Text
7	Fade test	95-100	See Text
8	Fade recovery procedure	45-50	See Text
9	Fade recovery test	45-50	See Text
10	Second burnish procedure	Max. Motorcycle Speed $\bar{0}$	N.A.
or Max. Moped Speed		45-50	N.A.
11	Third effectiveness test - All Service brake systems	Max. Motorcycle Speed $\bar{0}$	6.85
or Max. Moped Speed		45-50	6.85
95-100		6.35	
125-130		6.05	
See Text		5.45	

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No.	Series of Tests and Procedures	Initial Vehicle Speed km/h	Minimum Average Deceleration m/s ²
12	Partial failure	Max. Motorcycle Speed $\ddot{0}$ or Max. Moped Speed 45-50 95-100	3.0 3.0 3.0
13	Parking brake test	N.A.	N.A.
14	Second base line check	45-50	See Text
15	Test with brakes subject to wetting	Max. Motorcycle Speed $\ddot{0}$ or Max. Moped Speed 45-50	See Text See Text

$\ddot{0}$ Applicable only to motorcycles having a maximum motorcycle speed equal to or less than 50 km/h and to mopeds.

33A.3.2 No part of a brake system shall be replaced during testing nor shall any adjustments be made to a braking system unless otherwise stated.

33A.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 of tests without component failure. For the purpose of this Design Rule, component failure means:

- (a) detachment of brake linings from the shoes or pads
- (b) detachment or fracture of any components of the brake system
- (c) there is visible evidence of leakage of brake fluid or lubricant at any wheel cylinder, master cylinder reservoir, cover, seal or retention device, or at fluid line junctions.

33A.4 General Test Conditions

33A.4.1 The vehicle shall be operated at the laden motorcycle mass or the laden moped mass as appropriate.

33A.4.2 The ambient temperature at the test site shall be within the range of 0°C to 40°C.

33A.4.3 The ignition timing, engine idle speed and adjustable speed governor, if fitted, shall be set to the manufacturer's recommendation.

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- 33A.4.4 If provision for manual disengagement is provided, all stops shall be made with the engine disengaged from the transmission.
- 33A.4.5 The tyres fitted to the vehicle shall be inflated to the pressure recommended by the vehicle manufacturer for the laden motorcycle mass or the laden moped mass as appropriate.
- 33A.4.6 Decelerations shall be conducted on a test track or roadway that meets the following requirements:
- (a) 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%.
 - (b) in the case of all other deceleration tests, the upward gradient shall not exceed 1%.
- 33A.4.7 For all effectiveness and partial failure tests:
- (a) no part of the vehicle shall move outside a straight lane 2.5m in width in the case of two wheeled vehicles and overall vehicle width plus 1.55m in the case of three wheeled vehicles. The vehicle shall be positioned at the centre of the lane at the commencement of the deceleration;
 - (b) lockup shall not occur on any wheel unless such lockup results from the proper functioning of an antilock system.
- 33A.4.8 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.
- 33A.4.9 If the vehicle is not capable of attaining the initial speed requirements specified for a particular deceleration test, then, unless otherwise specified, the initial speed shall be a speed within 15 km/h of the maximum motorcycle speed or the maximum moped speed as appropriate.
- 33A.4.10 The braking effort required for any deceleration mode unless otherwise specified shall be within the limits of 20N to 250N in the case of hand operated controls, and within the limits of 40N to 405N in the case of foot operated controls.
- Application of braking effort shall be:
- (a) in the case of hand operated controls, not less than 30mm from the end of the brake lever. The direction of the force shall be perpendicular to the centreline of that portion of the handle grip on which the brake lever is mounted and shall be parallel to the plane in which the brake lever rotates;

(b) in the case of foot operated controls, in the centre of the foot contact pad of the brake pedal. The direction of the force shall be perpendicular to the surface of the foot contact pad and shall be parallel to the plane in which the brake pedal rotates.

- 33A.4.11 Except in the case of the wet brake recovery test, each test procedure may be preceded by a series of not more than 10 decelerations from not more than 50 km/h during which the deceleration shall not at any time exceed 3.1 m/s².
- 33A.5 Particular Test Conditions
- 33A.5.1 Instrumentation Check: The number of decelerations for the purpose of instrumentation checks shall not exceed twenty. Such decelerations shall be made from a speed of not more than 50 km/h during which the deceleration shall not exceed 3.1 m/s².
- 33A.5.2 First Effectiveness Test - All Service Brake Systems: The vehicle shall be deemed to pass this test if all the parameters specified for each set of conditions in Clause 33A.3.1 are met on at least one deceleration mode within a number of deceleration modes which shall not exceed six.
- 33A.5.3 Effectiveness Test - Independently Actuated Service Brake Systems: The vehicle shall be deemed to pass this test if, when each service brake system is tested individually, all the parameters for each set of conditions specified in Clause 33A.3.1 are met on at least one deceleration mode within a number of deceleration modes which shall not exceed six.
- 33A.5.4 First Burnish Procedure: This shall be conducted by making not more than 200 decelerations under the conditions specified in Clause 33A.3.1 such that the deceleration shall not at any time exceed 3.7 m/s². The braking interval between successive decelerations shall be not more than 1.6 km. The vehicle shall be accelerated at the maximum rate to the specified speed after each deceleration mode and maintained at that speed until initiating the next deceleration mode.
- On completion of the First Burnish Procedure, the brakes may be adjusted in accordance with the Manufacturer's recommendation.
- 33A.5.5 Second Effectiveness Test - All Service Brake Systems: The vehicle shall be deemed to pass this test:
- (a) if all the parameters for each of the first three sets of conditions specified in Clause 33A.3.1 are met on at least one deceleration mode within a number of deceleration modes shall not exceed six for the first two sets of conditions and four for the third set of conditions, and

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- (b) in the case where the motorcycle has a maximum motorcycle speed equal to or greater than 150 km/h, if the parameters for the fourth set of conditions are met on at least one deceleration mode within a number of deceleration modes which shall not exceed four, when testing is carried out from an initial speed within 15 km/h of maximum motorcycle speed.

- 33A.5.6 First Base Line Check Procedure: Under the conditions specified in Clause 33A.3.1, three stops shall be made during which the deceleration shall be maintained within the range of $3.2 \pm 0.2 \text{ m/s}^2$. The maximum force applied to each service brake control shall be recorded for each stop. The average of the maximum forces shall be calculated for each service brake control.
- 33A.5.7 Fade Test: Ten stops shall be conducted such that the sustained deceleration of each stop is not less than 4.55 m/s^2 . The sustained deceleration shall be attained in the minimum possible time and shall be maintained for not less than three quarters of the total stopping distance for each stop. The braking interval shall not be more than 650m.
- The motorcycle shall be deemed to pass if the required deceleration can be achieved on all stops under the conditions specified in Clause 33A.3.1.
- 33A.5.8 Fade Recovery Procedure: Immediately upon completion of the Fade Test, the motorcycle shall be conditioned by driving it at 45-50 km/h for not more than 1.6 km. Immediately after this conditioning, four stops shall be made during which the deceleration shall be maintained within the range of $3.2 \pm 0.2 \text{ m/s}^2$ under the conditions specified. After each stop the motorcycle shall immediately be subjected to maximum acceleration to the specified speed and maintained at that speed until initiating the next stop. The braking interval shall not be more than 1.6 km.
- 33A.5.9 Fade Recovery Test: Immediately upon completion of the Fade Recovery Procedure, the motorcycle shall be subjected to maximum acceleration to the specified speed and within 1.6 km from the start of the test the motorcycle shall be decelerated such that the deceleration is maintained within the range of $3.2 \pm 0.2 \text{ m/s}^2$. The motorcycle shall be deemed to pass if the maximum force applied to each service brake control is within + 90N and -45N of the average of the maximum control force recorded for that control determined for the First Base Line Check Procedure, Clause 33A.5.6.
- 33A.5.10 Second Burnish Procedure: This shall be a repeat of the First Burnish Procedure, Clause 33A.5.4 except that:
- (a) the number of decelerations shall be 35, and
 - (b) brakes may be adjusted at completion only if no tools are used.

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- 33A.5.11 Third Effectiveness Test - All Service Brake Systems: The vehicle shall be deemed to pass this test:
- (a) if all the parameters for each of the first three sets of conditions specified in Clause 33A.3.1 are met on at least one deceleration mode within a number of deceleration modes which shall not exceed six for the first two sets of conditions and four for the third set of conditions, and
 - (b) in the case where the motorcycle has a maximum motorcycle speed equal to or greater than 150 km/h, if the parameters for the fourth set of conditions are met on at least one deceleration mode within a number of deceleration modes which shall not exceed four, when testing is carried out from an initial speed within 15 km/h of maximum motorcycle speed.

- 33A.5.12 Partial Failure: The vehicle shall be deemed to pass if all the parameters specified in Clause 33A.3.1 are met on at least one deceleration mode within a number of deceleration modes, which shall not exceed six for each single type of potential failure including:

- (a) each subsystem of the split system
- (b) inoperative antilock system
- (c) 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 testing.

- 33A.5.13 Parking Brake Test: The parking brake shall be tested by positioning the motorcycle 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 motorcycle is parallel to the direction of the grade. The parking brake shall be applied, the transmission disengaged and the service brakes released, for a period of not less than 5 minutes. The position of the motorcycle on the grade shall then be reversed and the motorcycle again parked for a period of not less than 5 minutes.

The motorcycle shall be deemed to pass this test if

- (a) 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 wheel(s) to which the parking brake is applied, and
- (b) the force required to apply the parking brake does not exceed 405N in the case of a foot operated system or 245N in the case of a hand operated system.

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- 33A.5.14 Second Base Line Check Procedure: This procedure is the same as that specified in Clause 33A.5.6 as the First Base Line Check Procedure.
- 33A.5.15 Tests With Brakes Subject to Wetting
- 33A.5.15.1 The test with brakes subject to wetting shall be carried out under the same conditions as the test with dry brakes. There shall be no adjustment or alterations of the braking system other than fitting the equipment to allow brake wetting. In the case of vehicles where the front and rear brakes can be applied separately, the brakes shall be tested independently.
- 33A.5.15.2 The test equipment shall continuously wet the brakes for each test run at a flow rate of 15 l/hr for each brake. Two disc brakes on one wheel will be considered as two brakes.
- 33A.5.15.3 For exposed or partly exposed disc brakes, the prescribed amount of water shall be directed onto the rotating disc in such a manner that it is equally distributed on the surface or surfaces of the disc swept by the friction pad or pads.
- 33A.5.15.3.1 For fully exposed disc brakes, the water shall be directed onto the surface(s) of the disc one quarter of a revolution in advance of the friction pad(s).
- 33A.5.15.3.2 For partly exposed disc brakes, the water shall be directed onto the surface(s) of the disc one quarter of a revolution in advance of the shield or baffle.
- 33A.5.15.3.3 The water shall be directed onto the surface(s) of the disc(s) in a continuous jet, in a direction perpendicular to the surface of the disc, from single jet nozzles so positioned as to be between the inner extremity and a point two thirds of the distance from the outer extremity of that part of the disc swept by the friction pad(s) (see figure 1).
- 33A.5.15.4 For fully enclosed disc brakes, the water shall be directed onto both sides of the shield or baffle at a point in a manner corresponding with that described in paragraphs 33A.5.15.3.1 and 33A.5.15.3.3 of this clause. Where the nozzle would be coincident with a ventilation or inspection port, the water shall be applied one quarter of a revolution in advance of the said port.
- 33A.5.15.5 Where, in the preceding Clauses 33A.5.15.3 and 33A.5.15.4 it is not possible to apply the water in the position specified owing to the presence of some fixed part of the vehicle, the water shall be applied at the first point, exceeding one quarter of a revolution, where uninterrupted application is possible.
- 33A.5.15.6 To ensure correct wetting of the brakes, the vehicle shall be driven with the wetting equipment operating for a distance of not less than 1.0km at the test speed prior to the application of the brakes being tested.

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- 33A.5.15.7 For drum brakes, the prescribed amount of water shall be distributed equally on either side of the braking device (that is, on the stationary back plate and the rotating drum) from nozzles so positioned as to be two-thirds of the distance from the outer circumference of the rotating drum to the wheel hub.
- 33A.5.15.8 Subject to the requirements of clause 33A.5.15.7 and to the requirement that no nozzle shall be within 150 of or coincident with a ventilation or inspection port on the stationary back plate, the test equipment for drum brakes shall be so positioned as to obtain the optimum uninterrupted application of water.
- 33A.5.15.9 Performance Level Attained With Brake Subject To Wetting
- 33A.5.15.9.1 Each independently actuated service brake shall be tested in accordance with the procedures laid down in Clause 33A.5.6 "First Base Line Check Procedure".

The mean deceleration attained with wet brake(s) between 0.5 and 1.0 second after application shall be at least 60 per cent of that attained with dry brake(s) during the second base line check when the same control force is applied. The control force used, which must be applied as quickly as possible, shall be equivalent to that required to attain deceleration of $3.2 \pm 0.2 \text{ m/s}^2$ with dry brake(s). At no time during the wet brake test shall the deceleration exceed 120 per cent of that attained with dry brakes.

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METHOD OF WATER APPLICATION

