Transmitted by the expert from
the United States of America

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Attachment 2

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World Forum for Harmonization of Vehicle Regulations (WP.29)

Working Party on Brakes and Running Gear (GRRF)
(Fifty-eighth session, 20-23 September 2005
agenda item ~~xx~~.)

United States Comments to the
PROPOSAL FOR A NEW GLOBAL TECHNICAL REGULATION CONCERNING
MOTORCYCLE BRAKE SYSTEMS

DRAFT #1

Transmitted by the Expert from USA

Note: This document is distributed to the Experts on Brakes and Running Gear only.

A. STATEMENT OF TECHNICAL RATIONALE AND JUSTIFICATION (The US proposes that this section entitled "Statement of Technical Rational" be expanded to include the discussion contained in Informal Document No. GRRF-58-16, which was submitted by the expert from Canada.

1. Introduction

Some existing motorcycle brake regulations have not kept pace with the advancement of modern technologies. With the improvement of disc brake systems and the recent introduction of new technologies such as anti-lock brake systems (ABS) and combined brake system (CBS), modern motorcycles can be equipped with very sophisticated and effective braking systems. In addition, the motorcycle manufacturing and testing certification industry has become a global industry, serving a global market.

Together, the Contracting Parties to the 1998 Agreement and the motorcycle industry, have determined that work should be undertaken to address the braking performance of motorcycles as a means of improving road safety in their countries. The development of a gtr on motorcycle brake systems is intended to reduce the injuries and fatalities associated with motorcycle accidents. GRRF believes that it is time to update current national standards with a harmonized regulation, based on the best practices within existing Contracting Party national regulations, while taking into account modern brake system technologies.

2. Background

During the 126th session of WP.29 in March 2002, AC.3, the Executive Committee for the 1998 Global Agreement, adopted the 1998 Global Agreement Program of Work, which included the development of a Global Technical Regulation (gtr) on Motorcycle Brake Systems. Subsequently, Canada offered to sponsor the gtr on motorcycle braking requirements at the 52nd session of GRRF, in September 2002. To proceed with the development of the gtr, AC.3 endorsed Canada's request to establish and chair an informal group on motorcycle brakes, at the 130th session of WP.29 in June 2003.

Following approval of WP-29, Canada initiated and chaired four meetings of the informal group. The meetings were open to all interested parties. Due to the time schedule and nature of the task, discussions on the content of the gtr and research necessary to develop the gtr began on October 25, 2002, prior to the establishment of an informal group. A total of six meetings on the topic of the development of a motorcycle brake were held, including two before the informal group was established, as noted below:

- October 25, 2002, in Montreal, Canada
- February 6, 2003, in Geneva, Switzerland
- July 16-17, 2003, in Pisa, Italy. 1st meeting by the informal group on Motorcycle Brake Systems
- April 26-28, 2004, in Brussels, Belgium. 2nd meeting by the informal group on Motorcycle Brake Systems
- November 08-10, 2004, in Montreal, Canada. 3rd meeting by the informal group on Motorcycle Brake Systems
- June 27-29, 2005, in Munich, Germany. 4th meeting by the informal group on Motorcycle Brake Systems

The meetings were open to all interested parties. The attendees for the informal group included representatives of:

- Canada
- United States of America
- Italy
- Japan (JASIC (Japan Automobile Standards Internationalization Center))
- India (by correspondence)
- IMMA (International Motorcycle Manufacturers Association)
- FEMA (Federation of European Motorcyclists' Associations)
- AMA (American Motorcyclist Association)
- JAMA (Japan Automobile Manufacturers Association, Inc.)

Early work on a motorcycle brake gtr was initiated by The International Motorcycle Manufacturer's Association (IMMA). They initiated a programme of work at the 46/GRRF with the intention to complete a proposal for a gtr for motorcycle brakes. In an effort to select the most stringent performance requirements for a gtr, IMMA conducted an analysis of the relative severity of three national motorcycle brake system regulations in which the UN/ECE Regulation No. 78, the United States Federal Motor Vehicle Safety Standard FMVSS 122 and the Japanese Safety Standard JSS 12-61 were compared. These reports, along with suggested requirements for a gtr, were presented at the 51/GRRF as informal document number 15, and at 53/GRRF as informal document number 26.

The United States, in a joint project with Canada, conducted a similar study comparing the severity of the same three national regulations. This report was made available at 55/GRRF. Despite using different methodologies, the results were very similar to that of the IMMA work. The results of this report were discussed at a 2nd informal group meeting, held in Brussels. A preliminary consensus was reached among all participants, in which the outline of the performance requirements for a gtr on motorcycle brake systems was reached.

The United States and Canada conducted a further performance evaluation study, in which selected motorcycles equipped with anti-lock brake systems were compared to like models without ABS. This report was presented at the 3rd informal group meeting in Montreal.

The studies completed by the United States, IMMA and work completed by JASIC, provided the basis for the development of the technical requirements of the gtr.

A full report of the work of the Informal group, its deliberations and conclusions is provided in the informal group's Technical Report, [which was presented at the 58/GRRF as an informal document]. The Technical Report includes a summary of the technical justification for the performance requirements for each of the testing requirements.

This final report and appended gtr technical requirements are in response to Article 6 of the 1998 Agreement Concerning the Establishment of Global Technical Regulations for Wheeled Vehicles, Equipment and Parts Which Can be Fitted and/or Used on Wheeled Vehicles, known as the 1998 Global Agreement. This final report has been prepared after a thoughtful review by GRRF of the proposal submitted by Canada.

3. Existing Regulations, Directives, and International Voluntary Standards

While there were no regulations contained in the Compendium of Candidates, the following regulations and standards were reviewed and used as the basis for the development of the gtr:

UN/ECE Regulation 78 – Uniform provisions concerning the approval of vehicles of category L vehicles with regard to braking.

U.S. Code of Federal Regulations (CFR) Title 49: Transportation; Part 571.122: Motorcycle brake systems.

Canada Motor Vehicle Safety Regulation No. 122 – Motorcycle brake systems.

EU Directive 93/14/EEC, braking for category L vehicles (in effect, the same as ECE Regulation 78)

Japan Safety Standard J12-61

Australian Design Rule 33/00 – Brake systems for motorcycles and mopeds.

ISO 8710:1995, Motorcycles – Brakes and braking devices - tests and measurement methods

ISO 12364:2001, Two-wheeled motorcycles - Antilock braking systems (ABS) - tests and measurement methods

ISO 8709:1995, Mopeds – Brakes and braking devices - tests and measurement methods

ISO 12366:2001, Two-wheeled mopeds - Antilock braking systems (ABS) - tests and measurement methods

Most of these regulations and standards have been in existence for many years and the methods of measurement sometimes vary significantly. The technical experts were familiar with these requirements and held detailed discussions over them in their working sessions.

4. Discussion of Issues Addressed by the gtr

The gtr was developed so that it would be:

- representative of world-wide on-road motorcycle operation,
- able to provide the highest possible level of efficiency in controlling motorcycle braking;
- representative of state-of-the-art testing and measurement technology; and,
- applicable in practice to existing and foreseeable future braking technologies.

The informal group reviewed each of the listed regulations and standards and compared the requirements in each during the development of the gtr. These regulations and standards, in conjunction with the research and analysis, were used to develop a draft table of regulatory requirements. This draft table of requirements was continually updated as the technical issues were raised, discussed and resolved. At the 57/GRRF in February of 2005, this table was presented and the draft technical requirements discussed. The informal group used the feedback from the GRRF presentation to complete the final requirements for the gtr. The table of regulatory requirements was used to develop the text of the gtr, with the final text proposal being presented at the [58/GRRF in September 2005], and is presented below, in Part B of this document.

Where national regulations or standards address the same subject, e.g. dry stop or heat fade performance requirements, the informal group reviewed comparative data on the relative severity of the requirements

from the research and studies and included the most severe options. In many cases, individual members of the informal group were tasked with completing additional testing to confirm or refine the testing and performance requirements. Qualitative issues, such as which wet brake test to include, were discussed on the basis of the original rationales and the appropriateness of the tests to modern conditions and technologies.

In each of these steps, specific technical issues were raised, discussed, and resolved. The technical report describes this information. Additionally, other issues addressed in this gtr are identified below:

(a) Applicability

The Informal group followed the agreed terms of reference and has prepared a gtr for all Category 3 vehicles, (mopeds, motorcycles and three-wheelers).

(b) Definitions

The definitions used in this gtr were aligned with those of the Common definitions of vehicle categories, masses and dimensions (S.R.1). In addition, specific technical definitions were developed to align with the current definitions used by each of the contracting parties.

(c) Performance Requirements

The gtr contains performance requirements which are more stringent than the individual requirements of each of the Contracting Parties. This was accomplished by choosing the most stringent requirements of each of the Contracting Parties. The gtr includes the specific tests as noted:

1. dry stop tests:
    - with each brake control operated separately, in the laden condition
    - with all braking systems activated simultaneously, in the unladen condition
2. a high speed test
3. a heat fade test
4. a wet brake test
5. an ABS test

(d) General Requirements

General requirements, such as labelling and parking brake requirements, were aligned with the most severe requirements in the current Contracting Party regulations.

5. Regulatory Impact and Economic Effectiveness

Many global motorcycle brake regulations have not kept pace with the advancement of modern technologies. With the improvement of disc brake systems and the recent introduction of new technologies such as anti-lock brake systems (ABS) and combined brake system (CBS), modern motorcycles can be equipped with very sophisticated and effective braking systems.

Statistics compiled to date indicate that improved motorcycle brake systems would be beneficial in reducing motorcycle accidents. Fatal motorcycle accidents have been on the rise in North America since 1997. Of particular concern is the rise in motorcycle accident fatalities for the 40- year old and above age group, by 8.2% in Canada from 1994 to 2000, and 24.7% in the United States from 1994 to 1999. In addition, statistics from the United States of America for the period of 1991 to 1999 inclusively indicate

that about 13 per cent of the yearly average of 1,055 fatal single vehicle motorcycle crashes were related to braking manoeuvres. A request for additional motorcycle traffic accident data was made at the 52nd GRRF, to all nations, in an effort to prepare for the cost effectiveness study for the purposes of the gtr. No responses were received following this request.

The informal group reviewed the benefits of developing a gtr. The group concluded that there are many benefits to the consumer, Contracting Parties and for manufacturers. The following highlights some of the significant benefits raised during the discussions:

- The gtr includes technical requirements to access both recent technologies, such as Combined Brake Systems (CBS) and Anti-Lock Brakes (ABS). Most regulatory requirements of the Contracting Parties do not include such current requirements.

- A gtr enables motorcycle manufacturers to test their models to just one regulation/series of tests to sell globally. Currently, tests have to be carried out to many different regulations, e.g., FMVSS 122 in the USA, ECE Regulation 78 in Europe, SS 12-61 in Japan, ADR in Australia, CMVSS 122 in Canada etc.

- Carrying out just one set of tests to a gtr is particularly beneficial to new manufacturers and manufacturers from the emerging nations. Apart from the benefits outlined in above, their test department needs only to become familiar with the gtr.

- It has been many years since current regulations were reviewed for their relevance. In order to compare current regulations, members of the informal gtr group (NHTSA, Transport Canada, and IMMA) conducted motorcycle tests to compare the stringency of various requirements in the regulations and to evaluate ~~carried out many vehicle tests and analysis that effectively checked out~~ their suitability for the gtr, with modifications being incorporated as required.

- The informal group gave many individuals and organisations the opportunity to come together to directly influence and participate in the development and content of the gtr. This has in fact been the case where a broad cross section of motorcycle manufacturers, authorities of several countries, and the motorcycle riders group, have all participated.

- The gtr combines the better and more stringent procedures from current USA, ECE, and Japan regulations. This will result in an enhanced gtr that will benefit all motorcycle users in terms of brake performance, brake durability, and potential safety.

- Motorcycles sold in the USA will benefit from the following:
    - a wet brake test that simulates in service conditions by spraying water onto the disc.
    - a more stringent dry brake test
    - a more stringent heat fade test
    - a more stringent high speed test
    - an additional test to evaluate ABS performance.

- Motorcycles sold in Europe will benefit from the following:
    - a specified burnishing procedure for government conformity testing
    - an additional test from 100 km/h with both brakes applied
    - a more stringent high speed test
    - additional general requirements, e.g., warning lamp specification, brake system inspection
    - a specified test sequence

- Motorcycles sold in Japan will benefit from the following:
    - a specified burnishing procedure for government conformity testing
    - an additional test from 100km/h with both brakes applied
    - additional general requirements eg. warning lamp specification, brake system inspection
    - a specified test sequence

In addition, the text of the gtr will provide clear, straightforward instructions on test procedures and requirements that should be easy to follow for the tester. Additional documentation on interpretation (which is used currently) should not be necessary. This will provide a benefit to all Contracting Parties, manufacturers and testing facilities.

Motorcycles are vehicles, which are prepared for the world market. To the extent that manufacturers are preparing substantially different models in order to meet different braking regulations, testing costs and other production values are increased. It would be more economically efficient to have manufacturers using the same test procedure and meeting the same performance requirements worldwide. This will be achieved by this gtr and thus reduce the amount of resources utilized to test motorcycles. These savings will accrue not only to the manufacturer, but also more importantly, to the consumer as well.

In summary, as the gtr has been prepared on the basis of the most severe current requirements, there will be an increase in safety in all countries; since no one country has a monopoly of the most severe requirement for the common test procedures. In addition, the gtr provides testing requirements applicable to new technologies such as ABS and CBS that will benefit all road users.

B. REGULATORY LANGUAGE

1. SCOPE

This GTR specifies requirements for service brake and, where applicable, associated parking brake systems.
Its purpose is to ensure safe braking performance under normal and emergency riding conditions.
The GTR applies to power driven vehicles with 2 and 3 wheels as summarised in the following table:

CATEGORY	DESCRIPTION
3-1	2 wheels, engine < 50cc and max speed < 50 km/h
3-2	3 wheels, engine < 50cc and max speed < 50 km/h
3-3	2 wheels, engine > 50 cc or max speed > 50 km/h
3-4	3 wheels – symmetrical, engine > 50 cc or max speed >50 km/h .
3-5	3 wheels – asymmetric, engine > 50 cc or max speed > 50 km/h (motorcycle + sidecar)

Notes:
- the categories include vehicles with electric power.
- the categories do not include:
  a. vehicles with a V max. of < 25 km/h
  b. vehicles equipped for disabled drivers

2. DEFINITIONS

ABS (Antilock Brake System) means [a system which senses wheel slip and automatically modulates the pressure producing the braking forces at the wheel(s) to limit the degree of wheel slip.]

Baseline test means a stop or a series of stops carried out in order to confirm the performance of the brake prior to subjecting it to a further test e.g. Heating Procedure or Wet Brake Stop.

Brake means the parts of the brake system in which the forces opposing the movement of the vehicle are developed. (per ISO 8710)

Brake system means the combination of parts (excluding the engine) whose function is progressively to reduce the speed of a moving vehicle, bring it to a halt, and keep it stationary if already halted.
The system consists of the Control, the Transmission, and the Brake.

Combined Brakes System (CBS) means:
For category 3-1 & 3-3: a brake system where at least two brakes on different axles are actuated by the operation of a single control.
For category 3-2 & 3-4 a brake system where the brakes on all axles are actuated by the operation of a single control.
For category 3-5: a brake system where the brakes on at least the front and rear axles are actuated by the operation of a single control. (Where the rear wheel and sidecar wheel are braked simultaneously, this is regarded as the rear brake.)

Control means the part actuated directly by the rider in order to supply the energy to the transmission required for braking the vehicle.

Controller means the component designed to evaluate and operate on data transmitted by a sensor and transmit signals to the modulator

Engine disconnected means when the engine is no longer connected to the driving wheels.

Initial Brake Temperature means the temperature of the hottest brake 0.32 km. before any brake application.

Laden means "gross vehicle mass" ~~(taken from SR1)~~.
This is the maximum mass of the fully laden solo vehicle based on its construction and design performances, as declared by the manufacturer. This item needs to be explained more clearly~~This shall be less than or equal to the sum of the maximum axles' (group of axles) capacity.~~ *[Avoid the use of the term "shall" in a definition since the definition is not a requirement.]*

Modulator means component designed to vary braking force in accordance with the signal received from the controller

PFC (Peak Friction Coefficient) means the friction of the test surface, measured in accordance with the method specified in national legislation.

Sensor means a component designed to identify and transmit to the controller conditions of rotation of the wheel(s) or other dynamic conditions of the vehicle.

Single brake system means a brake system which acts on only one axle.

Split service braking system means a brake system consisting of two or more subsystems actuated by a single control designed so that a single failure in any subsystem (such as a leakage type failure of a hydraulic subsystem) does not impair the operation of any other subsystem.

Stopping distance means distance travelled by the vehicle from the point of application of the control to the point at which the vehicle reaches a full stop.

Test speed is the vehicle speed measured at the moment the rider begins to actuate brake system control(s)

Transmission means the combination of components that provide the functional link between the control and the brake.

Unladen means "mass in running order", ~~taken from SR1~~:
This is the nominal mass of the vehicle as determined by the following criteria:

Sum of unladen vehicle mass and driver's mass. The driver's mass is applied in accordance with paragraph 6.1 below:
In the case of 1-2 vehicles, additional crewmembers for which seating positions are provided ~~shall be~~ are included, their mass being equal to, and incorporated in the same way as, that of the driver. *[1-2 vehicles need to a better description to make it clear]*
The weight of test equipment including outriggers, if fitted, ~~will be~~ is included in the unladen weight.

Vmax means the highest speed attainable by accelerating at a maximum rate from a standing start for a distance of 1.6 km on a level surface, with the vehicle in the unladen condition. ~~The vehicle manufacturer may supply this information.~~

Wheel lock is the condition that occurs when there is a slip ratio of 1.00.
Note: In practice, wheel lock is judged to have occurred when the vehicle speed exceeds 15 km/h while the wheel speed falls below 5 km/h. at the tyre to road interface (per ISO 12364)

3. GENERAL REQUIREMENTS

3.1 **Brake system requirements**

3.1.1 – 2-wheeled vehicles (category 3-1 and 3-3) shall be equipped with two separate service brake systems, or a split service brake system, with at least one brake operating on the front wheel and at least one brake operating on the rear wheel.

3.1.2 - Category 3-5 vehicles shall have the same brake system requirements as outlined in 3.1.1 above. A brake on the sidecar wheel is not required providing the vehicle meets the prescribed performance requirements outlined in section 4 of this GTR.

3.1.3 – 3-wheeled vehicles of category 3-2 and 3-4 shall be equipped with a parking brake system plus one of the following service brake systems:

a. two separate service brake systems which, when applied together, actuate the brakes on all wheels, or

b. a service brake system that operates on all wheels and a secondary brake system which may be the parking brake, or

c. a split braking system which actuates the brakes on all wheels, actuated through a single control.

3.1.4 – Where two separate service brake systems are installed, there may be a common brake provided failure in one system does not affect the performance in the other.

3.1.5 – For vehicles with a hydraulic transmission, the master cylinder shall:
- have a separate reservoir for each brake system, with its own cover, seal and retention.
- have a minimum reservoir capacity equivalent to 1.5 times the total fluid displacement required to satisfy the new to fully worn lining condition with the worst case brake adjustment condition.
- have a reservoir where the fluid level is easily visible for checking without removal of the cover.

3.1.6 – Vehicles that are equipped with a split service brake system shall be fitted with a red warning lamp, that is mounted in clear view of the rider and which shall be activated:
- if there is a hydraulic failure when ≤ 90 N. max control force is applied

- without activation of a brake control, when the brake fluid level in the master cylinder reservoir falls below the level specified by the manufacturer or to ≤ 0.5 of the fluid reservoir capacity, whichever is the greater.
For function checking, the warning lamp shall be turned on briefly by the activation of the ignition switch. The warning lamp shall remain on whilst a failure condition exists whenever the ignition switch is in the "on" position.

3.1.7 – Vehicles that are equipped with an ABS system shall be fitted with an amber warning lamp that is mounted in clear view of the rider. The lamp shall be activated
whenever there is a malfunction that affects the generation or transmission of response or control signals in the vehicle's ABS system.
For function checking, the warning lamp shall be turned on briefly by the activation of the ignition switch. The warning lamp shall remain on whilst a failure condition exists whenever the ignition switch is in the "on" position.

3.1.8 – Brake friction material shall not contain asbestos. *[There must be a test procedure to accompany this requirement to check for asbestos.]The US may not be able to propose this in the US because it outside our agency authority. Environmental.*

3.1.9 Each vehicle must meet each of the tests specified for that vehicle category and for those brake features on the vehicle.

3.2 **Brake system, general operation**

3.2.1 Service brake system
The service brake system shall be capable of progressively reduceing the speed of the moving vehicle, bringing it to a halt, and keeping it stationary. ~~The rider shall~~ Vehicles shall have configurations that enable a rider to achieve this whilst seated in the normal driving position and with both hands on the steering control. *[The previous language appeared to place the requirement on the rider not the motorcycle.]*

3.2.2 Secondary brake system
Where a secondary brake system is fitted, it shall be capable of progressively reduceing the speed of the moving vehicle to a halt in the event of a failure of the service brake system.
~~The rider shall~~ Vehicles shall configurations that enable a rider to achieve this whilst seated in the normal driving position and with at least one hand on the steering control.

3.2.3 Parking brake system
Where a parking brake system is fitted, it must be capable of holding the vehicle stationary on the prescribed slope.
The parking brake shall:
a. have a control which is separate from the service brake controls and
b. be held in the locked position by solely mechanical means.
~~The rider shall~~ Vehicles shall have configurations that enable a rider to be able to operate the parking brake whilst seated in the normal driving position.

3.3 **Durability**

3.3.1 ~~–~~ Wear of the service brakes shall be compensated for by means of a system of automatic or manual adjustment. ~~The brake system shall take account of friction material wear automatically or by manual means~~.

3.3.2 - The friction material thickness shall be visible without disassembly, but for drum brakes, where the friction material is not visible, wear shall be assessed by means of a device designed for that purpose.

3.3.3 - During the tests and on their completion, there shall be no lining detachment and no leakage of brake fluid.

3.4 Measurement of Dynamic performance

The method utilized to measure performance shall be as specified in the respective tests in Section 4. There are three ways in which the brake performance may be measured:

3.4.1: MFDD (Mean Fully Developed Deceleration)

Calculation of MFDD :

$$d_m = \frac{V_b^2 - v_e^2}{25.92\ (S_e - S_b)} \quad m/s^2$$

Where :
d_m = mean fully developed deceleration
V_1 = vehicle speed when rider actuates control
V_b = vehicle speed at 0.8 V_1 in km/h
V_e = vehicle speed at 0.1 V_1 in km/h
S_b = distance traveled between V_1 and V_b in metres
S_e = distance traveled between V_1 and V_e in metres

3.4.2: Stopping distance:

Based on the basic equations of motion:
$S = 0.1\ V + (X)\ V^2$
Where:
S = stopping distance in metres
V = vehicle speed in km/h
X = a variable based on the requirement for each test

To calculate the corrected Stopping distance using the actual vehicle test speed, the following formula is used:

$$S\ s = 0.1\ Vs + (Sa - 0.1\ Va\ ) \times Vs^2/Va^2$$

Where:
S s = corrected stopping distance in metres
Vs = specified vehicle test speed in km/h
Sa = actual stopping distance in metres
Va = actual vehicle test speed in km/h

Note: This equation is only valid when the actual test speed (Va) is within ± 5 km/h of the specified test speed (Vs)

3.4.3 Continuous Deceleration Recording:

For tests such as the Wet Brake and Heat Fade – Heating Procedure,

there shall be a continuous recording of the vehicle deceleration from the point where the brake control is applied until the end of the stop. The mfdd and stopping distance measures are not applicable.

4. TEST CONDITIONS, PROCEDURES AND PERFORMANCE REQUIREMENTS.

4.1 **General**

4.1.1 Test surfaces:

4.1.1.1 Dynamic brake tests (excluding low friction ABS tests):
The test area shall have a clean, dry and level surface, with a gradient ≤ 1%
The surface shall have a nominal peak friction coefficient (PFC) of [0.9 ~~or less~~], unless otherwise specified. *[PFC of 0.9 or less is too broad since it includes low friction surface defined in 4.1.1.2. Use 0.85 to 0.90 if a range is needed.]*

4.1.1.2 Low friction ABS tests:
Vehicles with ABS shall also be tested on a surface with a peak friction coefficient of ≤ 0.45.

4.1.1.3 Parking brake tests:
The test area shall have a clean, dry and solid surface with the specified slope.

4.1.1.4 Lane width:
For a 2 wheeled vehicles (category 3-1 and 3-3) the lane width shall be 2.5 m.
For a 3 wheeled vehicles (category 3-2, 3-4 and 3-5) the lane width shall be 2.5 m + the vehicle width.

4.1.2 Ambient temperature:
The ambient temperature shall be between 4° C and 38° C.

4.1.3 Wind speed:
The wind speed shall be not more than 5 m/s

[4.1.4 Tolerances:
Unless otherwise specified, a general tolerance of ± 10% shall be applied to all test parameters.]

4.1.5 Automatic transmission:
Vehicles with automatic transmission shall complete all tests - whether they are for “engine connected” or “engine disconnected”.
If an automatic transmission has a neutral position, the neutral position shall be selected for tests where “engine disconnected” is specified.

4.1.6 Vehicle position and wheel lock:
- The vehicle shall be positioned in the centre of the test lane for the beginning of each stop.
- Stops shall be made without the vehicle wheels passing outside the test lane and without wheel lock.

4.1.7 Test sequence

TEST ORDER	SECTION
1. Dry Stop - single brake control activated	4.3
2. Dry Stop – all service brake controls activated	4.4
3. High Speed	4.5
4. Wet Brake	4.6
5. Heat Fade (1)	4.7
6. If fitted:	
6.1 Parking Brake	4.8
6.2 ABS	4.9
6.3 Partial failure, for split brake systems	4.10
6.4 Servo failure	4.11

Note (1): Heat Fade shall always be the last test carried out

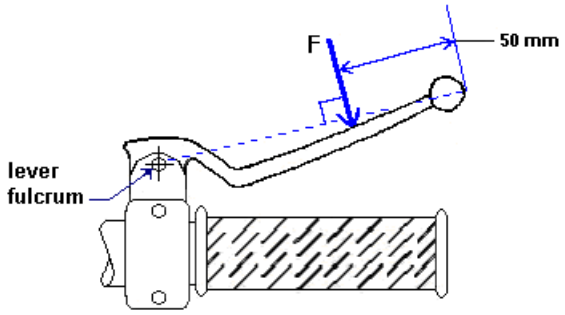
4.2 Preparation

4.2.1 Engine idle speed:
Engine idle speed shall be set to the manufacturer's specification.

4.2.2 Tyre pressures:
Tyres shall be inflated to the manufacturer's specification for the vehicle loading condition.

4.2.3 Control lever application points and direction:
For the hand control lever, the input force (F) shall be applied on the lever's forward surface perpendicular to the axis of the lever fulcrum and its outermost point on the plane along which the brake lever rotates. (see figure below).

The input force shall be located 50 mm from the outermost point of the lever, measured along the axis between the central axis of the fulcrum of the lever and its outermost point.



For the foot control pedal, the input force shall be applied to the centre of the foot contact pad of the brake pedal and at right angles to the pedal.

4.2.4 Brake temperature measurement:
The brake temperature shall be measured on the approximate centre of the braking path of the disc or drum using:

a. a rubbing thermocouple that is in contact with the surface of the disc or drum or
b. a thermocouple that is embedded in the friction material

Contracting parties may specify which method is acceptable to establish conformity to the requirements.

4.2.5 Burnishing procedure:
The manufacture may supply the vehicle for testing with the brakes burnished or the following procedure shall be used: This statement should be deleted. Does not work under self-certification.

- Vehicle unladen.

- Engine disconnected

- Test speed:
  Initial speed =≥50 km/h
  Final speed 5 to 10 km/h

- Brake application:
  Each brake control applied separately.

- Vehicle deceleration:
Front wheel braking only = 3.0-3.5 m/s^2
Rear wheel braking only = 1.5-2.0 m/s^2
Combined Brake System or split service brake system = 3.5-4.0 m/s^2

- Number of decelerations: 100 per brake system

- Initial brake temperature before each brake application ≤100° C.

- For the first stop, accelerate the vehicle to the test speed and then activate the brake control under the conditions specified above. Then reaccelerate to the initial test speed and maintain that speed until the brake temperature falls to the specified initial value. When these conditions are met, reapply the brake control as above. Repeat for the number of specified decelerations.

4.3 **Dry Stop Test – single brake control activated**

4.3.1 Vehicle condition.

- Laden
  For vehicles fitted with CBS: also unladen

- Engine disconnected

4.3.2 Test conditions and procedure

- Initial brake temperature: ≥55° C and ≤100° C

- Test speed **:**
  Category 3-1 & 3-2 vehicles: 40 km/h or 0.9 V max, whichever is the lower
  Category 3-3, 3-4 & 3-5 vehicles: 60 km/h or 0.9 V max, whichever is the lower

- Brake application:
  Each brake control separately.

- Brake actuation force:
  Hand control ≤200N
  Foot control ≤350N for 3-1, 3-2, 3-3, 3-5 vehicles
  ≤500N for 3-4 vehicles

- Number of stops : until the vehicle meets the performance requirements, with a maximum of 6 stops

- For each stop, accelerate the vehicle to the test speed and then activate the brake control under the conditions specified above

4.3.3 Performance requirements

When the brakes have been tested in accordance with test procedure 4.3.2, the stopping distance shall be as specified in column 2 or the MFDD shall be as specified in column 4 of the following table:

Category	STOPPING DISTANCE (S) (Where V is the specified test speed in km/h and S is the required stopping distance in metres)	**OR**	MFDD
Single front brakes only:			
3-1	$S \leq 0.1\ V + V^2/90$		$\geq 3.4 m/s^2$
3-2	$S \leq 0.1\ V + V^2/70$		$\geq 2.7 m/s^2$
3-3	$S \leq 0.1\ V + V^2/115$		$\geq 4.4 m/s^2$
3-4	$S \leq 0.1\ V + V^2/115$		$\geq 4.4 m/s^2$
3-5	$S \leq 0.1\ V + V^2/95$		$\geq 3.6 m/s^2$
Single rear brakes only			
3-1	$S \leq 0.1\ V + V^2/70$		$\geq 2.7\ m/s^2$
3-2	$S \leq 0.1\ V + V^2/70$		$\geq 2.7 m/s^2$
3-3	$S \leq 0.1\ V + V^2/75$		$\geq 2.9 m/s^2$
3-4	$S \leq 0.1\ V + V^2/75$		$\geq 2.9 m/s^2$
3-5	$S \leq 0.1\ V + V^2/95$		$\geq 3.6 m/s^2$
Vehicles with CBS or Split Service Brake Systems : laden and unladen			
3-1 + 3-2	$S \leq 0.1\ V + V^2/115$		$\geq 4.4 m/s^2$
3-3	$S \leq 0.1\ V + V^2/132$		$\geq 5.1 m/s^2$
3-4	$S \leq 0.1\ V + V^2/130$		$\geq 5.0 m/s^2$
3-5	$S \leq 0.1\ V + V^2/140$		$\geq 5.4 m/s^2$
Vehicles with CBS – secondary brake only			
ALL	$S \leq 0.1\ V + V^2/65$		$\geq 2.5\ m/s^2$

[Convert all equations in above Table to include numbers with decimal places in place of fractions, e.g., $S<0.1V+V^2/90$ should read $S<0.1V+0.0111V^2$]

4.4 **Dry Stop Test – all service brake controls activated**

4.4.1 Vehicle condition.

- Test is applicable to vehicle categories 3-3, 3-4, 3-5.
- Unladen
- Engine disconnected

4.4.2 Test conditions and procedure

- Initial brake temperature = ≥55° C and ≤100° C.
- Test speed**:** 100 km/h or 0.9 V max, whichever is the lower.
- Brake application:
  Simultaneous application of both brake controls, if so equipped, or of the single brake control in the case of a service brake system that operates on all wheels.
- Brake actuation force:
  Hand control ≤ 250N
  Foot control ≤ 400N
  ≤500N for 3-4 vehicles
- Number of stops : until the vehicle meets the performance requirements, with a maximum of 6 stops
- For each stop, accelerate the vehicle to the test speed and then apply the brakes under the conditions specified above

4.4.3 Performance requirements

When the brakes have been tested in accordance with the test procedure in 4.4.2, the stopping distance (S) shall be [$\leq 0.1\ V + 0.0051V^2$]
(where V is the specified test speed in km/h and S is the required stopping distance in metres)

4.5 **High Speed Test**

4.5.1 Vehicle condition

- Test is applicable to vehicle categories 3-3, 3-4, 3-5
- Test is not required for vehicles with Vmax ≤ 125 km/h
- Unladen

- Engine connected

4.5.2 Test conditions and procedure

- Initial brake temperature : ≥55° C and ≤100° C

- Test speed: 0.8 Vmax for vehicles with Vmax >125 km/h and < 200 km/h.
  160 km/h for vehicles with Vmax ≥ 200 km/h V max
- Brake application:
  Both brake controls shall be activated at the same moment

- Brake actuation force:
  Hand control ≤ 200N
  Foot control ≤ 350N for 3-3, 3-5 vehicles
  ≤ 500N for 3-4 vehicles

- Number of stops : until the vehicle meets the performance requirements, with a maximum of 4 stops

- For each stop, accelerate the vehicle to the test speed and then activate the brake control under the conditions specified above

4.5.3 Performance requirements

When the brakes have been tested in accordance with the test procedure in 4.5.2:

- Stopping distance (S) shall be $\leq 0.1\ V + V^2\ /149$
(where V is the specified test speed in km/h and S is the required stopping distance in metres)
or the MFDD shall be $\geq 5.8 m/s^2$

4.6 **Wet Brake Test**

4.6.1 General information:

- The test comprises two parts that shall be carried out consecutively for each brake system:
  a. A **baseline** test based on the Dry Stop Test - with single brake control activated (section 4.3).
  b. A single **wet brake** stop using the same test parameters as in a. above but with the brake(s) being continuously sprayed with water while the test is conducted, in order to assess the effect of riding in wet conditions.

- The test is not applicable to parking brakes

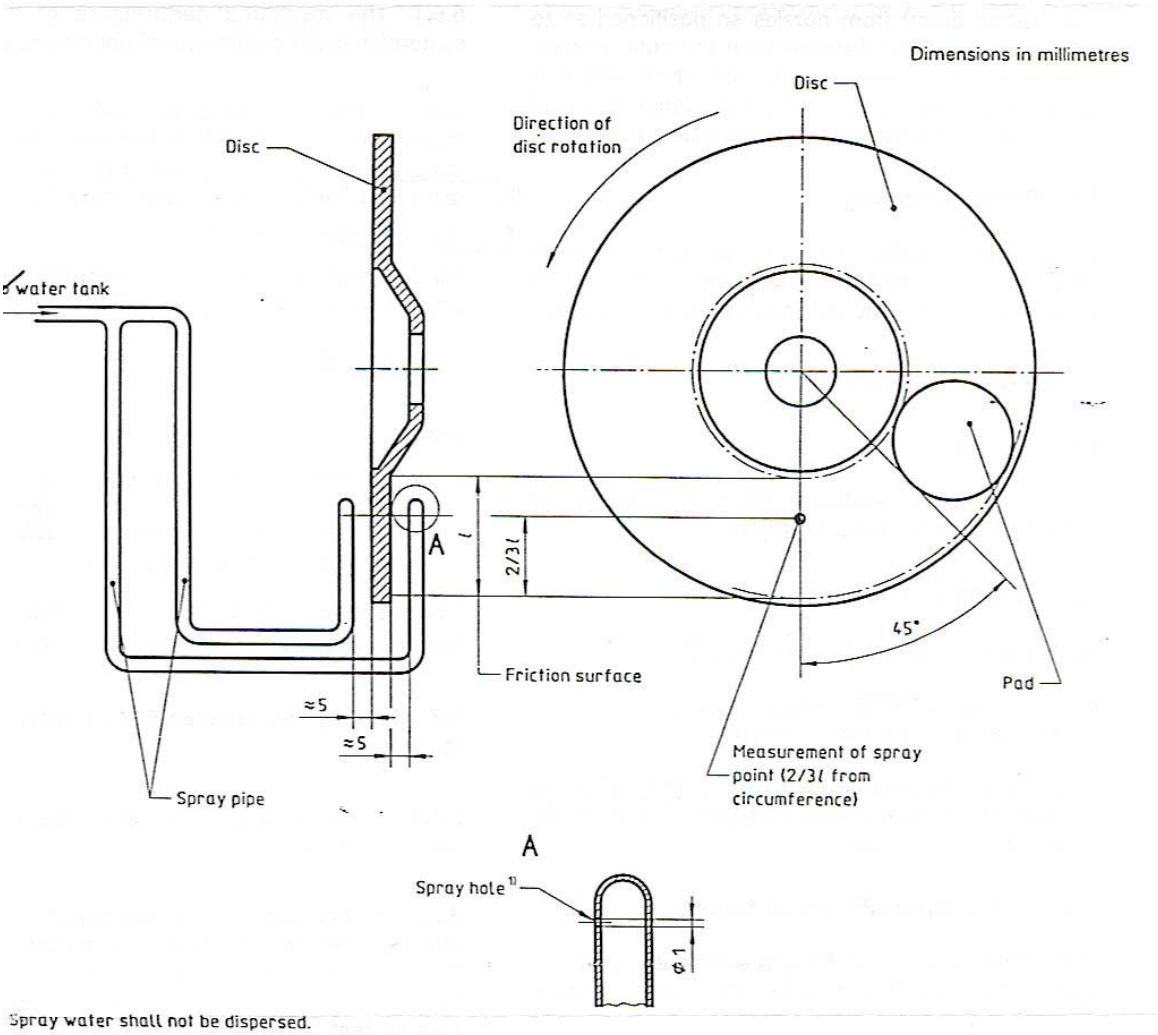
- Drum brakes are exempt from this test unless ventilation or open inspection ports are present.

- This test requires the vehicle to be fitted with instrumentation that gives a continuous recording of vehicle deceleration. The MFDD and the stopping distance alternative are not appropriate in this case.

4.6.2 Vehicle condition.

- Test is applicable to all vehicle categories
- Laden
  For vehicles fitted with CBS : also unladen
- Engine disconnected
- Each brake shall be fitted with water spray equipment:

a. Disc Brakes : Sketch of water spray equipment:



Notes on the installation of the disc brake water spray equipment:

- Water shall be sprayed onto each brake with a flow rate of 15 litres/hr. The water shall be equally distributed on each side of the rotor.
- If the surface of the rotor has any shielding, the spray shall be applied 45° prior to the shield.
- If it is not feasible to position the spray at 45° as shown on the sketch, or if the spray coincides with a brake ventilation hole or similar, the spray may be moved 90° max prior to this position.

b. Drum Brakes with ventilation and open inspection ports:

- Water with a flow rate 15 litres/hr. shall be distributed equally on either side of the drum brake unit (on the stationary back plate and on the rotating drum) from nozzles positioned two thirds of the distance from the outer circumference of the rotating drum to the wheel hub centre.
- The nozzle shall be > 15 ° from the edge of any opening in the drum back plate.

4.6.3 Baseline Test:

- Carry out the test in section 4.3 (Dry Stop Test - with single brake control activated) for each brake system but with a constant brake control force that results in a vehicle deceleration of 2.5 – 3.0 $m/s^{2.}$.
- To ensure repeatability:
  a. 3 baseline stops shall be performed
  b. For each baseline stop, the brake control force and vehicle deceleration shall be recorded. The average brake control force shall be determined for the period between 80 and 10% of the specified test speed.
  c. The average of these 3 control force values shall be used for the subsequent Wet Brake Stop.

4.6.4 Wet Brake Stop:

4.6.4.1 Test conditions and procedure

a. The vehicle shall be ridden at the test speed used in the Baseline test 4.6.3 with the water spray equipment operating on the brake(s) to be tested and with no activation of the brake system.
b. After a distance of ≥500 m, apply the control for the brake system being tested with the average input force derived in the Baseline Test.

4.6.5. Performance requirements

When tested in accordance with 4.6.4.1, the wet brake deceleration performance shall be:
≥ 60% of the average deceleration performance recorded in the Baseline test in the period 0.5 to 1.0 seconds after brake control application.

≤ 120% of the average deceleration performance recorded in the Baseline test for the complete stop.

4.7 **Heat Fade Test**

4.7.1 General information:

- The test is comprised of three parts that shall be carried out consecutively for each brake system:
  a. A **baseline** test based on the Dry Stop Test - single brake control activated (section 4.3).
  b A **heating procedure** which includes a series of repeated stops in order to heat the brake(s)
  c. A **hot brake** stop based on the Dry Stop Test - single brake control activated (section 4.3), to measure the brake's performance after the heating procedure.

- Test is applicable to vehicle categories 3-3, 3-4, 3-5.

- Test is not applicable to parking brakes or secondary brakes.

- All stops with vehicle laden

- The heating procedure requires the vehicle to be fitted with instrumentation that gives a continuous recording of vehicle deceleration and brake actuation control force. Therefore, the stopping distance and mfdd are not used for the heating procedure. The baseline and hot brake stops require the measurement of either MFDD or the stopping distance.

4.7.2 Baseline Test:

4.7.2.1 Vehicle condition.

- Engine disconnected

4.7.2.2 Test conditions and procedure

- Initial brake temperature : ≥55° C and ≤100° C

- Test speed **:** 60 km/h

- Brake application:
  Separate test using each brake control.

- Brake actuation force:
  Hand control ≤ 200N
  Foot control ≤ 350N for 3-3 & 3-5 vehicles
  ≤ 500N for 3-4 vehicles

- Accelerate the vehicle to the test speed, activate the brake control under the conditions specified above, and record the control force to achieve the vehicle braking performance requirements specified in the table in section 4.3.3

4.7.3 Heating Procedure

4.7.3.1 ~~Test c~~Conditions and procedure

- Initial brake temperature prior to first stop only: ≥55° C and ≤100° C

- ~~Test~~ Specified speed:
  Front brakes(s): 100 km/h or 0.7 V max, whichever is the lower.
  Rear brake(s): 80 km/h or 0.7 V max, whichever is the lower.
  CBS: 100 km/h or 0.7 V max, whichever is the lower.

- Brake application:
  Separate ~~test~~ application for each brake control.

- Brake actuation force:

A constant control force that achieves an average vehicle deceleration rate of 3.0 – 3.5 m/s^2 for the duration of the first stop.
The brake control force and vehicle deceleration shall be recorded for the duration of the stop. The average brake control force shall be determined for the period between 80% and 10% of the specified ~~test~~ speed.

The average brake control input force used for the first stop shall be repeated for each of the remaining stops.

- Number of stops: 10

- Interval between stops: 1000 m.

- Engine transmission:
  a. From the ~~test~~ specified speed to 50% ~~test~~ specified speed: connected, with the highest gear selected.
  b. From 50% ~~test~~ specified speed to standstill : disconnected.

- Carry out a stop to the conditions specified above and then immediately use maximum acceleration to reach the ~~test~~ specified speed and maintain that speed until the next stop is made.

4.7.4 Hot Brake Stop:

4.7.4.1 Test conditions and procedure

Perform a single stop following the conditions used in the baseline test (4.7.2) for the brake system that has been heated during test 4.7.3. This stop shall be carried out within one minute of the completion of test 4.7.3 with an average brake actuation force ≤ the average force used in 4.7.2.

4.7.5 Performance Requirements

When the brakes have been tested in accordance with 4.7.4.1, performance shall be:

If based on MFDD, ≥ 60% of the MFDD recorded in test 4.7.2.

If based on stopping distance, [$S_2 \leq 1.67\ S_1 - 0.67$ x 0.1V]

Where:
S_1 = stopping distance in metres achieved in baseline test 4.7.2
S_2 = stopping distance in metres achieved in hot brake stop 4.7.4.1
V = test speed in km/h.

4.8 **Parking Brake Test – for vehicles equipped with parking brakes**

4.8.1 Vehicle condition.

- Laden

- Engine disconnected

4.8.2 Test conditions and procedure

- Initial brake temperature: ≤100° C

- Test surface gradient = 18%

- Brake actuation force:
  Hand control ≤ 400 N.
  Foot control ≤ 500 N.

- For the first part of the test, park the vehicle on the test surface gradient facing up the slope by activating the brake system under the conditions specified above. If the vehicle remains stationary, start the measurement of time.

- On completion of the test with vehicle facing up, repeat the same test procedure with the vehicle facing down the gradient.

4.8.3 Performance requirements
When tested in accordance with test procedure 4.8.2, the parking brake system shall hold the vehicle stationary for 5 minutes in both forward and reverse directions on the gradient.

4.9 **ABS Tests**

4.9.1 General information:

- The tests are only applicable to the brake systems of categories 3-1 and 3-3 vehicles that are equipped with an Anti lock Brake System (ABS)

- The test series comprises the following individual tests, which may be carried out in any order:

ABS TESTS		SECTION
a.	Stops on a high friction surface - as used for tests in 4.3	4.9.3
b.	Stops on a low friction surface - ≤0.45	4.9.4
c.	Wheel lock checks on high and low friction surfaces.	4.9.5
d.	Wheel lock check - high to low friction surface transition.	4.9.6
e.	Wheel lock check - low to high friction surface transition.	4.9.7
f.	Stops with an ABS electrical failure.	4.9.8

4.9.2 Vehicle condition

- Unladen

- Engine disconnected

4.9.3 Stops on a high friction surface:

4.9.3.1 Test conditions and procedure

- Initial brake temperature : ≥55° C and ≤100° C

- Test speed: 60 km/h or 0.9 V max, whichever is lower.

- Brake application:
  Each brake control separately.

- Brake actuation force:
  Hand control = 200N ± 10%
  Foot control = 350N ± 10%
  These forces may be increased in order to ensure ABS cycling.

- Number of stops: until the vehicle meets the performance requirements, with a maximum of 6 stops.

- For each stop, accelerate the vehicle to the test speed and then activate the brake control under the conditions specified above.

4.9.3.2 Performance requirements

When the vehicle has been tested in accordance with the test procedures in 4.9.3.1, there shall be no wheel lock [and the stopping distance shall be as specified in column 2 or the MFDD shall be as specified in column 4 of the following table (based on [0.7] x the performance requirements specified in 4.3.3 – Dry Stop Test – single brake control activated)] :

Category	STOPPING DISTANCE (S) (Where V is the specified test speed in km/h and S is the required stopping distance in metres)	**OR**	MFDD
For single front brakes only:			
3-1	$S \leq 0.1\ V + V^2/64$		$\geq 2.4 m/s^2$
3-3	$S \leq 0.1\ V + V^2/81$		$\geq 3.1 m/s^2$
For single rear brakes only			
3-1	$S \leq 0.1\ V + V^2/49$		$\geq 1.9\ m/s^2$
3-3	$S \leq 0.1\ V + V^2/52$		$\geq 2.0 m/s^2$
For CBS:			
3-1	$S \leq 0.1\ V + V^2/81$		$\geq 3.1 m/s^2$
3-3	$S \leq 0.1\ V + V^2/93$		$\geq 3.6 m/s^2$

4.9.4 Stops on a low friction surface:

4.9.4.1 Test conditions and procedure

Repeat section 4.9.3.1 but using the low friction surface instead of the high friction one.

4.9.4.2 Performance requirements

When the vehicle has been tested in accordance with the test procedures in 4.9.4.1, there shall be no wheel lock and the vehicle wheels shall stay within the test lane.
Note: The measurement of stopping distance or MFDD is not required..

4.9.5 Wheel lock checks on high and low friction surfaces.

4.9.5.1 Test conditions and procedure

- Test surfaces:
  a. High friction
  b. Low friction

- Initial brake temperature : ≥55° C and ≤100° C

- Test speed: 80 km/h or 0.8 V max, whichever is lower.

- Brake application:
  a. Each brake control separately.
  b. Where ABS is fitted to both brake systems, both controls shall also be activated at the same moment.

- Brake actuation force:
  Hand control = 200N ± 10%
  Foot control = 350N ± 10%
  These forces may be increased in order to ensure ABS cycling.

- Brake application rate:
  The brake actuation force shall be applied in 0.2 – 0.5 seconds

- Number of stops: Maximum of 3 stops

- For each stop, accelerate the vehicle to the test speed and then activate the brake control under the conditions specified above. The brake control may be released and the test concluded when the vehicle speed has reduced by 20 km/h.

- Record wheel rotation.

4.9.5.2 Performance requirements

When the vehicle has been tested in accordance with the test procedures in 4.9.5.1, there shall be no wheel lock and the vehicle wheels shall stay within the test lane.

4.9.6 Wheel lock check - high to low friction surface transition.

4.9.6.1 Test conditions and procedure

- Test surfaces:
  A ~~length of~~ high friction surface immediately followed by a ~~length of~~ low friction surface.

- Initial brake temperature : ≥55° C and ≤100° C

- Test speed:
  The speed that will result in 50 km/h or 0.5 V max, whichever is the lower, at the point where the vehicle passes from the high friction to the low friction surface.

- Brake application:
  a. Each brake control separately.
  b. Where ABS is fitted to both brake systems, both controls shall also be activated at the same moment.

- Brake actuation force:
  Hand control = 200N ± 10%
  Foot control = 350N ± 10%
  These forces may be increased in order to ensure ABS cycling.

- Number of stops: Maximum of 3 stops

- For each stop, accelerate the vehicle to the test speed and then activate the brake control under the conditions specified above. The brake control may be released and the test concluded when the vehicle speed has reduced by 20 km/hr after crossing the surface transition point.

- ~~Record wheel rotation~~. *[Since no wheel lock is the required performance and wheel lock has been defined, there is no need to include this unless an explanation is provided in more detail as to what aspect of wheel rotation is recorded.]*

4.9.6.2 Performance requirements

When the vehicle has been tested in accordance with the test procedures in 4.9.6.1, there shall be no wheel lock and the vehicle wheels shall stay within the test lane.

4.9.7 Wheel lock check - low to high friction surface transition.

4.9.7.1 Test conditions and procedure

- Test surfaces:
  A ~~length of~~ low friction surface immediately followed by a ~~length of~~ high friction surface.
- Initial brake temperature : ≥55° C and ≤100° C

- Test speed:
  The speed that will result in 50 km/h or 0.5 V max, whichever is the lower, at at the point where the vehicle passes from the low friction to the high friction surface.

- Brake application:
  a. Each brake control separately.
  b. Where ABS is fitted to both brake systems, both controls shall also be activated at the same moment.

- Brake actuation force:
  Hand control = [200N ± 10%]
  Foot control = [350N ± 10%]
  These forces may be increased in order to promote ABS cycling.

- Number of stops: Maximum of 3 stops

- For each stop, accelerate the vehicle to the test speed and then activate the brake control under the conditions specified above.

- Record ~~wheel rotation, and~~ the vehicle's continuous deceleration.

4.9.7.2 Performance requirements

- When the vehicle has been tested in accordance with the test procedures in 4.9.7.1, there shall be no wheel lock and the vehicle wheels shall stay within the test lane.
- After passing over the transition point between low and high friction on the test surface, [the vehicle deceleration shall increase]. *[This requirement needs to be stated in more objective terms.]* If there is no objective test for this requirement, then we should remove this requirement. If that is the case then should we retain a low to high mu requirement at all.

4.9.8 Stops with an ABS electrical failure.

4.9.8.1 Test conditions and procedure

- Carry out the test in section 4.3 (Dry stop test – with single brake control activated) applying the conditions relevant to the brake system and vehicle being tested.

4.9.8.2 Performance requirements

When the brakes have been tested in accordance with test procedure 4.9.8.1, the minimum requirements for stopping distance or MFDD shall be as specified in the **single rear brakes only** section of the table in section 4.3.3.

4.10 **Partial failure test – for split service brake systems**

4.10.1 General information:

- Test is only applicable to vehicles that are equipped with split service brake systems.

- Test is to confirm the performance of the remaining sub system in the event of a hydraulic system leakage failure.

4.10.2 Vehicle condition

- Unladen

- Engine disconnected

4.10.3 Test conditions and procedure

- Initial brake temperature: ≥55° C and ≤100° C

- Test speeds: 50 km/h and 100 km/h or 0.8 V max, whichever is lower.

- Minimum test speed = 25 km/h

- Brake actuation force:

Hand control ≤ 250N

Foot control ≤ 400N

- Number of stops: until the vehicle meets the performance requirements, with a maximum of 6 tests.

- The service brake system must be altered to induce a complete loss of braking in any one subsystem. Then, for each stop, accelerate the vehicle to the test speed and then apply the brakes under the conditions specified above. Repeat for each subsystem.

4.10.4 Performance requirements

When the brakes have been tested in accordance with the test procedure in section 4.10.3:

- the system shall comply with the failure warning requirements of 3.1.6 and
- Stopping distance (S) shall be $\leq 0.1\ V + V^2\ /85$
  (where V is the specified test speed in km/h and S is the required stopping distance in metres)
  or the MFDD shall be $\geq 3.3 m/s^2$

4.11 **Servo Failure Test**

4.11.1 General information:

- Test is not required when the vehicle is equipped with another separate service brake system.

- Test is to confirm the performance of the brake system in the event of failure of servo assistance.

4.11.2 Test conditions and procedure

- Carry out the test in section 4.3 (Dry Stop Test – with single brake control activated), if required, for each brake system with the servo disabled.

4.11.3 Performance requirements

- When the brakes have been tested in accordance with test procedure 4.11.2: Stopping distance (S) shall be $\leq 0.1\ V + V^2/65$
  (where V is the specified test speed in km/h and S is the corrected stopping distance in metres)
  or the MFDD shall be [$\geq 2.5 m/s^2$]

- Note that if the servo is activated by more than one control, the above performance shall be achieved for each control applied separately.

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