

## MOTORCYCLE BRAKES GTR.

**PROPOSAL FOR NEXT VERSION BY INCLUDING COMMENTS RECEIVED ETC.**  
**Dated Sept. 30th**  
**FOR DISCUSSION AT 5/MCGTR INFORMAL MEETING**

Where text is coloured, these are comments from:

India

Japan

TC

US – Informal document GRRF-58-24

Blue = General editing

CURRENT TEXT (1ST FINAL DRAFT)	PROPOSAL FOR NEXT VERSION	ISSUES + NOTES	JPN COMMENTS FOR 2ND FINAL DRAFT																		
<p>MOTORCYCLE BRAKES GTR</p> <p><u>1<sup>st</sup> FINAL DRAFT – Prepared by the informal GTR Group</u></p> <p>1. SCOPE</p> <p>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:</p> <table><tr><th>CATEGORY</th><th>DESCRIPTION</th></tr><tr><td>3-1</td><td>2 wheels, engine &lt; 50cc and max speed &lt; 50 km/h</td></tr><tr><td>3-2</td><td>3 wheels, engine &lt; 50cc and max speed &lt; 50 km/h</td></tr><tr><td>3-3</td><td>2 wheels, engine &gt; 50 cc or max speed &gt; 50 km/h</td></tr></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	<p>MOTORCYCLE BRAKES GTR</p> <p><u>2<sup>nd</sup> FINAL DRAFT – Prepared by the informal GTR Group - Dated 05 – 09 – 30</u></p> <p>1. SCOPE</p> <p>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:</p> <table><tr><th>CATEGORY</th><th>DESCRIPTION</th></tr><tr><td>3-1</td><td>2 wheels, engine ≤ 50cc and max speed ≤ 50 km/h</td></tr><tr><td>3-2</td><td>3 wheels, engine ≤ 50cc and max speed ≤ 50 km/h</td></tr><tr><td>3-3</td><td>2 wheels, engine ≥ 50 cc or max speed ≥ 50 km/h</td></tr><tr><td>3-4</td><td>3 wheels – symmetrical, engine ≥ 50 cc or max speed ≥ 50 km/h</td></tr></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	<p>Check “Description” against SR1</p>	<p>- Change to”cm<sup>3</sup>” from “cc”</p> <p>- Delete “=” for vehicle categories 3-3,3-4 and 3-5</p>
CATEGORY	DESCRIPTION																				
3-1	2 wheels, engine < 50cc and max speed < 50 km/h																				
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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)	Revise “Description” to include electric power.	“- the categories include vehicles with electric power. In this case, vehicles are classified into each category by the max speed.”
3-5	3 wheels – asymmetric, engine > 50 cc or max speed > 50 km/h (motorcycle + sidecar)				
<p>Notes:</p> <ul style="list-style-type: none"><li>- the categories include vehicles with electric power.</li><li>- the categories do not include:<ul style="list-style-type: none"><li>a. vehicles with a V max. of &lt; 25 km/h</li><li>b. vehicles equipped for disabled drivers</li></ul></li></ul>		<p>Notes:</p> <ul style="list-style-type: none"><li>- the categories include vehicles with electric power.</li><li>- the categories do not include:<ul style="list-style-type: none"><li>a. vehicles with a V max. of &lt; 25 km/h</li><li>b. vehicles equipped for disabled drivers</li></ul></li></ul>			
2. DEFINITIONS		2. DEFINITIONS			
<p><i>ABS (Antilock Brake System)</i> 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.]</p> <p><i>Baseline test</i> 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.</p> <p><i>Brake</i> means the parts of the brake system in which the forces opposing the movement of the vehicle are developed. (per ISO 8710)</p> <p><i>Brake system</i> 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.</p> <p>The system consists of the Control, the Transmission, and the Brake.</p> <p><i>Combined Brakes System (CBS)</i> means: For category 3-1 &amp; 3-2: a brake system where at least two brakes on different axles are actuated by the operation of a single control. For category 3-2 &amp; 3-4 a brake system where the brakes</p>		<p><i>ABS (Antilock Brake System)</i> 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.]</p> <p><i>Baseline test</i> 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.</p> <p><i>Brake</i> means the parts of the brake system in which the forces opposing the movement of the vehicle are developed. (per ISO 8710)</p> <p><i>Brake system</i> 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.</p> <p>The system consists of the Control, the Transmission, and the Brake.</p> <p><i>Combined Brakes System (CBS)</i> means: For category 3-1 &amp; 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 &amp; 3-4 a brake system where the brakes on all axles are actuated by the operation of a single</p>		IMMA to confirm this ABS definition.	

<p>on all axles are actuated by the operation of a single control.</p> <p>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.)</p> <p><i>Control</i> means the part actuated directly by the rider in order to supply the energy to the transmission required for braking the vehicle.</p> <p><i>Controller</i> means the component designed to evaluate and operate on data transmitted by a sensor and transmit signals to the modulator</p> <p><i>Engine disconnected</i> means when the engine is no longer connected to the driving wheels.</p> <p><i>Initial Brake Temperature</i> means the temperature of the hottest brake 0.32 km. before any brake application.</p> <p><i>Laden</i> 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 shall be less than or equal to the sum of the maximum axles’ (group of axles) capacity.</p> <p><i>Modulator</i> means component designed to vary braking force in accordance with the signal received from the controller</p> <p><i>PFC (Peak Friction Coefficient)</i> means the friction of the test surface, measured in accordance with the method specified in national legislation.</p> <p><i>Sensor</i> 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.</p> <p><i>Single brake system</i> means a brake system which acts on only one axle.</p> <p><i>Split service braking system</i> means a brake system consisting of two or more subsystems actuated by a</p>	<p>control.</p> <p>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.)</p> <p><i>Control</i> means the part actuated directly by the rider in order to supply the energy to the transmission required for braking the vehicle.</p> <p><i>Controller</i> means the component designed to evaluate and operate on data transmitted by a sensor and transmit signals to the modulator</p> <p><i>Driver mass</i> means the nominal mass of a driver that shall be 75 kg (subdivided into 68 kg occupant mass at the seat and 7 kg luggage mass.</p> <p><i>Engine disconnected</i> means when the engine is no longer connected to the driving wheels.</p> <p><i>Initial Brake Temperature</i> means the temperature of the hottest brake <del>0.32 km.</del> before any brake application.</p> <p><i>Laden</i> means the “gross vehicle mass” <del>(as defined in SR1),</del> which is the maximum mass of the fully laden solo vehicle based on its construction and design performances, as declared by the manufacturer. <i>This shall be less than or equal to the sum of the maximum axles’ (group of axles) capacity.</i></p> <p><del><i>Unladen</i> means the</del>  <i>Mass in running order, (as defined in SR1) is the nominal mass of the vehicle as determined by the following criteria:</i>  Sum of unladen vehicle mass and driver’s mass.  The mass of any test equipment including outriggers, if fitted, <i>is included in ? is added to the unladen mass.</i></p> <p><i>Modulator</i> means the component designed to vary braking force in accordance with the signal received from the controller</p> <p><i>Power assisted braking system</i> means a braking</p>	<p>Proposal from IMMA – taken from ISO 2416.</p> <p>Explain more clearly avoiding the word “shall” in a definition.</p> <p>Title and definition to be agreed at 5/GTR and then edited throughout the GTR.</p> <p>Text proposed by IMMA NB. <i>Driver mass</i> definition added. Specify a value? 75 kg.?</p>	<p>“The mass of any test equipment <del>including</del> <i>excluding</i> outriggers, if fitted, <del>is included in ? is added to the unladen mass.</del>”</p>
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<p>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.</p> <p><i>Stopping distance</i> 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.</p> <p><i>Test speed</i> is the vehicle speed measured at the moment the rider begins to actuate brake system control(s)</p> <p><i>Transmission</i> means the combination of components that provide the functional link between the control and the brake.</p> <p><i>Unladen</i> 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 included, their mass being equal to, and incorporated in the same way as, that of the driver. The weight of test equipment including outriggers, if fitted, will be included in the unladen weight.</p> <p><i>Vmax</i> 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.</p> <p><i>Wheel lock</i> 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)</p>	<p><b>system in which the energy necessary to produce the braking force is supplied by the physical effort of the driver assisted by one or more energy supplying devices, for example vacuum assisted (with vacuum booster)</b></p> <p><i>Peak Friction Coefficient (PFC)</i> means the friction of the test surface, measured in accordance with the method specified in national legislation.</p> <p><i>Secondary brake system</i> means the second (?service) brake system on a vehicle equipped with a combined brake system, which is not the combined brake system.</p> <p><i>Sensor</i> means a component designed to identify the condition of rotation of the wheel(s) or other dynamic conditions of the vehicle and transmit them to the controller.</p> <p><i>Service brake system</i> means the brake systems which are used for slowing the vehicle when in motion.</p> <p><i>Single brake system</i> means a brake system which acts on only one axle.</p> <p><i>Split service braking system</i> 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.</p> <p><i>Stopping distance</i> means the distance travelled by the vehicle from the point of application of the control to the point at which the vehicle reaches a full stop.</p> <p><i>Test speed</i> means the vehicle speed measured at the moment of application of the brake control(s)</p> <p><i>Transmission</i> means the combination of components that provide the functional link between the control and the brake.</p>	<p>Replaces “Servo” in current version of GTR. No apparent definition of “Servo” Taken from ISO 611</p> <p>Proposal from IMMA.</p> <p>Proposal from IMMA</p> <p>Proposal from IMMA</p>	<p>(This definition should be discussed at 5/GTR meeting.)</p> <p>(This definition should also be discussed in conjunction with the definition of 2ndary brake system.)</p>
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<p>3. GENERAL REQUIREMENTS</p> <p>3.1 Brake system requirements</p> <p>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.</p> <p>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.</p> <p>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:</p> <ol style="list-style-type: none"> <li>two separate service brake systems which, when applied together, actuate the brakes on all wheels, or</li> <li>a service brake system that operates on all wheels and a secondary brake system which may be the parking brake, or</li> <li>a split braking system which actuates</li> </ol>	<p><i>V<sub>max</sub></i> 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. <del>The vehicle manufacturer may supply this information.</del></p> <p><i>Wheel lock</i> means the condition that occurs when there is a slip ratio of 1.00.</p> <p>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)</p> <p>3. GENERAL REQUIREMENTS</p> <p>3.1 Brake system requirements</p> <p>3.1.1 – 2-wheeled vehicles (category 3-1 and 3-3) shall be equipped with <del>either</del> 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.</p> <p>3.1.2 - Category 3-5 vehicles shall <del>meet the same</del> brake system requirements as outlined in 3.1.1 above. A brake on the sidecar wheel is <b>not required</b> providing the vehicle meets the prescribed performance requirements <del>prescribed outlined</del> in section 4 of this GTR.</p> <p>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 system options:</p> <ol style="list-style-type: none"> <li>two separate service brake systems which, when applied together, actuate the brakes on all wheels, or</li> <li>a service brake system that <del>operates</del> <b>actuates</b> on all wheels and a secondary brake system which may be the parking brake, or</li> <li>a split <b>service</b> braking system which actuates the brakes on all wheels, actuated through a single control.</li> </ol>	<p>GRRF – Germany request that all wheels should be braked due to potential instability problems. Discuss at 5/GTR</p> <p>GRRF – Denmark noted that the original L5 in R78 specified only 1 control. The current specification follows the request from TC/NHTSA.</p>	
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<p>the brakes on all wheels, actuated through a single control.</p> <p>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.</p> <p>3.1.5 – For vehicles with a hydraulic transmission, the master cylinder shall:</p> <ul style="list-style-type: none"> <li>- have a separate reservoir for each brake system, with its own cover, seal and retention.</li> <li>- 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.</li> <li>- have a reservoir where the fluid level is easily visible for checking without removal of the cover.</li> </ul> <p>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:</p> <ul style="list-style-type: none"> <li>- if there is a hydraulic failure when <math>\leq 90</math> N. max control force is applied</li> <li>- 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 <math>\leq 0.5</math> of the fluid reservoir capacity, whichever is the greater.</li> </ul> <p>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.</p> <p>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.</p> <p>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.</p>	<p>3.1.4 – Where two separate service brake systems are installed, there may be a common <b>brake, provided</b> failure in one system does not affect the performance <b>of</b> the other.</p> <p>3.1.5 – For vehicles with a hydraulic transmission, the master cylinder shall:</p> <ul style="list-style-type: none"> <li>- have a separate reservoir for each brake system, with its own cover, seal and retention.</li> <li>- have a minimum reservoir capacity equivalent to 1.5 times the total fluid displacement required to satisfy the condition of new to fully worn linings with the worst case brake adjustment.</li> <li>- have a reservoir where the fluid level is easily visible for checking without removal of the cover.</li> </ul> <p>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:</p> <ul style="list-style-type: none"> <li>- if there is a hydraulic failure when a <b>maximum control force <math>\leq 90</math> N is applied</b></li> <li>- 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 <math>\leq 0.5</math> of the fluid reservoir capacity, whichever is the greater.</li> </ul> <p>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 <b>whenever the ignition switch is in the “on” position.</b></p> <p>3.1.7 – Vehicles that are equipped with an ABS system shall be fitted with an <del>amber</del> <b>yellow</b> 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.</p> <p>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.</p> <p>3.1.8 – Brake friction material shall not contain asbestos.</p>	<p>GRRF – EU comment re inclusion of other dangerous substances</p> <p><b>- USA question whether this</b></p>	<p>“- have a separate reservoir for each brake system, <del>with its own cover, seal and retention.</del>” (The requirement for each component is not necessary)</p> <p>Delete either “maximum” or “&lt;”</p> <p>“- 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 <b>falls</b> to <math>\leq 0.5</math> of the fluid reservoir capacity, whichever is the greater.”</p> <p>“.... The lamp shall be activated whenever there is an <b>electrical</b> malfunction that affects the generation or transmission of response or control signals in the vehicle's ABS system. ....”</p>
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<p>3.1.8 – Brake friction material shall not contain asbestos.</p> <p><b>3.2 Brake system, general operation</b></p> <p>3.2.1 Service brake system The service brake system shall progressively reduce the speed of the moving vehicle, bring it to a halt, and keep it stationary. The rider shall achieve this whilst seated in the normal driving position and with both hands on the steering control.</p> <p>3.2.2 Secondary brake system Where a secondary brake system is fitted, it shall progressively reduce the speed of the moving vehicle to a halt in the event of a failure of the service brake system. The rider shall achieve this whilst seated in the normal driving position and with at least one hand on the steering control.</p> <p>3.2.3 Parking brake system Where a parking brake system is fitted, it must hold the vehicle stationary on the prescribed slope. The parking brake shall:</p> <ol style="list-style-type: none"> <li>have a control which is separate from the service brake controls and</li> <li>be held in the locked position by solely mechanical means.</li> </ol> <p>The rider shall be able to operate the parking brake whilst seated in the normal driving position.</p> <p><b>3.3 Durability</b></p> <p>3.3.1 - The brake system shall take account of friction material wear automatically or by manual means.</p> <p>3.3.2 - The friction material thickness shall be visible without disassembly, but for drum brakes, where the</p>	<p>3.1.9 – Each vehicle must meet each of the tests specified for that vehicle category and for those brake features on the vehicle.</p> <p><b>3.2 Brake system, general operation</b></p> <p>3.2.1 Service brake system The service brake system shall be capable of progressively reducing the speed of the moving vehicle, bringing it to a halt, and keeping it stationary. 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.</p> <p><del>3.2.2 Secondary brake system Where a secondary brake system is fitted, it shall progressively reduce the speed of the moving vehicle to a halt in the event of a failure of the service brake system. The rider shall achieve this whilst seated in the normal driving position and with at least one hand on the steering control.</del></p> <p>3.2.2 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:</p> <ol style="list-style-type: none"> <li>have a control which is separate from the service brake controls and</li> <li>be held in the locked position by solely mechanical means.</li> </ol> <p>Vehicles shall have configurations that enable a rider to be able to operate the parking brake whilst seated in the normal driving position.</p> <p><b>3.3 Durability</b></p> <p>3.3.1 – Wear of the service brakes shall be compensated for by means of a system of automatic or manual adjustment.</p> <p>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</p>	<p>requirement should be included as there is no test procedure. Environmental issue not transport.</p> <p>Put the onus on the vehicle, not the rider</p> <p>IMMA proposal. This section moved to Definitions.</p>	<p>This part is necessary. (The text should be re-considered at 5/GTR meeting.)</p>
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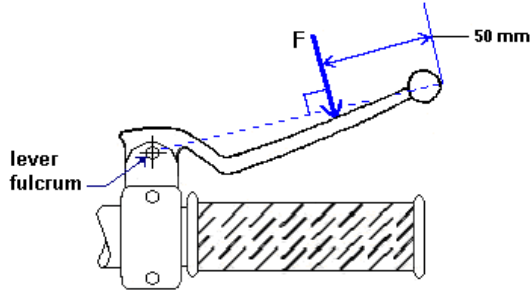
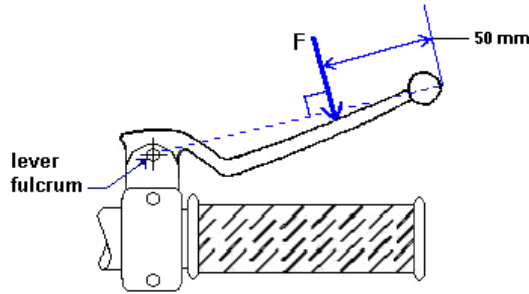


<p>friction material is not visible, wear shall be assessed by means of a device designed for that purpose.</p> <p>3.3.3 - During the tests and on their completion, there shall be no lining detachment and no leakage of brake fluid.</p> <p><b>3.4 Measurement of Dynamic performance</b></p> <p>The method 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:</p> <p><u>3.4.1: MFDD (Mean Fully Developed Deceleration)</u></p> <p>Calculation of MFDD :</p> $d_m = \frac{V_b^2 - V_e^2}{25.92 (S_e - S_b)}$ <p>Where :</p> <p><math>d_m</math> = mean fully developed deceleration  <math>V_1</math> = vehicle speed when rider actuates control  <math>V_b</math> = vehicle speed at 0.8 <math>V_1</math> in km/h  <math>V_e</math> = vehicle speed at 0.1 <math>V_1</math> in km/h  <math>S_b</math> = distance traveled between <math>V_1</math> and <math>V_b</math> in metres  <math>S_e</math> = distance traveled between <math>V_1</math> and <math>V_e</math> in metres</p> <p><u>3.4.2: Stopping distance:</u></p> <p>Based on the basic equations of motion:  <math>S = 0.1 V + (X) V^2</math>  Where:  <math>S</math> = stopping distance in metres  <math>V</math> = vehicle speed in km/h  <math>X</math> = a variable based on the requirement for each test</p> <p>To calculate the corrected Stopping distance using the actual vehicle test speed, the following formula is used:</p> $S_s = 0.1 V_s + (S_a - 0.1 V_a) \times V_s^2 / V_a^2$ <p>Where:</p>	<p>means of a device designed for that purpose.</p> <p>3.3.3 - During the tests and on their completion, there shall be no lining detachment and no leakage of brake fluid.</p> <p><b>3.4 Measurement of Dynamic performance</b></p> <p>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:</p> <p><u>3.4.1: MFDD (Mean Fully Developed Deceleration)</u></p> <p>Calculation of MFDD :</p> $d_m = \frac{V_b^2 - V_e^2}{25.92 (S_e - S_b)}$ <p>Where :</p> <p><math>d_m</math> = mean fully developed deceleration  <math>V_1</math> = vehicle speed when rider actuates control  <math>V_b</math> = vehicle speed at 0.8 <math>V_1</math> in km/h  <math>V_e</math> = vehicle speed at 0.1 <math>V_1</math> in km/h  <math>S_b</math> = distance traveled between <math>V_1</math> and <math>V_b</math> in metres  <math>S_e</math> = distance traveled between <math>V_1</math> and <math>V_e</math> in metres</p> <p><u>3.4.2: Stopping distance:</u></p> <p>Based on the basic equations of motion:  <math>S = 0.1 V + (X) V^2</math>  Where:  <math>S</math> = stopping distance in metres  <math>V</math> = vehicle speed in km/h  <math>X</math> = a variable based on the requirement for each test</p> <p>To calculate the corrected Stopping distance using the actual vehicle test speed, the following formula is used:</p> $S_s = 0.1 V_s + (S_a - 0.1 V_a) \times V_s^2 / V_a^2$ <p>Where:</p>	<p>Confirm equation and concept at 5/GTR</p>	<p>Word "friction material" might be more appropriate than "lining"</p> <p>"The corrected stopping distance <math>S_s</math> shall be used as the required stopping distance <math>S</math>. To calculate the corrected Stopping distance using the actual vehicle test speed, the</p>
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<p>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</p> <p>Note: This equation is only valid when the actual test speed (Va) is within <math>\pm 5</math> km/h of the specified test speed (Vs)</p> <p><u>3.4.3 Continuous Deceleration Recording:</u></p> <p>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.</p> <p>4. TEST CONDITIONS, PROCEDURES AND PERFORMANCE REQUIREMENTS.</p> <p><b>4.1 General</b></p> <p>4.1.1 Test surfaces:</p> <p>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 <math>\leq 1\%</math>  The surface shall have a nominal peak friction coefficient (PFC) of [0.9 or less], unless otherwise specified.</p> <p>4.1.1.2 Low friction ABS tests:  Vehicles with ABS shall also be tested on a surface with a peak friction coefficient of <math>\leq 0.45</math>.</p> <p>4.1.1.3 Parking brake tests:  The test area shall have a clean, dry and solid surface with the specified slope.</p> <p>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.</p>	<p>Sa = actual stopping distance in metres  Va = actual vehicle test speed in km/h</p> <p>Note: This equation is only valid when the actual test speed (Va) is within <math>\pm 5</math> km/h of the specified test speed (Vs)</p> <p><u>3.4.3 Continuous Deceleration Recording:</u></p> <p>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.</p> <p>4. TEST CONDITIONS, PROCEDURES AND PERFORMANCE REQUIREMENTS.</p> <p><b>4.1 General</b></p> <p>4.1.1 Test surfaces:</p> <p>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 <math>\leq 1\%</math>  The surface shall have a nominal peak friction coefficient (PFC) of <b>0.9 or less</b>, unless otherwise specified.</p> <p>4.1.1.2 Low friction ABS tests:  Vehicles with ABS shall also be tested on a surface with a peak friction coefficient of <math>\leq 0.45</math>.</p> <p>4.1.1.3 Parking brake tests:  The test area shall have a clean, dry and solid surface with the specified slope.</p> <p>4.1.1.4 <b>Test</b> lane width:  For a 2 wheeled vehicles (category 3-1 and 3-3) the <b>test</b> lane width shall be 2.5 m.  For a 3 wheeled vehicles (category 3-2, 3-4 and 3-5) the <b>test</b> lane width shall be 2.5 m + the vehicle width.</p> <p>4.1.2 Ambient temperature:  The ambient temperature shall be between 4° C and <b>38</b></p>	<p><b>GTR Group to discuss test speed tolerances:  With self certification, maker tests at &gt; specified speed and authority checks at &lt; specified speed. Stopping distance requirement based on specified speed.  JSS specifies <math>\pm 5</math> km/h for all speeds.  No tolerance in ECE.</b></p> <p>Text is too broad. Needs tolerance (0.85 – 0.9) and note low friction also.  Confirm text.</p>	<p>following formula is used:”</p> <p>“<del>Vehicles with ABS shall also be tested on a surface with a peak friction coefficient of <math>\leq 0.45</math>.</del>  The test area shall have a clean and level surface, with a gradient <math>\leq 1\%</math>. The surface shall have a nominal peak friction coefficient (PFC) of <math>\leq 0.45</math> unless otherwise specified.”</p>
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<p>4.1.2 Ambient temperature: The ambient temperature shall be between 4° C and 38° C.</p> <p>4.1.3 Wind speed: The wind speed shall be not more than 5 m/s</p> <p>[4.1.4 Tolerances: Unless otherwise specified, a general tolerance of ± 10% shall be applied to all test parameters.]</p> <p>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.</p> <p>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.</p> <p>4.1.7 Test sequence</p> <table><tr><th>TEST ORDER</th><th>SECTION</th></tr><tr><td>1. Dry Stop - single brake control activated</td><td>4.3</td></tr><tr><td>2. Dry Stop – all service brake controls activated</td><td>4.4</td></tr><tr><td>3. High Speed</td><td>4.5</td></tr><tr><td>4. Wet Brake</td><td>4.6</td></tr><tr><td>5. Heat Fade (1)</td><td>4.7</td></tr><tr><td><b>6. If fitted:</b></td><td></td></tr><tr><td>6.1 Parking Brake</td><td>4.8</td></tr><tr><td>6.2 ABS</td><td>4.9</td></tr><tr><td>6.3 Partial failure, for split brake systems</td><td>4.10</td></tr><tr><td>6.4 Servo failure</td><td>4.11</td></tr></table> <p>Note (1): Heat Fade shall always be the last test carried out</p>	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	<b>6. If fitted:</b>		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	<p>45° C.</p> <p>4.1.3 Wind speed: The wind speed shall be not more than 5 m/s</p> <p>[4.1.4 Tolerances: Unless otherwise specified, a general tolerance of ± 10% shall be applied to all test parameters.]</p> <p>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.</p> <p>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.</p> <p>4.1.7 Test sequence</p> <table><tr><th>TEST ORDER</th><th>SECTION</th></tr><tr><td>1. Dry Stop – all service brake controls activated</td><td>4.4</td></tr><tr><td>2. High Speed</td><td>4.5</td></tr><tr><td>3. ABS <b>If fitted</b></td><td>4.9</td></tr><tr><td>4. Dry Stop - single brake control activated</td><td>4.3</td></tr><tr><td>5. Parking Brake <b>If fitted</b></td><td>4.8</td></tr><tr><td>6. Partial failure, for split brake systems <b>If fitted</b></td><td>4.10</td></tr><tr><td>7. <b>Power-assisted braking system</b> failure <b>If fitted</b></td><td>4.11</td></tr><tr><td>7. Wet Brake</td><td>4.6</td></tr><tr><td>8. Heat Fade (1)</td><td>4.7</td></tr></table> <p>Note (1): Heat Fade shall always be the last test carried out</p> <p><b>4.2 Preparation</b></p>	TEST ORDER	SECTION	1. Dry Stop – all service brake controls activated	4.4	2. High Speed	4.5	3. ABS <b>If fitted</b>	4.9	4. Dry Stop - single brake control activated	4.3	5. Parking Brake <b>If fitted</b>	4.8	6. Partial failure, for split brake systems <b>If fitted</b>	4.10	7. <b>Power-assisted braking system</b> failure <b>If fitted</b>	4.11	7. Wet Brake	4.6	8. Heat Fade (1)	4.7	<p>Include this paragraph? See section 3.4.2 etc..</p> <p>This new test order was proposed by USMMA in order to simplify vehicle loading/unloading.</p> <p>Text will be reordered and renumbered after 5/GTR meeting. Keep as is for now to ease comparison.</p>	<p>If the tolerances are necessary, they should be specified for individual item, not in General part.</p> <p>The newly proposed test order is not practical. Test order should be kept as in the 1st final draft.</p>
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																																												
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8. Heat Fade (1)	4.7																																												

<p><b>4.2 Preparation</b></p> <p>4.2.1 Engine idle speed: Engine idle speed shall be set to the manufacturer's specification.</p> <p>4.2.2 Tyre pressures: Tyres shall be inflated to the manufacturer's specification for the vehicle loading condition.</p> <p>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).</p> <p>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.</p>  <p>For the foot control pedal, the input force shall be applied to the centre of the pedal and at right angles to the pedal.</p> <p>4.2.4 Brake temperature measurement: The brake temperature shall be measured on the</p>	<p>4.2.1 Engine idle speed: The engine idle speed shall be set to the manufacturer's specification.</p> <p>4.2.2 Tyre pressures: The tyres shall be inflated to the manufacturer's specification for the vehicle loading condition.</p> <p>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).</p> <p>The input force application point 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.</p>  <p>For the foot control pedal, the input force shall be applied to the centre of the pedal and at right angles to the pedal.</p> <p>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:</p>		
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<p>approximate centre of the braking path of the disc or drum using:</p> <ul style="list-style-type: none"> <li>a. a rubbing thermocouple that is in contact with the surface of the disc or drum or</li> <li>b. a thermocouple that is embedded in the friction material</li> </ul> <p>Contracting parties may specify which method is acceptable to establish conformity to the requirements.</p> <p>4.2.5 Burnishing procedure: The manufacture may supply the vehicle for testing with the brakes burnished or the following procedure shall be used:</p> <ul style="list-style-type: none"> <li>- Vehicle unladen.</li> <li>- Engine disconnected</li> <li>- Test speed: Initial speed <math>\geq 50</math> km/h Final speed 5 to 10 km/h</li> <li>- Brake application: Each brake control applied separately.</li> <li>- Vehicle deceleration: Front wheel braking only = <math>3.0\text{--}3.5 \text{ m/s}^2</math> Rear wheel braking only = <math>1.5\text{--}2.0 \text{ m/s}^2</math> Combined Brake System or split service brake system = <math>3.5\text{--}4.0 \text{ m/s}^2</math></li> <li>- Number of decelerations: 100 per brake system</li> <li>- Initial brake temperature before each brake application <math>\leq 100^\circ \text{C}</math>.</li> <li>- For the first stop, accelerate the vehicle to the</li> </ul>	<ul style="list-style-type: none"> <li>a. a rubbing thermocouple that is in contact with the surface of the disc or drum or</li> <li>b. a thermocouple that is embedded in the friction material</li> </ul> <p>Contracting parties may specify which method is acceptable to establish conformity with the requirements.</p> <p>4.2.5 Burnishing procedure: <del>The manufacturer may supply the vehicle for testing with the brakes burnished or</del> the following procedure shall be used:</p> <ul style="list-style-type: none"> <li>- Vehicle unladen.</li> <li>- Engine disconnected</li> <li>- Test speed: Initial speed <math>\geq 50</math> km/h for category 3-3, 3-4, 3-5 <math>\geq 0.7 V_{\text{max}}</math>, for category 3-1, 3-2 Final speed 5 to 10 km/h</li> <li>- Brake application: Each brake control applied separately.</li> <li>- Vehicle deceleration: Front wheel braking only : <math>3.0\text{--}3.5 \text{ m/s}^2</math> for Category 3-3, 3-4, 3-5 <math>1.5\text{--}2.0 \text{ m/s}^2</math> for Category 3-1, 3-2 Rear wheel braking only: <math>1.5\text{--}2.0 \text{ m/s}^2</math> CBS or split service brake system: <math>3.5\text{--}4.0 \text{ m/s}^2</math></li> <li>- Number of decelerations: 100 per brake system</li> <li>- Initial brake temperature before each brake application <math>\leq 100^\circ \text{C}</math>.</li> </ul>	<p>USA proposal. Does not work under self certification.</p> <p>What about eg. 3-3 vehicles with <math>V_{\text{max}}</math> 52 km/h? <math>0.7 V_{\text{max}}</math> is slow but is in line with repeated stops as in Fade test. Should it be <math>0.9 V_{\text{max}}</math> ?</p> <p>Proposals from India in consideration of mopeds.</p>	<p>“The following procedure shall be used. However, if certification system permits, the manufacturer may supply the vehicle for testing with the brakes burnished by equivalent procedure.”</p> <p>“Initial speed <math>\geq 50</math> km/h for category 3-3, 3-4, 3-5 <math>\geq 0.7 V_{\text{max}}</math>, for category 3-1, 3-2 .....”</p>
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<p>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.</p> <p><b>4.3 Dry Stop Test – single brake control activated</b></p> <p>4.3.1 Vehicle condition.</p> <ul style="list-style-type: none"> <li>- Laden For vehicles fitted with CBS: also unladen</li> <li>- Engine disconnected</li> </ul> <p>4.3.2 Test conditions and procedure</p> <ul style="list-style-type: none"> <li>- Initial brake temperature: <math>\geq 55^{\circ}\text{C}</math> and <math>\leq 100^{\circ}\text{C}</math></li> <li>- Test speed : Category 3-1 &amp; 3-2 vehicles: 40 km/h or 0.9 V max, whichever is the lower Category 3-3, 3-4 &amp; 3-5 vehicles: 60 km/h or 0.9 V max, whichever is the lower</li> <li>- Brake application: Each brake control separately.</li> <li>- Brake actuation force: Hand control <math>\leq 200\text{N}</math> Foot control <math>\leq 350\text{N}</math> for 3-1, 3-2, 3-3, 3-5 vehicles <math>\leq 500\text{N}</math> for 3-4 vehicles</li> </ul>	<p>- For the first stop, accelerate the vehicle to the <b>initial</b> speed and then activate the brake control under the conditions specified above <b>until the final speed is reached</b>. 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 <b>this procedure</b> for the number of specified decelerations.</p> <p><b>4.3 Dry Stop Test – single brake control activated</b></p> <p>4.3.1 Vehicle condition.</p> <ul style="list-style-type: none"> <li>- <b>The test is applicable to all vehicle categories.</b></li> <li>- Laden For vehicles fitted with CBS: also unladen</li> <li>- Engine disconnected</li> </ul> <p>4.3.2 Test conditions and procedure</p> <ul style="list-style-type: none"> <li>- Initial brake temperature: <math>\geq 55^{\circ}\text{C}</math> and <math>\leq 100^{\circ}\text{C}</math></li> <li>- Test speed : Category 3-1 &amp; 3-2 vehicles: 40 km/h or 0.9 V max, whichever is the lower Category 3-3, 3-4 &amp; 3-5 vehicles: 60 km/h or 0.9 V max, whichever is the lower</li> <li>- Brake application: Each brake control separately.</li> <li>- Brake actuation force: Hand control: <math>\leq 200\text{N}</math> Foot control: <math>\leq 350\text{N}</math> for <b>category</b> 3-1, 3-2, 3-3, 3-5 vehicles <math>\leq 500\text{N}</math> for <b>category</b> 3-4 vehicles</li> </ul>		<p>“For vehicles fitted with CBS: <b>mass in running order condition shall be tested in addition to laden condition.</b>” (“also unladen” may causes misleading)</p>
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<ul style="list-style-type: none"> <li>- Number of stops : until the vehicle meets the performance requirements, with a maximum of 6 stops</li> <li>- For each stop, accelerate the vehicle to the test speed and then activate the brake control under the conditions specified above</li> </ul> <p>4.3.3 Performance requirements</p> <p>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:</p>				<ul style="list-style-type: none"> <li>- Number of stops : until the vehicle meets the performance requirements, with a maximum of 6 stops</li> <li>- For each stop, accelerate the vehicle to the test speed and then activate the brake control under the conditions specified above</li> </ul> <p>4.3.3 Performance requirements</p> <p>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:</p>											
Category	STOPPING DISTANCE (S) (Where V is the specified test speed in km/h and S is the required stopping distance in metres)	O R	MFDD	Category	STOPPING DISTANCE (S) (Where V is the specified test speed in km/h and S is the required stopping distance in metres)	O R	MFDD	Category	STOPPING DISTANCE (S) (Where V is the specified test speed in km/h and S is the required stopping distance in metres)	O R	MFDD	Category	STOPPING DISTANCE (S) (Where V is the specified test speed in km/h and S is the required stopping distance in metres)	O R	MFDD
<b>Single front brakes only:</b>				<b>Single front brakes only:</b>				<b>Single rear brakes only</b>				<b>Vehicles with CBS or Split Service Brake Systems : laden and unladen</b>			
3-1	$S \leq 0.1 V + V^2/90$		$\geq 3.4\text{m/s}^2$	3-1	$S \leq 0.1 V + V^2/90$		$\geq 3.4\text{m/s}^2$	3-1	$S \leq 0.1 V + V^2/70$		$\geq 2.7 \text{ m/s}^2$	3-1 + 3-2	$S \leq 0.1 V + V^2 /115$		$\geq 4.4\text{m/s}^2$
3-2	$S \leq 0.1 V + V^2/70$		$\geq 2.7\text{m/s}^2$	3-2	$S \leq 0.1 V + V^2/70$		$\geq 2.7\text{m/s}^2$	3-2	$S \leq 0.1 V + V^2/70$		$\geq 2.7\text{m/s}^2$	3-3	$S \leq 0.1 V + V^2 /132$		$\geq 5.1\text{m/s}^2$
3-3	$S \leq 0.1 V + V^2/115$		$\geq 4.4\text{m/s}^2$	3-3	$S \leq 0.1 V + V^2/115$		$\geq 4.4\text{m/s}^2$	3-3	$S \leq 0.1 V + V^2/75$		$\geq 2.9\text{m/s}^2$	3-4	$S \leq 0.1 V + V^2 /130$		$\geq 5.0\text{m/s}^2$
3-4	$S \leq 0.1 V + V^2/115$		$\geq 4.4\text{m/s}^2$	3-4	$S \leq 0.1 V + V^2/115$		$\geq 4.4\text{m/s}^2$	3-4	$S \leq 0.1 V + V^2/75$		$\geq 2.9\text{m/s}^2$	3-5	$S \leq 0.1 V + V^2 /140$		$\geq 5.4\text{m/s}^2$
3-5	$S \leq 0.1 V + V^2/95$		$\geq 3.6\text{m/s}^2$	3-5	$S \leq 0.1 V + V^2/95$		$\geq 3.6\text{m/s}^2$	3-5	$S \leq 0.1 V + V^2/95$		$\geq 3.6\text{m/s}^2$	<b>Vehicles with CBS – secondary brake only</b>			
<b>Single rear brakes only</b>				<b>Single rear brakes only</b>				<b>Vehicles with CBS or Split Service Brake Systems : laden and unladen</b>				<b>Vehicles with CBS – secondary brake only</b>			
3-1	$S \leq 0.1 V + V^2/70$		$\geq 2.7 \text{ m/s}^2$	3-1	$S \leq 0.1 V + V^2/70$		$\geq 2.7 \text{ m/s}^2$	3-1	$S \leq 0.1 V + V^2/70$		$\geq 2.7 \text{ m/s}^2$	ALL	$S \leq 0.1 V + V^2 /65$		$\geq 2.5 \text{ m/s}^2$
3-2	$S \leq 0.1 V + V^2/70$		$\geq 2.7\text{m/s}^2$	3-2	$S \leq 0.1 V + V^2/70$		$\geq 2.7\text{m/s}^2$	3-2	$S \leq 0.1 V + V^2/70$		$\geq 2.7\text{m/s}^2$				
3-3	$S \leq 0.1 V + V^2/75$		$\geq 2.9\text{m/s}^2$	3-3	$S \leq 0.1 V + V^2/75$		$\geq 2.9\text{m/s}^2$	3-3	$S \leq 0.1 V + V^2/75$		$\geq 2.9\text{m/s}^2$				
3-4	$S \leq 0.1 V + V^2/75$		$\geq 2.9\text{m/s}^2$	3-4	$S \leq 0.1 V + V^2/75$		$\geq 2.9\text{m/s}^2$	3-4	$S \leq 0.1 V + V^2/75$		$\geq 2.9\text{m/s}^2$				
3-5	$S \leq 0.1 V + V^2/95$		$\geq 3.6\text{m/s}^2$	3-5	$S \leq 0.1 V + V^2/95$		$\geq 3.6\text{m/s}^2$	3-5	$S \leq 0.1 V + V^2/95$		$\geq 3.6\text{m/s}^2$				
<b>Vehicles with CBS or Split Service Brake Systems : laden and unladen</b>				<b>Vehicles with CBS or Split Service Brake Systems : laden and unladen</b>				<b>Vehicles with CBS or Split Service Brake Systems : laden and unladen</b>				<b>Vehicles with CBS or Split Service Brake Systems : laden and unladen</b>			
3-1 + 3-2	$S \leq 0.1 V + V^2 /115$		$\geq 4.4\text{m/s}^2$	3-1 + 3-2	$S \leq 0.1 V + V^2 /115$		$\geq 4.4\text{m/s}^2$	3-1 + 3-2	$S \leq 0.1 V + V^2 /115$		$\geq 4.4\text{m/s}^2$	3-1 + 3-2	$S \leq 0.1 V + V^2 /115$		$\geq 4.4\text{m/s}^2$
3-3	$S \leq 0.1 V + V^2 /132$		$\geq 5.1\text{m/s}^2$	3-3	$S \leq 0.1 V + V^2 /132$		$\geq 5.1\text{m/s}^2$	3-3	$S \leq 0.1 V + V^2 /132$		$\geq 5.1\text{m/s}^2$	3-3	$S \leq 0.1 V + V^2 /132$		$\geq 5.1\text{m/s}^2$
3-4	$S \leq 0.1 V + V^2 /130$		$\geq 5.0\text{m/s}^2$	3-4	$S \leq 0.1 V + V^2 /130$		$\geq 5.0\text{m/s}^2$	3-4	$S \leq 0.1 V + V^2 /130$		$\geq 5.0\text{m/s}^2$	3-4	$S \leq 0.1 V + V^2 /130$		$\geq 5.0\text{m/s}^2$
3-5	$S \leq 0.1 V + V^2 /140$		$\geq 5.4\text{m/s}^2$	3-5	$S \leq 0.1 V + V^2 /140$		$\geq 5.4\text{m/s}^2$	3-5	$S \leq 0.1 V + V^2 /140$		$\geq 5.4\text{m/s}^2$	3-5	$S \leq 0.1 V + V^2 /140$		$\geq 5.4\text{m/s}^2$
<b>Vehicles with CBS – secondary brake only</b>				<b>Vehicles with CBS – secondary brake only</b>				<b>Vehicles with CBS – secondary brake only</b>				<b>Vehicles with CBS – secondary brake only</b>			
ALL	$S \leq 0.1 V + V^2 /65$		$\geq 2.5 \text{ m/s}^2$	ALL	$S \leq 0.1 V + V^2 /65$		$\geq 2.5 \text{ m/s}^2$	ALL	$S \leq 0.1 V + V^2 /65$		$\geq 2.5 \text{ m/s}^2$	ALL	$S \leq 0.1 V + V^2 /65$		$\geq 2.5 \text{ m/s}^2$

All fractions to be changed to decimals.

The requirements for category 3-4 should be equal to those for category 3-5.

(Delete the note.)  
Note:

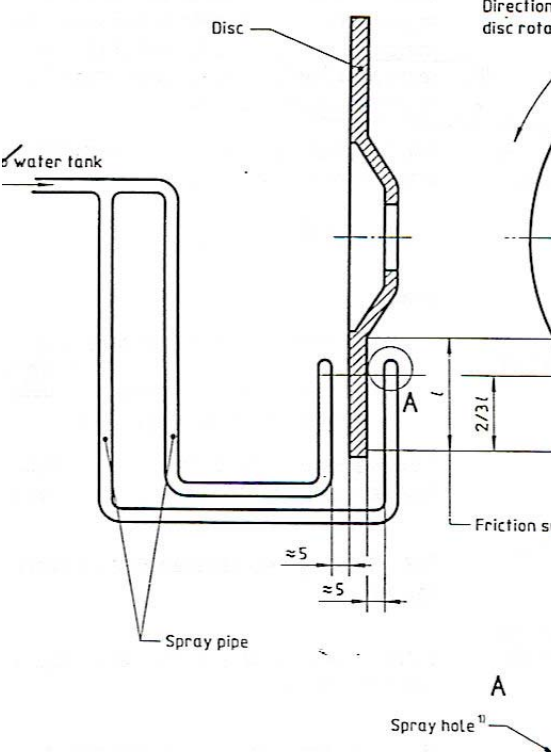
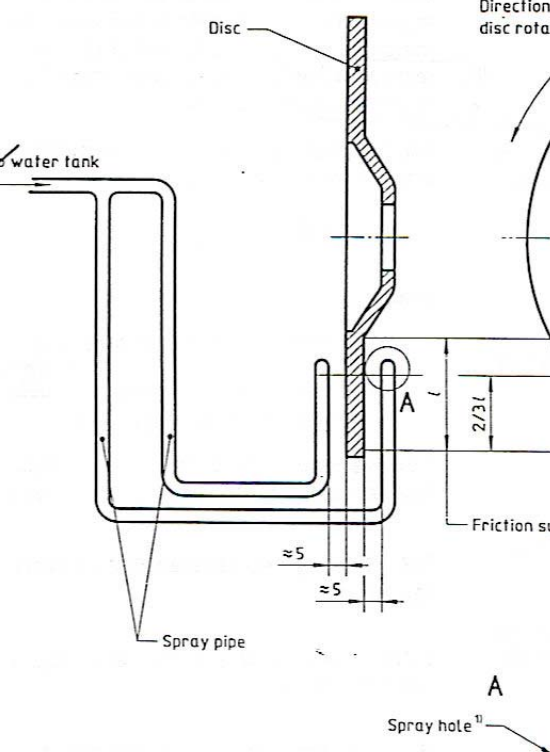
ALL	$S \leq 0.1 V + V^2 / 65$	$\geq 2.5 \text{ m/s}^2$			
<p><b>4.4 Dry Stop Test – all service brake controls activated</b></p> <p>4.4.1 Vehicle condition.</p> <ul style="list-style-type: none"> <li>- Test is applicable to vehicle categories 3-3, 3-4, 3-5.</li> <li>- Unladen</li> <li>- Engine disconnected</li> </ul> <p>4.4.2 Test conditions and procedure</p> <ul style="list-style-type: none"> <li>- Initial brake temperature = <math>\geq 55^\circ \text{ C}</math> and <math>\leq 100^\circ \text{ C}</math>.</li> <li>- Test speed: 100 km/h or 0.9 V max, whichever is the lower.</li> <li>- 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.</li> <li>- Brake actuation force: Hand control <math>\leq 250\text{N}</math> Foot control <math>\leq 400\text{N}</math> <math>\leq 500\text{N}</math> for 3-4 vehicles</li> </ul>			<p><b>Note:</b> If the values marked * cannot be achieved due to limited adhesion, perform an additional test using the procedure as specified in 4.3.2, but with the simultaneous application of both brake controls. The revised MFDD shall be: Category 3-2 <math>\geq 4.4\text{m/s}^2</math> Category 3-3 <math>\geq 5.8\text{m/s}^2</math> Category 3-4 <math>\geq 5.0\text{m/s}^2</math></p> <p><b>4.4 Dry Stop Test – all service brake controls activated</b></p> <p>4.4.1 Vehicle condition.</p> <ul style="list-style-type: none"> <li>- The test is applicable to vehicle categories 3-3, 3-4, 3-5.</li> <li>- Unladen</li> <li>- Engine disconnected</li> </ul> <p>4.4.2 Test conditions and procedure</p> <ul style="list-style-type: none"> <li>- Initial brake temperature = <math>\geq 55^\circ \text{ C}</math> and <math>\leq 100^\circ \text{ C}</math>.</li> <li>- Test speed: 100 km/h or 0.9 V max, whichever is the lower.</li> <li>- 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.</li> <li>- Brake actuation force: Hand control: <math>\leq 250\text{N}</math> Foot control: <math>\leq 400\text{N}</math> <math>\leq 500\text{N}</math> for 3-4 vehicles</li> <li>- Number of stops : until the vehicle meets the performance requirements, with a maximum of 6 stops</li> </ul>	<p>This note is included in ECE R78 but was not included in the GTR because it was believed to be not used. India propose inclusion. Issue also raised by UK at GRRF Discuss at 5/GTR</p> <p>GRRF – UK noted the inconsistency between the control forces for this test and the others. Complete test taken from FMVSS 122.</p>	<p><del>If the values marked * cannot be achieved due to limited adhesion, perform an additional test using the procedure as specified in 4.3.2, but with the simultaneous application of both brake controls.</del> <del>The revised MFDD shall be:</del> <del>Category 3-2 <math>\geq 4.4\text{m/s}^2</math></del> <del>Category 3-3 <math>\geq 5.8\text{m/s}^2</math></del> <del>Category 3-4 <math>\geq 5.0\text{m/s}^2</math></del></p> <p>“Initial brake temperature <del><math>\geq 55^\circ \text{ C}</math></del> and <math>\leq 100^\circ \text{ C}</math>.”</p>



<ul style="list-style-type: none"> <li>- Number of stops : until the vehicle meets the performance requirements, with a maximum of 6 stops</li> <li>- For each stop, accelerate the vehicle to the test speed and then apply the brakes under the conditions specified above</li> </ul> <p>4.4.3 Performance requirements</p> <p>When the brakes have been tested in accordance with the test procedure in 4.4.2, the stopping distance (S) shall be <math>[ \leq 0.1 V + 0.0051V^2 ]</math> (where V is the specified test speed in km/h and S is the required stopping distance in metres)</p> <p>4.5 High Speed Test</p> <p>4.5.1 Vehicle condition</p> <ul style="list-style-type: none"> <li>- Test is applicable to vehicle categories 3-3, 3-4, 3-5</li> <li>- Test is not required for vehicles with <math>V_{max} \leq 125</math> km/h</li> <li>- Unladen</li> <li>- Engine connected</li> </ul> <p>4.5.2 Test conditions and procedure</p> <ul style="list-style-type: none"> <li>- Initial brake temperature : <math>\geq 55^{\circ}</math> C and <math>\leq 100^{\circ}</math> C</li> </ul>	<ul style="list-style-type: none"> <li>- For each stop, accelerate the vehicle to the test speed and then apply the brakes under the conditions specified above</li> </ul> <p>4.4.3 Performance requirements</p> <p>When the brakes have been tested in accordance with the test procedure in 4.4.2, the stopping distance (S) shall be :</p> <p>a. For test speeds <math>\geq 80</math> km/h : <math>\leq 0.1 V + 0.0051V^2</math> b. For test speeds <math>\leq 80</math> km/h : ??????? TC</p> <p>(where V is the specified test speed in km/h and S is the required stopping distance in metres)</p> <p>4.5 High Speed Test</p> <p>4.5.1 Vehicle condition</p> <ul style="list-style-type: none"> <li>- The test is applicable to vehicle categories 3-3, 3-4, 3-5</li> <li>- Test is not required for vehicles with <math>V_{max} \leq 125</math> km/h</li> <li>- Unladen</li> <li>- Engine connected</li> </ul> <p>4.5.2 Test conditions and procedure</p> <ul style="list-style-type: none"> <li>- Initial brake temperature : <math>\geq 55^{\circ}</math> C and <math>\leq 100^{\circ}</math> C</li> <li>- Test speed: 0.8 Vmax for vehicles with</li> </ul>	<p>GRRF – USA question the inconsistency of specifying just stopping distance for only this test in the GTR.</p> <p>Japan proposed that the stopping distance requirements are taken directly from the FMVSS table. TC state that the table does cater for the instances where the specified test speed cannot be reached and counter proposes that a 2<sup>nd</sup> equation is used for speeds below 80 km/h. – to follow</p>	<p>“a. For test speeds <math>\geq 80</math> km/h : <math>S \leq 0.1 V + 0.0051V^2 \leq 0.0060 V^2</math> b. For test speeds <math>\leq 80</math> km/h : <math>S \leq 0.0055 V^2</math>” (Japan agrees with new 2 equations proposed by TC.)</p> <p>“The test is applicable to vehicle categories 3-3, 3-4, and 3-5”</p>
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<ul style="list-style-type: none"> <li>- Test speed: 0.8 V<sub>max</sub> for vehicles with V<sub>max</sub> &gt;125 km/h and &lt; 200 km/h. 160 km/h for vehicles with V<sub>max</sub> ≥ 200 km/h V<sub>max</sub></li> <li>- Brake application: Both brake controls shall be activated at the same moment</li> <li>- Brake actuation force: Hand control ≤ 200N Foot control ≤ 350N for 3-3, 3-5 vehicles ≤ 500N for 3-4 vehicles</li> <li>- Number of stops : until the vehicle meets the performance requirements, with a maximum of 4 stops</li> <li>- For each stop, accelerate the vehicle to the test speed and then activate the brake control under the conditions specified above</li> </ul> <p>4.5.3 Performance requirements</p> <p>When the brakes have been tested in accordance with the test procedure in 4.5.2:</p> <p>- Stopping distance (S) shall be <math>\leq 0.1 V + V^2 / 149</math> (where V is the specified test speed in km/h and S is the required stopping distance in metres) or the MFDD shall be <math>\geq 5.8 \text{ m/s}^2</math></p> <p><b>4.6 Wet Brake Test</b></p> <p>4.6.1 General information:</p>	<p>V<sub>max</sub> &gt;125 km/h and &lt; 200 km/h. 160 km/h for vehicles with V<sub>max</sub> ≥ 200 km/h V<sub>max</sub></p> <ul style="list-style-type: none"> <li>- Brake application: <del>Both brake controls shall be activated at the same moment</del> 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</li> <li>- Brake actuation force: Hand control ≤ 200N Foot control ≤ 350N for category 3-3, and 3-5 vehicles ≤ 500N for category 3-4 vehicles</li> <li>- Number of stops : until the vehicle meets the performance requirements, with a maximum of 4 stops</li> <li>- For each stop, accelerate the vehicle to the test speed and then activate the brake control under the conditions specified above</li> </ul> <p>4.5.3 Performance requirements</p> <p>When the brakes have been tested in accordance with the test procedure in 4.5.2:</p> <p>- The stopping distance (S) shall be <math>\leq 0.1 V + V^2 / 149</math> (where V is the specified test speed in km/h and S is the required stopping distance in metres) or the MFDD shall be <math>\geq 5.8 \text{ m/s}^2</math></p> <p><b>4.6 Wet Brake Test</b></p> <p>4.6.1 General information:</p> <ul style="list-style-type: none"> <li>- The test comprises two parts that shall be carried out consecutively for each brake</li> </ul>	<p>Aligned with 4.4.2</p>	<p>“V<sub>max</sub> ≥ 200 km/h <del>V<sub>max</sub></del>”</p> <p>“Number of stops : until the vehicle meets the performance requirements, with a maximum of <b>4 6</b> stops” (Aligned with other dry stop test.)</p>
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<ul style="list-style-type: none"> <li>- The test comprises two parts that shall be carried out consecutively for each brake system: <ul style="list-style-type: none"> <li>a. A <b>baseline</b> test based on the Dry Stop Test - with single brake control activated (section 4.3).</li> <li>b. A single <b>wet brake</b> stop using the same test parameters as in a. above but with the brake(s) being continuously sprayed with water in order to assess the effect of riding in wet conditions.</li> </ul> </li> <li>- The test is not applicable to parking brakes</li> <li>- Drum brakes are exempt from this test unless ventilation or open inspection ports are present.</li> <li>- 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.</li> </ul> <p>4.6.2 Vehicle condition.</p> <ul style="list-style-type: none"> <li>- Test is applicable to all vehicle categories</li> <li>- Laden For vehicles fitted with CBS : also unladen</li> <li>- Engine disconnected</li> <li>- Each brake shall be fitted with water spray equipment:</li> </ul> <p>a. Disc Brakes : Sketch of water spray equipment:</p>	<p>system:</p> <ul style="list-style-type: none"> <li>a. A <b>baseline</b> test based on the Dry Stop Test - single brake control activated (section 4.3).</li> <li>b. A single <b>wet brake</b> stop using the same test parameters as in a. above but with the brake(s) being continuously sprayed with water <b>while the test is conducted</b> in order to assess the effect of riding in wet conditions.</li> </ul> <ul style="list-style-type: none"> <li>- The test is not applicable to parking brakes</li> <li>- Drum brakes are exempt from this test unless ventilation or open inspection ports are present.</li> <li>- This test requires the vehicle to be fitted with instrumentation that gives a continuous recording of <b>brake control force</b> and vehicle deceleration. The MFDD and the stopping distance alternatives are not appropriate in this case.</li> </ul> <p>4.6.2 Vehicle condition.</p> <ul style="list-style-type: none"> <li>- The test is applicable to all vehicle categories</li> <li>- Laden For vehicles fitted with CBS : also unladen</li> <li>- Engine disconnected</li> <li>- Each brake shall be fitted with water spray equipment:</li> </ul> <p>a. Disc Brakes : Sketch of water spray equipment:</p>		<p>“For vehicles fitted with CBS: <b>mass in running order condition shall be tested in addition to laden condition.</b>”  <b>(“also unladen” may causes misleading)</b></p>
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 <p>Spray water shall not be dispersed.</p> <p>Notes on the installation of the disc brake water spray equipment:</p> <ul style="list-style-type: none"> <li>- 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.</li> <li>- If the surface of the rotor has any</li> </ul>	 <p>Spray water shall not be dispersed.</p> <p>The disc brake water spray equipment shall be installed as follows:</p> <ul style="list-style-type: none"> <li>- 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.</li> <li>- If the surface of the rotor has any shielding, the spray shall be applied 45° prior to the shield.</li> </ul>	<p>Better sketch required.</p>	
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<p>shielding, the spray shall be applied 45° prior to the shield.</p> <ul style="list-style-type: none"> <li>- 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.</li> </ul> <p>b. Drum Brakes with ventilation and open inspection ports:</p> <ul style="list-style-type: none"> <li>- 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.</li> <li>- The nozzle shall be &gt; 15 ° from the edge of any opening in the drum back plate.</li> </ul> <p>4.6.3 Baseline Test:</p> <ul style="list-style-type: none"> <li>- 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<sup>2</sup>.</li> <li>- To ensure repeatability: <ul style="list-style-type: none"> <li>a. 3 baseline stops shall be performed</li> <li>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.</li> <li>c. The average of these 3 control force values shall be used for the subsequent Wet Brake Stop.</li> </ul> </li> </ul> <p>4.6.4 Wet Brake Stop:</p> <p>4.6.4.1 Test conditions and procedure</p> <p>a. The vehicle shall be ridden at the test</p>	<ul style="list-style-type: none"> <li>- 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.</li> </ul> <p>b. Drum Brakes with ventilation and open inspection ports:</p> <p>The water spray equipment shall be installed as follows:</p> <ul style="list-style-type: none"> <li>- Water shall be sprayed equally onto both sides of the drum brake assembly (on the stationary back plate and on the rotating drum) with a flow rate 15 litres/hr.</li> <li>- The spray nozzles shall be positioned two thirds of the distance from the outer circumference of the rotating drum to the wheel hub centre.</li> <li>- The nozzle shall be &gt; 15 ° from the edge of any opening in the drum back plate.</li> </ul> <p>4.6.3 Baseline Test:</p> <ul style="list-style-type: none"> <li>- 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 <b>value</b> that results in a vehicle deceleration of 2.5 – 3.0 m/s<sup>2</sup>.</li> <li>- To ensure repeatability: <ul style="list-style-type: none"> <li>a. 3 baseline stops shall be performed</li> <li>b. <del>For each baseline stop, the constant brake control force and vehicle deceleration shall be recorded.</del> The <b>constant</b> brake control force and vehicle deceleration shall be determined for the period between 80 and 10% of the specified test speed.</li> <li>c. The average of these 3 <b>constant</b> control force values shall be used for the subsequent Wet Brake Stop.</li> <li>d. The average of the 3 <b>vehicle decelerations</b> shall be used in the subsequent performance requirements.</li> </ul> </li> </ul> <p>4.6.4 Wet Brake Stop:</p>	<p>Already in 4.6.1</p>	<p>“The nozzle <b>position</b> shall be &gt; 15 ° from the edge of any opening in the drum back plate.”</p> <p>“d. The average of the 3 vehicle decelerations <b>in the period of 0.5 to 1.0 seconds after brake control application</b> shall be used in the subsequent</p>
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<p>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.</p> <p>b. After a distance of <math>\geq 500</math> m, apply the control for the brake system being tested with the average input force derived in the Baseline Test.</p> <p>4.6.5. Performance requirements</p> <p>When tested in accordance with 4.6.4.1, the wet brake deceleration performance shall be:  <math>\geq 60\%</math> of the average deceleration performance recorded in the Baseline test in the period 0.5 to 1.0 seconds after brake control application.</p> <p><math>\leq 120\%</math> of the average deceleration performance recorded in the Baseline test for the complete stop.</p> <p><b>4.7 Heat Fade Test</b></p> <p>4.7.1 General information:</p> <ul style="list-style-type: none"> <li>- The test is comprised of three parts that shall be carried out consecutively for each brake system: <ul style="list-style-type: none"> <li>a. A <b>baseline</b> test based on the Dry Stop Test - single brake control activated (section 4.3).</li> <li>b. A <b>heating procedure</b> which includes a series of repeated stops in order to heat the brake(s)</li> <li>c. A <b>hot brake</b> stop based on the Dry Stop Test - single brake control activated (section 4.3), to measure the brake's performance after the heating procedure.</li> </ul> </li> <li>- Test is applicable to vehicle categories 3-3,</li> </ul>	<p>4.6.4.1 Test conditions and procedure</p> <p>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.</p> <p>b. After a distance of <math>\geq 500</math> m, apply the control for the brake system being tested with the <b>constant control</b> force value derived in the Baseline Test.</p> <p>c. <b>Measure the average vehicle deceleration in the period 0.5 to 1.0 seconds after brake control application</b></p> <p>4.6.5. Performance requirements</p> <p>When tested in accordance with 4.6.4.1, the wet brake deceleration performance shall be:</p> <p><math>\geq 60\%</math> of the <b>deceleration value</b> recorded in the Baseline test, in the period 0.5 to 1.0 seconds after brake control application.</p> <p><math>\leq 120\%</math> of the <b>deceleration value</b> recorded in the Baseline test <b>during</b> the complete stop.</p> <p><b>4.7 Heat Fade Test</b></p> <p>4.7.1 General information:</p> <ul style="list-style-type: none"> <li>- The test is comprised of three parts that shall be carried out consecutively for each brake system: <ul style="list-style-type: none"> <li>b. A <b>baseline</b> test <del>based on</del> <b>using</b> the Dry Stop Test - single brake control activated (section 4.3).</li> <li>b. A <b>heating procedure</b> which <del>includes</del> <b>consists of</b> a series of repeated stops in order to heat the brake(s)</li> <li>c. A <b>hot brake</b> stop <del>based on</del> <b>using</b> the Dry Stop Test - single brake control activated (section 4.3), to measure the brake's performance after the heating</li> </ul> </li> </ul>	<p>performance requirements.</p> <p>e. <b>The average of the 3 vehicle peak decelerations during the complete stop except 0.5 seconds before halt shall be used in the subsequent performance requirements.</b> ”</p> <p>“b. After a distance of <math>\geq 500</math> m, apply the control for the brake system being tested with the constant control force value derived in the Baseline Test 4.6.3c.”</p> <p>“When tested in accordance with 4.6.4.1, <del>the wet brake deceleration performance shall be:</del>  a- <b>The average deceleration in the period 0.5 to 1.0 seconds after brake control application shall be <math>\geq 60\%</math> of the deceleration value recorded derived in the Baseline test 4.6.3.d in the period 0.5 to 1.0 seconds after brake control application.</b>  b- <b>The maximum deceleration during the complete stop procedure 4.6.4.1.e. except 0.5 seconds before halt complete stop shall be <math>\leq 120\%</math> of the deceleration value recorded derived in the Baseline test during the complete stop 4.6.3.e.</b>”</p> <p>“<del>b</del> a. <b>A baseline test ....</b>”</p> <p>“The test is applicable to vehicle</p>
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<p>3-4, 3-5.</p> <ul style="list-style-type: none"> <li>- Test is not applicable to parking brakes or secondary brakes.</li> <li>- All stops with vehicle laden</li> <li>- The heating procedure requires the vehicle to be fitted with instrumentation that gives a continuous recording of vehicle deceleration and brake actuation control force. The baseline and hot brake stops require the measurement of either MFDD or the stopping distance.</li> </ul> <p>4.7.2 Baseline Test:</p> <p>4.7.2.1 Vehicle condition.</p> <ul style="list-style-type: none"> <li>- Engine disconnected</li> </ul> <p>4.7.2.2 Test conditions and procedure</p> <ul style="list-style-type: none"> <li>- Initial brake temperature : <math>\geq 55^{\circ}\text{C}</math> and <math>\leq 100^{\circ}\text{C}</math></li> <li>- Test speed : 60 km/h</li> <li>- Brake application: Separate test using each brake control.</li> <li>- Brake actuation force: Hand control <math>\leq 200\text{N}</math> Foot control <math>\leq 350\text{N}</math> for 3-3 &amp; 3-5 vehicles <math>\leq 500\text{N}</math> for 3-4 vehicles</li> </ul>	<p>procedure.</p> <ul style="list-style-type: none"> <li>- The test is applicable to vehicle categories 3-3, 3-4, 3-5.</li> <li>- The test is not applicable to parking brakes or secondary brakes.</li> <li>- All stops shall be carried out with the vehicle laden</li> <li>- The heating procedure requires the vehicle to be fitted with instrumentation that gives a continuous recording of vehicle deceleration and brake actuation control force. <del>Therefore, the stopping distance and MFDD are not used for the heating procedure.</del> The baseline and hot brake stops require the measurement of either MFDD or the stopping distance.</li> </ul> <p>4.7.2 Baseline Test:</p> <p>4.7.2.1 Vehicle condition.</p> <ul style="list-style-type: none"> <li>- Engine disconnected</li> </ul> <p>4.7.2.2 Test conditions and procedure</p> <ul style="list-style-type: none"> <li>- Initial brake temperature : <math>\geq 55^{\circ}\text{C}</math> and <math>\leq 100^{\circ}\text{C}</math></li> <li>- Test speed : 60 km/h or 0.9 Vmax, whichever is the lower.</li> <li>- Brake application: Separate test using each brake control.</li> <li>- Brake actuation force: Hand control <math>\leq 200\text{N}</math> Foot control <math>\leq 350\text{N}</math> for 3-3 &amp; 3-5 vehicles <math>\leq 500\text{N}</math> for 3-4 vehicles</li> </ul>	<p>Aligned with text in 4.3.2.</p>	<p>categories 3-3, 3-4, and 3-5.”</p> <p>“The test is not applicable to parking brakes <del>or</del> and secondary brakes.”</p> <p>(Use consistent wording as 4.6.1.)</p> <p>“The heating procedure requires the vehicle to be fitted with instrumentation that gives a continuous recording of vehicle <del>deceleration and brake actuation control force</del> brake control force and vehicle deceleration. <del>Therefore,</del> The stopping distance and MFDD .... ”</p> <p>(Common phrase is needed.)</p> <p>(Enough.)</p>
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<ul style="list-style-type: none"> <li>- 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</li> </ul> <p>4.7.3 Heating Procedure</p> <p>4.7.3.1 Test conditions and procedure</p> <ul style="list-style-type: none"> <li>- Initial brake temperature prior to first stop only: <math>\geq 55^{\circ}\text{C}</math> and <math>\leq 100^{\circ}\text{C}</math></li> <li>- Test 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.</li> <li>- Brake application: Separate test for each brake control.</li> <li>- Brake actuation force: A constant control force that achieves an average vehicle deceleration rate of <math>3.0 - 3.5\text{ m/s}^2</math> 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.</li> <li>- Number of stops: 10</li> <li>- Interval between stops: 1000 m.</li> <li>- Engine transmission:</li> </ul>	<ul style="list-style-type: none"> <li>- 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</li> </ul> <p>4.7.3 Heating Procedure</p> <p>4.7.3.1 Test conditions and procedure</p> <ul style="list-style-type: none"> <li>- Initial brake temperature prior to first stop only: <math>\geq 55^{\circ}\text{C}</math> and <math>\leq 100^{\circ}\text{C}</math></li> <li>- Specified Test 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.</li> <li>- Brake application: Separate application test for each brake control.</li> <li>- Brake actuation force: A constant control force that achieves a vehicle deceleration rate of <math>3.0 - 3.5\text{ m/s}^2</math> for the duration of the first stop. The brake control force and vehicle deceleration shall be recorded for the duration of the stop. The constant brake control force shall be determined for the period between 80% and 10% of the specified test speed.  The average constant brake control input force used for the first stop shall be repeated for each of the remaining stops.</li> <li>- Number of stops: 10</li> <li>- Interval between stops: 1000 m.</li> <li>- Engine transmission:</li> </ul>	<p>1 stop enough?</p>	<p>“- Brake actuation force: For the first stop; A constant control force that achieves a vehicle deceleration rate of <math>3.0 - 3.5\text{ m/s}^2</math> for the period between 80% and 10% of the specified speed for the duration of the first stop. The constant brake control force shall be determined for the period between 80% and 10% of the specified test speed.  For remaining stops; The average constant brake control input force used for the first stop shall be repeated for each of the remaining stops.”</p>
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<p>a. From the test speed to 50% test speed: connected, with the highest gear selected.</p> <p>b. From 50% test speed to standstill : disconnected.</p> <p>- Carry out a stop to the conditions specified above and then immediately use maximum acceleration to reach the test speed and maintain that speed until the next stop is made.</p> <p>4.7.4 Hot Brake Stop:</p> <p>4.7.4.1 Test conditions and procedure</p> <p>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 <math>\leq</math> the average force used in 4.7.2.</p> <p>4.7.5 Performance Requirements</p> <p>When the brakes have been tested in accordance with 4.7.4.1, performance shall be:</p> <p>If based on MFDD, <math>\geq 60\%</math> of the MFDD recorded in test 4.7.2.</p> <p>If based on stopping distance, <math>[S_2 \leq 1.67 S_1 - 0.67 \times 0.1V]</math></p> <p>Where:  <math>S_1</math> = stopping distance in metres achieved in baseline test 4.7.2  <math>S_2</math> = stopping distance in metres achieved in hot brake stop 4.7.4.1  <math>V</math> = test speed in km/h.</p> <p>4.8 Parking Brake Test – for vehicles equipped with</p>	<p>a. From the <del>test</del> <b>specified</b> speed to 50% test speed: connected, with the highest <u>appropriate gear selected such that the engine speed remains above the manufacturers specified idle speed.</u></p> <p>b. From 50% <del>test</del> <b>specified</b> speed to standstill : disconnected.</p> <p>- Carry out a stop to the conditions specified above and then immediately use maximum acceleration to reach the <del>test</del> <b>specified</b> speed and maintain that speed until the next stop is made.</p> <p>4.7.4 Hot Brake Stop:</p> <p>4.7.4.1 Test conditions and procedure</p> <p>Perform a single stop under the conditions used in the baseline test (4.7.2) for the brake system that has been heated during <del>test</del> <b>the procedure</b> in 4.7.3. This stop shall be carried out within one minute of the completion of test 4.7.3 with <del>an average</del> <b>a</b> brake actuation force <math>\leq</math> the <del>average</del> force used in 4.7.2.</p> <p>4.7.5 Performance Requirements</p> <p>When the brakes have been tested in accordance with 4.7.4.1, <b>their</b> performance shall be:</p> <p>If based on MFDD, <math>\geq 60\%</math> of the MFDD recorded in test 4.7.2.</p> <p>If based on stopping distance, <math>[S_2 \leq 1.67 S_1 - 0.67 \times 0.1V]</math></p> <p>Where:  <math>S_1</math> = <b>corrected</b> stopping distance in metres achieved in baseline test 4.7.2  <math>S_2</math> = <b>corrected</b> stopping distance in metres achieved in hot brake stop 4.7.4.1  <math>V</math> = test speed in km/h.</p> <p>4.8 Parking Brake Test – for vehicles equipped with</p>	<p>Proposal from USMMA and agreed at 58/GRRF pre meeting.</p>	<p>(Japan thinks this proposal is not necessary.)</p> <p>“.....a brake actuation force <math>\leq</math> <b>less than or equal to</b> the <del>average</del> force used in 4.7.2.”</p> <p>“<math>S_1</math> = <b>corrected</b> stopping distance in metres achieved in baseline test 4.7.2  <math>S_2</math> = <b>corrected</b> stopping distance in metres achieved in hot brake stop 4.7.4.1”</p>
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<p><b>parking brakes</b></p> <p>4.8.1 Vehicle condition.</p> <ul style="list-style-type: none"> <li>- Laden</li> <li>- Engine disconnected</li> </ul> <p>4.8.2 Test conditions and procedure</p> <ul style="list-style-type: none"> <li>- Initial brake temperature: <math>\leq 100^{\circ}\text{C}</math></li> <li>- Test surface gradient = 18%</li> <li>- Brake actuation force: Hand control <math>\leq 400\text{ N}</math>. Foot control <math>\leq 500\text{ N}</math>.</li> <li>- 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.</li> <li>- On completion of the test with vehicle facing up, repeat the same test procedure with the vehicle facing down the gradient.</li> </ul> <p>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.</p> <p><b>4.9 ABS Tests</b></p> <p>4.9.1 General information:</p> <ul style="list-style-type: none"> <li>- The tests are only applicable to the brake systems of categories 3-1 and 3-3 vehicles</li> </ul>	<p><b>parking brakes</b></p> <p>4.8.1 Vehicle condition.</p> <ul style="list-style-type: none"> <li>- The test is applicable to vehicle categories 3-2, 3-4, 3-5.</li> <li>- Laden</li> <li>- Engine disconnected</li> </ul> <p>4.8.2 Test conditions and procedure</p> <ul style="list-style-type: none"> <li>- Initial brake temperature: <math>\leq 100^{\circ}\text{C}</math></li> <li>- Test surface gradient = 18%</li> <li>- Brake actuation force: Hand control <math>\leq 400\text{ N}</math>. Foot control <math>\leq 500\text{ N}</math>.</li> <li>- 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 the test period.</li> <li>- On completion of the test with vehicle facing up the gradient, repeat the same test procedure with the vehicle facing down the gradient.</li> </ul> <p>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 when facing both up and down in both forward and reverse directions on the gradient.</p> <p><b>4.9 ABS Tests</b></p> <p>4.9.1 General information:</p> <ul style="list-style-type: none"> <li>- The tests are only applicable to the brake systems of categories 3-1 and 3-3 vehicles</li> </ul>		<p><del>“The test is applicable to vehicle categories 3-2, 3-4, 3-5.”</del> (The comment for the 1st draft was from JAMA, not Japan)</p> <p>Might need inclusion of categories 3-2, 3-4 and 3-5.</p>
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that are equipped with an Anti lock Brake System (ABS)		that are equipped with an Anti lock Brake System (ABS)			“.... System (ABS) -The test is to confirm the performance of the brake system equipped with ABS including the performance under the event of electrical failure of the ABS. ”  “a. Stops on a high friction surface – as specified <del>used for tests in 4.3</del> 4.1.1.1” “b. Stops on a low friction surface - <del>≤0.45</del> as specified in 4.1.1.2.”
- The test series comprises the following individual tests, which may be carried out in any order:		- The test series comprises the following individual tests, which may be carried out in any order:			
ABS TESTS	SECTION	ABS TESTS	SECTION		
a. Stops on a high friction surface - as used for tests in 4.3	4.9.3	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	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	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	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	e. Wheel lock check - low to high friction surface transition.	4.9.7		
f. Stops with an ABS electrical failure.	4.9.8	f. Stops with an ABS electrical failure.	4.9.8		
4.9.2 Vehicle condition		4.9.2 Vehicle condition			
- Unladen		- Unladen			
- Engine disconnected		- Engine disconnected			
4.9.3 Stops on a high friction surface:		4.9.3 Stops on a high friction surface:			
4.9.3.1 Test conditions and procedure		4.9.3.1 Test conditions and procedure			
- Initial brake temperature : ≥55° C and ≤100° C		- Initial brake temperature : ≥55° C and ≤100° C			
- Test speed: 60 km/h or 0.9 V max, whichever is lower.		- Test speed: 60 km/h or 0.9 V max, whichever is lower.			
- Brake application: Each brake control separately.		- Brake application: Each brake control separately.			

<div><ul style="list-style-type: none"><li>- Brake actuation force: Hand control = 200N ± 10% Foot control = 350N ± 10% These forces may be increased in order to ensure ABS cycling.</li><li>- Number of stops: until the vehicle meets the performance requirements, with a maximum of 6 stops.</li><li>- For each stop, accelerate the vehicle to the test speed and then activate the brake control under the conditions specified above.</li></ul></div> <div>4.9.3.2 Performance requirements</div> <div>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)]:</div> <table><tr><th>Category</th><th>STOPPING DISTANCE (S) (Where V is the specified test speed in km/h and S is the required stopping distance in metres)</th><th>O R</th><th>MFDD</th></tr><tr><td colspan="4">For single front brakes only:</td></tr><tr><td>3-1</td><td><math>S \leq 0.1 V + V^2/64</math></td><td rowspan="2"></td><td><math>\geq 2.4\text{m/s}^2</math></td></tr><tr><td>3-3</td><td><math>S \leq 0.1 V + V^2/81</math></td><td><math>\geq 3.1\text{m/s}^2</math></td></tr><tr><td colspan="4">For single rear brakes only</td></tr><tr><td>3-1</td><td><math>S \leq 0.1 V + V^2/49</math></td><td rowspan="2"></td><td><math>\geq 1.9 \text{ m/s}^2</math></td></tr><tr><td>3-3</td><td><math>S \leq 0.1 V + V^2/52</math></td><td><math>\geq 2.0\text{m/s}^2</math></td></tr><tr><td colspan="4">For CBS:</td></tr><tr><td>3-1</td><td><math>S \leq 0.1 V + V^2/81</math></td><td></td><td><math>\geq 3.1\text{m/s}^2</math></td></tr></table>	Category	STOPPING DISTANCE (S) (Where V is the specified test speed in km/h and S is the required stopping distance in metres)	O R	MFDD	For single front brakes only:				3-1	$S \leq 0.1 V + V^2/64$		$\geq 2.4\text{m/s}^2$	3-3	$S \leq 0.1 V + V^2/81$	$\geq 3.1\text{m/s}^2$	For single rear brakes only				3-1	$S \leq 0.1 V + V^2/49$		$\geq 1.9 \text{ m/s}^2$	3-3	$S \leq 0.1 V + V^2/52$	$\geq 2.0\text{m/s}^2$	For CBS:				3-1	$S \leq 0.1 V + V^2/81$		$\geq 3.1\text{m/s}^2$	<div><ul style="list-style-type: none"><li>- Brake actuation force: Hand control = 200N ± 10% Foot control = 350N ± 10% These forces may be increased in order to ensure that the ABS is <u>fully</u> cycling.</li><li>- Number of stops: until the vehicle meets the performance requirements, with a maximum of 6 stops.</li><li>- For each stop, accelerate the vehicle to the test speed and then activate the brake control under the conditions specified above.</li><li>- <u>Record wheel rotation.</u></li></ul></div> <div>4.9.3.2 Performance requirements</div> <div>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) :</div> <table><tr><th>Category</th><th>STOPPING DISTANCE (S) (Where V is the specified test speed in km/h and S is the required stopping distance in metres)</th><th>O R</th><th>MFDD</th></tr><tr><td colspan="4">For single front brakes only:</td></tr><tr><td>3-1</td><td><math>S \leq 0.1 V + V^2/64</math></td><td rowspan="2"></td><td><math>\geq 2.4\text{m/s}^2</math></td></tr><tr><td>3-3</td><td><math>S \leq 0.1 V + V^2/81</math></td><td><math>\geq 3.1\text{m/s}^2</math></td></tr><tr><td colspan="4">For single rear brakes only</td></tr><tr><td>3-1</td><td><math>S \leq 0.1 V + V^2/49</math></td><td rowspan="2"></td><td><math>\geq 1.9 \text{ m/s}^2</math></td></tr><tr><td>3-3</td><td><math>S \leq 0.1 V + V^2/52</math></td><td><math>\geq 2.0\text{m/s}^2</math></td></tr><tr><td colspan="4">For CBS:</td></tr><tr><td>3-1</td><td><math>S \leq 0.1 V + V^2/81</math></td><td></td><td><math>\geq 3.1\text{m/s}^2</math></td></tr></table>	Category	STOPPING DISTANCE (S) (Where V is the specified test speed in km/h and S is the required stopping distance in metres)	O R	MFDD	For single front brakes only:				3-1	$S \leq 0.1 V + V^2/64$		$\geq 2.4\text{m/s}^2$	3-3	$S \leq 0.1 V + V^2/81$	$\geq 3.1\text{m/s}^2$	For single rear brakes only				3-1	$S \leq 0.1 V + V^2/49$		$\geq 1.9 \text{ m/s}^2$	3-3	$S \leq 0.1 V + V^2/52$	$\geq 2.0\text{m/s}^2$	For CBS:				3-1	$S \leq 0.1 V + V^2/81$		$\geq 3.1\text{m/s}^2$	<div>Some ABS systems give a fluctuating force at the control that cannot maintain ± 10% value. Discuss at 5/GTR. Proposal ? Applies to all ABS tests except failure test. It is proposed that “fully” cycling is specified. Definition? Applies to all ABS tests except failure test.</div> <div>IMMA was actioned to supply data confirm or increase 0.7 value. Insufficient data available at present and so 0.7 value is proposed.</div>	<div>Delete “fully” because difficult to define for various ABS systems and regulations.</div> <div>The requirement needs discussion.</div>
Category	STOPPING DISTANCE (S) (Where V is the specified test speed in km/h and S is the required stopping distance in metres)	O R	MFDD																																																																				
For single front brakes only:																																																																							
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For single rear brakes only																																																																							
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3-3	$S \leq 0.1 V + V^2/52$		$\geq 2.0\text{m/s}^2$																																																																				
For CBS:																																																																							
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For single rear brakes only																																																																							
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For CBS:																																																																							
3-1	$S \leq 0.1 V + V^2/81$		$\geq 3.1\text{m/s}^2$																																																																				

3-3	$S \leq 0.1 V + V^2 / 93$	$\geq 3.6 \text{m/s}^2$	3-3	$S \leq 0.1 V + V^2 / 93$	$\geq 3.6 \text{m/s}^2$		
<p>4.9.4 Stops on a low friction surface:</p> <p>4.9.4.1 Test conditions and procedure</p> <p>Repeat section 4.9.3.1 but using the low friction surface instead of the high friction one.</p> <p>4.9.4.2 Performance requirements</p> <p>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..</p> <p>4.9.5 Wheel lock checks on high and low friction surfaces.</p> <p>4.9.5.1 Test conditions and procedure</p> <ul style="list-style-type: none"> <li>- Test surfaces: <ul style="list-style-type: none"> <li>a. High friction</li> <li>b. Low friction</li> </ul> </li> <li>- Initial brake temperature : <math>\geq 55^\circ \text{C}</math> and <math>\leq 100^\circ \text{C}</math></li> <li>- Test speed: 80 km/h or 0.8 Vmax, whichever is lower.</li> <li>- Brake application: <ul style="list-style-type: none"> <li>a. Each brake control separately.</li> <li>b. Where ABS is fitted to both brake systems, both controls shall also be activated at the same moment.</li> </ul> </li> <li>- Brake actuation force: Hand control = <math>200\text{N} \pm 10\%</math></li> </ul>			<p>4.9.4 Stops on a low friction surface:</p> <p>4.9.4.1 Test conditions and procedure</p> <p>Repeat <b>the test in</b> section 4.9.3.1 but using the low friction surface instead of the high friction one.</p> <p>4.9.4.2 Performance requirements</p> <p>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..</p> <p>4.9.5 Wheel lock checks on high and low friction surfaces.</p> <p>4.9.5.1 Test conditions and procedure</p> <ul style="list-style-type: none"> <li>- Test surfaces: <ul style="list-style-type: none"> <li>a. High friction</li> <li>b. Low friction</li> </ul> </li> <li>- Initial brake temperature : <math>\geq 55^\circ \text{C}</math> and <math>\leq 100^\circ \text{C}</math></li> <li>- Test speed: 80 km/h or 0.8 Vmax, whichever is lower. <b>Note: Where the low friction test surface has a PFC <math>\leq 0.35</math>, the test speed may be reduced for safety reasons.</b></li> <li>- Brake application: <ul style="list-style-type: none"> <li>a. Each brake control separately.</li> <li>b. Where ABS is fitted to both brake systems, both controls shall also be activated at the same moment.</li> </ul> </li> <li>- Brake actuation force: Hand control = <math>200\text{N} \pm 10\%</math></li> </ul>			<p>This proposal from Japan is included in ECE R78 – to be agreed in 5/GTR meeting. Propose a speed? Increase in steps?</p>	<p>“- Test surfaces: <b>The vehicle shall be tested on both;</b> a. High friction <b>surface and</b> b. Low friction <b>surface.</b>”</p> <p>“- Brake application: .... b. Where ABS is fitted to both brake systems, <b>in addition to test with separate application</b>, both controls shall also be activated at the same moment.”</p>

<p>Foot control = 350N <math>\pm</math> 10% These forces may be increased in order to ensure ABS cycling.</p> <ul style="list-style-type: none"> <li>- Brake application rate: The brake actuation force shall be applied in 0.2 – 0.5 seconds</li> <li>- Number of stops: Maximum of 3 stops</li> <li>- 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.</li> <li>- Record wheel rotation.</li> </ul> <p>4.9.5.2 Performance requirements</p> <p>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.</p> <p>4.9.6 Wheel lock check - high to low friction surface transition.</p> <p>4.9.6.1 Test conditions and procedure</p> <ul style="list-style-type: none"> <li>- Test surfaces: A length of high friction surface immediately followed by a length of low friction surface.</li> <li>- Initial brake temperature : <math>\geq 55^{\circ}</math> C and <math>\leq 100^{\circ}</math> C</li> <li>- 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.</li> <li>- Brake application:</li> </ul>	<p>Foot control = 350N <math>\pm</math> 10% These forces may be increased in order to ensure ABS cycling.</p> <ul style="list-style-type: none"> <li>- Brake application rate: The brake actuation force shall be applied in 0.2 – 0.5 seconds</li> <li>- Number of stops: Maximum of 3 stops</li> <li>- 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.</li> <li>- Record wheel rotation.</li> </ul> <p>4.9.5.2 Performance requirements</p> <p>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.</p> <p>4.9.6 Wheel lock check - high to low friction surface transition.</p> <p>4.9.6.1 Test conditions and procedure</p> <ul style="list-style-type: none"> <li>- Test surfaces: A length of high friction surface immediately followed by a length of low friction surface.</li> <li>- Initial brake temperature : <math>\geq 55^{\circ}</math> C and <math>\leq 100^{\circ}</math> C</li> <li>- 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.</li> <li>- Brake application:</li> </ul>		<p>“- Test surface: A length of high friction surface immediately followed by a length of low friction surface. The high friction surface shall have a peak friction coefficient of <math>\geq 0.8</math>.” (Informal doc. GRRF-58-23)</p>
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<p>a. Each brake control separately. b. Where ABS is fitted to both brake systems, both controls shall also be activated at the same moment.</p> <ul style="list-style-type: none"> <li>- Brake actuation force: Hand control = 200N ± 10% Foot control = 350N ± 10% These forces may be increased in order to ensure ABS cycling.</li> <li>- Number of stops: Maximum of 3 stops</li> <li>- 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.</li> <li>- Record wheel rotation.</li> </ul> <p>4.9.6.2 Performance requirements</p> <p>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.</p> <p>4.9.7 Wheel lock check - low to high friction surface transition.</p> <p>4.9.7.1 Test conditions and procedure</p> <ul style="list-style-type: none"> <li>- Test surfaces: A length of low friction surface immediately followed by a length of high friction surface.</li> <li>- Initial brake temperature : ≥55° C and ≤100° C</li> </ul>	<p>a. Each brake control separately. b. Where ABS is fitted to both brake systems, both controls shall also be activated at the same moment.</p> <ul style="list-style-type: none"> <li>- Brake actuation force: Hand control = 200N ± 10% Foot control = 350N ± 10% These forces may be increased in order to ensure ABS cycling.</li> <li>- Number of stops: Maximum of 3 stops</li> <li>- For each stop, accelerate the vehicle to the test speed and then activate the brake control <u>before the vehicle reaches the transition from one friction surface to the other. under the conditions specified above.</u></li> <li>- <del>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.</del></li> <li><del>— Record wheel rotation.</del></li> </ul> <p>4.9.6.2 Performance requirements</p> <p>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.</p> <p>4.9.7 Wheel lock check - low to high friction surface transition.</p> <p>4.9.7.1 Test conditions and procedure</p> <ul style="list-style-type: none"> <li>- Test surfaces: A <del>length of</del> low friction surface immediately followed by a <del>length of</del> high friction surface.</li> <li>- Initial brake temperature : ≥55° C and ≤100° C</li> </ul>	<p>This is not included in ECE R78. Not necessary to include in GTR ?</p> <p>US proposal because no wheel lock is a requirement and wheel lock is defined.</p> <p>US proposal</p> <p>Should all of the high friction</p>	<p>“b. Where ABS is fitted to both brake systems, <b>in addition to test with separate application</b>, both controls shall also be activated at the same moment.”</p> <p>“- Test surface: <del>A length of</del> low friction surface immediately followed by a <del>length of</del> friction surface. <b>The high friction surface shall have a peak friction coefficient of ≥ 0.8.</b>”</p>
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<ul style="list-style-type: none"> <li>- 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 low friction to the high friction surface.</li> <li>- 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.</li> <li>- Brake actuation force: Hand control = [200N ± 10%] Foot control = [350N ± 10%] These forces may be increased in order to promote ABS cycling.</li> <li>- Number of stops: Maximum of 3 stops</li> <li>- For each stop, accelerate the vehicle to the test speed and then activate the brake control under the conditions specified above.</li> <li>- Record wheel rotation, and the vehicle's continuous deceleration.</li> </ul> <p>4.9.7.2 Performance requirements</p> <ul style="list-style-type: none"> <li>- 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.</li> <li>- After passing over the transition point between low and high friction on the test surface, [the vehicle deceleration shall increase].</li> </ul> <p>4.9.8 Stops with an ABS electrical failure.</p> <p>4.9.8.1 Test conditions and procedure</p>	<ul style="list-style-type: none"> <li>- 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 low friction to the high friction surface.</li> <li>- 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.</li> <li>- Brake actuation force: Hand control = 200N ± 10% Foot control = 350N ± 10% These forces may be increased in order to promote ABS cycling.</li> <li>- Number of stops: Maximum of 3 stops</li> <li>- For each stop, accelerate the vehicle to the test speed and then activate the brake control <b>before the vehicle reaches the transition from one friction surface to the other. under the conditions specified above.</b></li> <li>- Record wheel rotation, and the vehicle's continuous deceleration.</li> </ul> <p>4.9.7.2 Performance requirements</p> <ul style="list-style-type: none"> <li>- 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.</li> <li>- After passing over the transition point between <b>the</b> low and high friction <b>surfaces, the vehicle deceleration shall increase.</b></li> </ul> <p>4.9.8 Stops with an ABS electrical failure.</p> <p>4.9.8.1 Test conditions and procedure</p>	<p>surface be wet to overcome the inconsistency caused by a drying tyre ?</p> <p>IMMA was actioned to supply data to specify requirements more precisely. Insufficient data available at present. Discuss at 5/GTR. <b>USA require an objective performance requirement for this test or suggest it may be removed.</b></p>	<p>(Informal doc. GRRF-58-23)</p> <p>“b. Where ABS is fitted to both brake systems, <b>in addition to test with separate application</b>, both controls shall also be activated at the same moment.”</p>
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<ul style="list-style-type: none"> <li>- 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.</li> </ul> <p>4.9.8.2 Performance requirements</p> <p>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 <b>single rear brakes only</b> section of the table in section 4.3.3.</p> <p><b>4.10 Partial failure test – for split service brake systems</b></p> <p>4.10.1 General information:</p> <ul style="list-style-type: none"> <li>- Test is only applicable to vehicles that are equipped with split service brake systems.</li> <li>- Test is to confirm the performance of the remaining sub system in the event of a hydraulic system leakage failure.</li> </ul> <p>4.10.2 Vehicle condition</p> <ul style="list-style-type: none"> <li>- Unladen</li> <li>- Engine disconnected</li> </ul> <p>4.10.3 Test conditions and procedure</p> <ul style="list-style-type: none"> <li>- Initial brake temperature: <math>\geq 55^{\circ}\text{C}</math> and <math>\leq 100^{\circ}\text{C}</math></li> <li>- Test speeds: 50 km/h and 100 km/h or 0.8</li> </ul>	<ul style="list-style-type: none"> <li>- <b>With the ABS electrical system disabled,</b> 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.</li> </ul> <p>4.9.8.2 Performance requirements</p> <p>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 <b>single rear brakes only</b> section of the table in section 4.3.3.</p> <p><b>4.10 Partial failure test – for split service brake systems</b></p> <p>4.10.1 General information:</p> <ul style="list-style-type: none"> <li>- <b>The</b> test is only applicable to vehicles that are equipped with split service brake systems.</li> <li>- <b>The</b> test is to confirm the performance of the remaining sub system in the event of a hydraulic system leakage failure.</li> </ul> <p>4.10.2 Vehicle condition</p> <ul style="list-style-type: none"> <li>- <b>The test is applicable to vehicle categories 3-3, 3-4, 3-5</b></li> <li>- Unladen</li> <li>- Engine disconnected</li> </ul> <p>4.10.3 Test conditions and procedure</p> <ul style="list-style-type: none"> <li>- Initial brake temperature: <math>\geq 55^{\circ}\text{C}</math> and <math>\leq 100^{\circ}\text{C}</math></li> <li>- Test speeds: 50 km/h and 100 km/h or 0.8</li> </ul>	<p>“... – with single brake control activated) <b>applying the conditions relevant to the brake system and vehicle being tested.</b>”</p> <p>When the brakes have been tested in accordance with test procedure 4.9.8.1:  - <b>the system shall comply with the failure warning requirements of paragraph 3.1.7. and</b>  - 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.  <b>(Informal doc. GRRF-58-23)</b></p> <p>“The test is applicable to vehicle categories 3-3, 3-4, <b>and</b> 3-5”</p> <p><b>How many tests are required, both 50km/h and 100km/h?</b></p> <p><b>When is this Min. speed used?</b></p>
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<p>V max, whichever is lower.</p> <ul style="list-style-type: none"> <li>- Minimum test speed = 25 km/h</li> <li>- Brake actuation force: Hand control <math>\leq 250\text{N}</math> Foot control <math>\leq 400\text{N}</math></li> <li>- Number of stops: until the vehicle meets the performance requirements, with a maximum of 6 tests.</li> <li>- 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.</li> </ul> <p>4.10.4 Performance requirements</p> <p>When the brakes have been tested in accordance with the test procedure in section 4.10.3:</p> <ul style="list-style-type: none"> <li>- the system shall comply with the failure warning requirements of 3.1.6 and</li> <li>- Stopping distance (S) shall be <math>\leq 0.1 V + V^2 / 85</math> (where V is the specified test speed in km/h and S is the required stopping distance in metres) or the MFDD shall be <math>\geq 3.3\text{m/s}^2</math></li> </ul> <p>4.11 Servo Failure Test</p> <p>4.11.1 General information:</p> <ul style="list-style-type: none"> <li>- Test is not required when the vehicle is equipped with another separate service brake system.</li> <li>- Test is to confirm the performance of the brake system in the event of failure of servo assistance.</li> </ul>	<p>V max, whichever is lower.</p> <ul style="list-style-type: none"> <li>- Minimum test speed = 25 km/h</li> <li>- Brake actuation force: Hand control <math>\leq 250\text{N}</math> Foot control <math>\leq 400\text{N}</math></li> <li>- Number of stops: until the vehicle meets the performance requirements, with a maximum of 6 tests.</li> <li>- The service brake system shall 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 the test for each subsystem.</li> </ul> <p>4.10.4 Performance requirements</p> <p>When the brakes have been tested in accordance with the test procedure in section 4.10.3:</p> <ul style="list-style-type: none"> <li>- the system shall comply with the failure warning requirements of 3.1.6 and</li> <li>- the stopping distance (S) shall be <math>\leq 0.1 V + V^2 / 85</math> (where V is the specified test speed in km/h and S is the <u>required</u> stopping distance in metres) or the MFDD shall be <math>\geq 3.3\text{m/s}^2</math></li> </ul> <p>4.11 Power-assisted braking system failure Test</p> <p>4.11.1 General information:</p> <ul style="list-style-type: none"> <li>- The test is not required when the vehicle is equipped with another separate service brake system.</li> <li>- The test is to confirm the performance of the brake system in the event of failure of the power assistance.</li> </ul>		
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“- Carry out the test in section

<p>4.11.2 Test conditions and procedure</p> <ul style="list-style-type: none"> <li>- 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.</li> </ul> <p>4.11.3 Performance requirements</p> <ul style="list-style-type: none"> <li>- When the brakes have been tested in accordance with test procedure 4.11.2: Stopping distance (S) shall be <math>\leq 0.1 V + V^2/65</math> (where V is the specified test speed in km/h and S is the corrected stopping distance in metres) or the MFDD shall be <math>[\geq 2.5\text{m/s}^2]</math></li> <li>- Note that if the servo is activated by more than one control, the above performance shall be achieved for each control applied separately.</li> </ul>	<p>4.11.2 Test conditions and procedure</p> <ul style="list-style-type: none"> <li>- Carry out the test in section 4.3 (Dry Stop Test – with single brake control activated), if required, for each brake system with the <b>power assistance</b> disabled.</li> </ul> <p>4.11.3 Performance requirements</p> <ul style="list-style-type: none"> <li>- When the brakes have been tested in accordance with test procedure 4.11.2: Stopping distance (S) shall be <math>\leq 0.1 V + V^2/65</math> (where V is the specified test speed in km/h and S is the <u>corrected</u> stopping distance in metres) or the MFDD shall be <math>\geq 2.5\text{m/s}^2</math></li> <li>- Note that if the <b>power assistance</b> is activated by more than one control, the above performance shall be achieved for each control applied separately.</li> </ul>	<p>GRRF – UK thought <math>2.5 \text{ m/s}^2</math> was too low.</p>	<p>4.3 (Dry Stop Test – with single brake control activated), <del>if</del> <b>required</b>, for each brake system with the <b>power assistance</b> disabled.”</p>
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