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## Economic Commission for Europe

### Inland Transport Committee

### World Forum for Harmonization of Vehicle Regulations

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Item 14.1 of the provisional agenda

**Consideration and vote by AC.3 of draft gtrs and/or  
draft amendments to established gtrs - Proposal for  
Amendment 2 to gtr No. 3 (Motorcycle braking)**

### **Proposal for Amendment 2 to global technical regulation No. 3 (Motorcycle braking)**

#### **Submitted by the Working Party on Brakes and Running Gear\***

The text reproduced below was adopted by the Working Party on Brakes and Running Gear (GRRF) at its seventy-eighth session (ECE/TRANS/WP.29/GRRF/78, para. 21). It is based on ECE/TRANS/WP.29/GRRF/2014/22 as amended by paragraph 21 of the report. It is submitted to the World Forum for Harmonization of Vehicle Regulations (WP.29) and to the Executive Committee of the 1998 Agreement (AC.3) for consideration.

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\* In accordance with the programme of work of the Inland Transport Committee for 2012–2016 (ECE/TRANS/224, para. 94 and ECE/TRANS/2012/12, programme activity 02.4), the World Forum will develop, harmonize and update Regulations in order to enhance the performance of vehicles. The present document is submitted in conformity with that mandate.

## **A. Statement of technical rationale and justification**

### **I. Objective**

1. The objective of this proposal is to recommend the adoption of an amendment to the current global technical regulation (gtr) on motorcycle brake systems. At the June 2013 session of the Executive Committee (AC.3), Contracting Parties to the 1998 Global Agreement, under the World Forum for Harmonization of Vehicle Regulations (WP.29), gave their consent to amend gtr No. 3.

### **II. Introduction**

2. One of the main purposes of gtr No. 3 is to reduce the injuries and fatalities associated with motorcycle accidents by addressing the braking performance of motorcycles as a means of improving road safety.

3. Gtr No. 3 provides clear and objective test procedures and requirements that can be easily followed and also addresses the development in current Combined Braking System (CBS) and Anti-lock Braking System (ABS) technologies.

4. The objective of this proposal is to clarify the current text of gtr No. 3 on motorcycle brake systems on concerns raised about the possible confusion of the gtr text caused by the interpretation of the terms "inoperative" and "disconnected".

5. The proposal introduces the text of the "K-method" into the gtr.

6. Gtr No. 3, paragraph 3.1.9., requires that "two separate brake systems may only share a common brake if a failure in one system does not affect the performance of the other", limits the application of CBS.

7. Not all CBS architectures can meet this requirement although they will outperform conventional brake systems.

8. Not all CBS architectures, however, existed at the time the original CBS requirements were drafted (in the 1980s) and it is, therefore, understood that GRRF did not consider such systems when introducing this requirement.

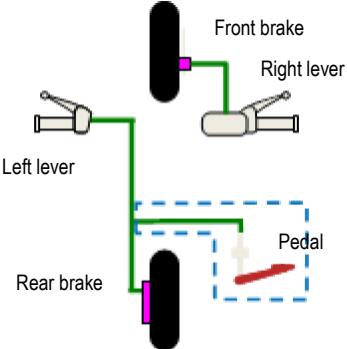
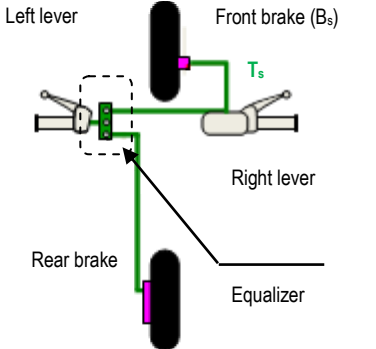
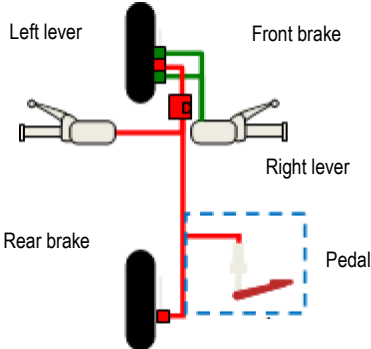
9. In order to ensure that, in case of a failure in one system, the performance of the other system still equals that of a conventional system, it is proposed to allow two separate brake systems to share a brake and/or a transmission, provided that the other system meets the single brake system performance requirements in case of a failure of such shared components(s). To that end, a failure test is proposed for CBS brake systems of Architecture B. Italy is of the opinion that such a failure test requirement should ensure the acceptance of such a CBS in terms of demonstrated robustness and guaranteed minimum braking performance.

### **III. Justification of changes**

10. The terms "inoperative" and "disconnected": for the disconnected-method the brake-line pressure is the maximum braking pressure just before wheel-locking (higher pressure than ABS operating start) where as for the inoperative-method the brake-line pressure is lower than ABS operating start, so braking pressure during K-measurement can be adjusted only lower range than ABS operating.

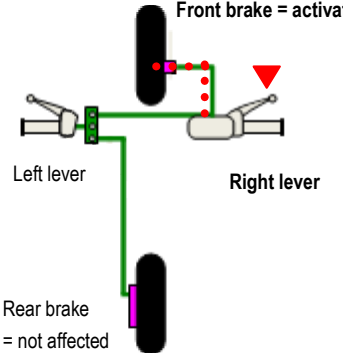
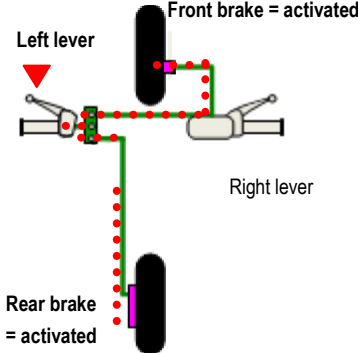
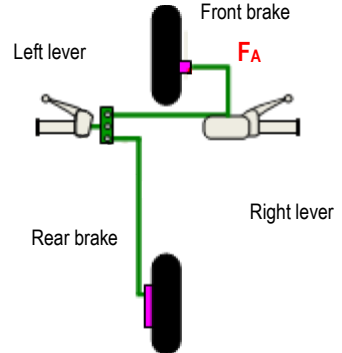
11. This amendment clarifies the term "inoperative" by clearly stating that it refers to when the ABS function is disabled.
12. Clarification of cross-references to ensure correct test is used for the right category of vehicles.
13. The clarification of "Fully cycling" ensures that brake force modulates repeatedly or continuously during ABS braking. This allows for a wider range of modulations, not limited to the traditional ABS cycles. The term "cycle fully" has been replaced by "fully cycling" in the text for sake of consistency.

"The force applied is that which is necessary to ensure that the ABS will **be fully cycling** throughout each stop, down to 10 km/h."
14. This amendment updates the use of SI units and change in decimal points.
15. It has been noticed during testing that the brake application rate specified in paragraph 4.9.5.1. can result in a large number of test failures. Allowing the reduction tends to make the regulation more stringent by including a greater number of brake force application rates and eliminates restrictive test requirements.
16. The amendment to paragraph 3.1.4. clarifies the cross-reference and refers to the category of vehicles to prevent any misunderstanding that may have been created by the current cross-reference as to which category of vehicles were subject to the parking brake test; the current cross-reference to the slope in paragraph 4.8.2., could be misunderstood as the parking brake test also being relevant to categories 3-1 and 3-3.
17. The K-method (alternative method for determining the PBC (peak brake coefficient)) text has been introduced as paragraph 5. rather than being referenced to allow clarity and ease of reference, especially if the K-method was updated.
18. Gtr No. 3, paragraph 3.1.9., requires that "two separate brake systems may only share a common brake if a failure in one system does not affect the performance of the other", limits the application of Combined Brake Systems (CBS).
19. Not all CBS architectures can meet this requirement although they will outperform conventional brake systems.
20. Not all CBS architectures were however existing at the time the original CBS requirements were drafted (in the 1980s) and it is therefore understood that GRRF did not consider such systems when introducing this requirement.
21. Architecture B is an example of a CBS that shares a transmission (Ts) and a brake (Bs).

<i>Conventional Brake System</i>	<i>Combined Brake System (CBS)</i>	
<i>Architecture A</i>	<i>Architecture B</i>	<i>Architecture C</i>
		
<ul style="list-style-type: none"> <li>▪ Left lever (pedal) operates rear brake only</li> <li>▪ Right lever operates front brake only</li> </ul>	<ul style="list-style-type: none"> <li>▪ Left lever operates CBS</li> <li>▪ Right lever operates front brake only</li> </ul>	<ul style="list-style-type: none"> <li>▪ Left lever (pedal) operates CBS</li> <li>▪ Right lever operates front brake only</li> </ul>

**CBS Architecture B**

22. While a failure in e.g. the "front system" ( $F_A$ ) may affect the performance of the CBS, the rear system (operated by the left lever) will continue to be operational.

<i>Normal operating conditions</i>		<i>Fail conditions</i>
<i>Right lever operation</i>	<i>Left lever operation (CBS)</i>	<i>Failure A (FA)</i>
		
<b>Front brake</b>		Defect
<b>Rear brake</b>		Operational by left lever

23. In order to ensure that, in case of a failure in one system, the performance of the other system still equals that of a conventional system, it is proposed to allow that two separate brake systems share a brake and/or a transmission, provided that the other system meets the single brake system performance requirements in case of a failure of such shared component(s). To that end, a failure test is proposed for CBS brake systems of Architecture B. Italy is of the opinion that such a failure test requirement should ensure the acceptance of such a CBS in terms of demonstrated robustness and guaranteed minimum braking performance.

#### **Other CBS architectures such as Architecture C**

24. A failure test is not necessary for this type of CBS architecture because there are no shared components with the exception of a brake cylinder, which is one of the components that are regarded to not be liable to breakage.

## **B. Proposed amendments**

*In the text of the regulation (part B)*

*Contents page, add to the end of the current contents list:*

"5. Alternative method for the determination of peak braking coefficient (pbc)"

*Paragraph 3.1.4., amend to read:*

"3.1.4. Parking brake system:

If a parking brake system is fitted, it shall hold the vehicle stationary on the slope prescribed in paragraph 4.1.1.4.

The parking brake system shall:

- (a) Have a control which is separate from the service brake system controls; and;
- (b) Be held in the locked position by solely mechanical means.

Vehicles shall have configurations that enable a rider to be able to actuate the parking brake system while seated in the normal driving position.

For 3-2, 3-4 and 3-5, the parking brake system shall be tested in accordance with paragraph 4.8."

*Paragraph 3.1.9., amend to read:*

"3.1.9. In cases where two separate service brake systems are installed, the systems may share a common brake a common transmission, or both if the requirements of paragraph 4.12. are met."

*Paragraphs 4.1.1.3. and 4.1.1.4., amend to read:*

"4.1.1.3. Measurement of PBC

The PBC is measured as specified in national or regional legislation using either:

- (a) An ASTM International (ASTM) E1136-93 (Re-approved 2003) standard reference test tyre, in accordance with ASTM Method E1337-90 (Re-approved 2008), at a speed of 40 mph; or
- (b) The method specified in paragraph 5.

4.1.1.4. Parking brake system tests

The specified test slope shall have a test surface gradient of 18 per cent and shall have a clean and dry surface that does not deform under the weight of the vehicle."

*Paragraphs 4.4.2.(c), and 4.5.2.(c), amend to read:*

"(c) Brake application:

Simultaneous actuation of both brake controls in the case of a vehicle with two service brake systems or actuation of the single brake control in the case of a vehicle with one service brake system."

*Paragraph 4.9.1., amend to read:*

"4.9.1. General:

...

- (c) "Fully cycling" means that the anti-lock system is repeatedly or continuously modulating the brake force to prevent the directly controlled wheels from locking."

*Paragraph 4.9.3.1., amend to read*

"4.9.3.1. Test conditions and procedure:

...

(c) Brake application:

Simultaneous actuation of both brake controls in the case of a vehicle with two service brake systems or actuation of the single brake control in the case of a vehicle with one service brake system.

(d) Brake actuation force:

The force applied is that which is necessary to ensure that the ABS will be fully cycling throughout each stop, down to 10 km/h."

*Paragraph 4.9.5.1., amend to read*

"4.9.5.1. Test conditions and procedure:

...

(e) Brake actuation force:

The force applied is that which is necessary to ensure that the ABS will be fully cycling throughout each stop, down to 10 km/h.

(f) Brake application rate:

The brake control actuation force is applied in 0.1 – 0.5 seconds."

*Paragraph 4.9.6.1., amend to read*

"4.9.6.1. Test conditions and procedure:

...

(e) Brake actuation force:

The force applied is that which is necessary to ensure that the ABS will be fully cycling throughout each stop, down to 10 km/h."

Paragraph 4.9.7.1., amend to read

"4.9.7.1. Test conditions and procedure:

...

(e) Brake actuation force:

The force applied is that which is necessary to ensure that the ABS will be fully cycling throughout each stop, down to 10 km/h."

Insert new paragraph 4.12., to read:

"4.12. CBS failure test

4.12.1. General information:

- (a) This test will only apply to vehicles fitted with CBS of which the separate service brake systems share a common hydraulic or common mechanical transmission;
- (b) The test is to confirm the performance of the service brake systems in the event of a transmission failure. This can be demonstrated by a common hydraulic hose or mechanical cable failure.

4.12.2. Test conditions and procedure:

- (a) Alter the brake system to produce a failure causing a complete loss of braking in the portion of the system which is shared.
- (b) Perform the dry stop test specified in section 4.3. in the laden condition. Other conditions to be observed are 4.3.1.(c) and 4.3.2.(a), (b), (d), (e) and (f). Instead of the provisions in section 4.3.2.(c), only apply the control for the brake not affected by the failure."

4.12.3. Performance requirements

When the brakes are tested in accordance with the test procedure set out in paragraph 4.12.2., the stopping distance shall be as specified in column 2 or the MFDD shall be as specified in column 3 of the following table:

Column 1	Column 2	Column 3
Vehicle Category	STOPPING DISTANCE (S) (Where V is the specified test speed in km/h and S is the required stopping distance in metres)	MFDD
Front wheel(s) braking only		
3-1	$S \leq 0.1 V + 0.0111 V^2$	$\geq 3.4 \text{ m/s}^2$
3-2	$S \leq 0.1 V + 0.0143 V^2$	$\geq 2.7 \text{ m/s}^2$
3-3	$S \leq 0.1 V + 0.0087 V^2$	$\geq 4.4 \text{ m/s}^2$
3-4	$S \leq 0.1 V + 0.0105 V^2$	$\geq 3.6 \text{ m/s}^2$
3-5	$S \leq 0.1 V + 0.0117 V^2$	$\geq 3.3 \text{ m/s}^2$
Rear wheel(s) braking only		
3-1	$S \leq 0.1 V + 0.0143 V^2$	$\geq 2.7 \text{ m/s}^2$
3-2	$S \leq 0.1 V + 0.0143 V^2$	$\geq 2.7 \text{ m/s}^2$
3-3	$S \leq 0.1 V + 0.0133 V^2$	$\geq 2.9 \text{ m/s}^2$
3-4	$S \leq 0.1 V + 0.0105 V^2$	$\geq 3.6 \text{ m/s}^2$
3-5	$S \leq 0.1 V + 0.0117 V^2$	$\geq 3.3 \text{ m/s}^2$

Insert new paragraph 5., to read:

"5. Alternative method for the determination of Peak Braking Coefficient (PBC)

5.1. General

- (a) The test is to establish a PBC for the vehicle when being braked on the test surfaces described in paragraphs 4.1.1.1. and 4.1.1.2.
- (b) The test comprises a number of stops with varying brake control forces. Both wheels shall be braked simultaneously up to the point reached before wheel lock, in order to achieve the maximum vehicle deceleration rate on the given test surface.
- (c) The maximum vehicle deceleration rate is the highest value recorded during all the test stops.
- (d) The PBC is calculated from the test stop that generates the maximum vehicle deceleration rate, as follows:

$$PBC = \frac{0.566}{t}$$

where:

t = time taken for the vehicle speed to reduce from 40 km/h to 20 km/h in seconds.

Note: For vehicles unable to achieve a test speed of 50 km/h, PBC shall be measured as follows:

$$PBC = \frac{0.566}{t}$$

where:

t = time taken, in seconds, for the speed of the vehicle to reduce from  $0.8 V_{\max}$  to  $(0.8 V_{\max} - 20)$ , where  $V_{\max}$  is measured in km/h.

- (e) The value of PBC shall be rounded to two decimal places.

5.2. Vehicle condition

- (a) The test is applicable to vehicle categories 3-1 and 3-3.
- (b) The anti-lock system, if fitted, shall be either disconnected or inoperative (ABS function disabled), between 40 km/h and 20 km/h.
- (c) Lightly loaded.
- (d) Engine disconnected.

5.3. Test conditions and procedure

- (a) Initial brake temperature:  $\geq 55$  °C and  $\leq 100$  °C.
- (b) Test speed: 60 km/h or  $0.9 V_{\max}$ , whichever is lower.
- (c) Brake application:

Simultaneous actuation of both service brake system controls, if so equipped, or of the single service brake system control in the case of a service brake system that operates on all wheels.



For vehicles equipped with a single service brake system control, it may be necessary to modify the brake system if one of the wheels is not approaching maximum deceleration.

- (d) Brake actuation force:

The control force that achieves the maximum vehicle deceleration rate as defined in paragraph 5.1.(c).

The application of the control force must be constant during braking.

- (e) Number of stops:

Until the vehicle meets its maximum deceleration rate.

- (f) For each stop, accelerate the vehicle to the test speed and then actuate the brake control(s) under the conditions specified in this paragraph."
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