



# Economic and Social Council

Distr.: General  
5 July 2013

Original: English

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## Economic Commission for Europe

### Inland Transport Committee

### World Forum for Harmonization of Vehicle Regulations

#### Working Party on Brakes and Running Gear

#### Seventy-fifth session

Geneva, 17-19 September 2013

Item 5(b) of the provisional agenda

#### Motorcycle braking – Global Technical Regulation No. 3

## Proposal for amendments to Global Technical Regulation No. 3 (Motorcycle brake systems)

### Submitted by the representative from Italy\*

The text reproduced below was prepared by the expert from Italy in order to introduce amendments to clarify the text of the Regulation. The modifications to the current text of the Regulation are marked in bold for new or strikethrough for deleted characters.

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\* In accordance with the programme of work of the Inland Transport Committee for 2010–2014 (ECE/TRANS/208, para. 106, ECE/TRANS/2010/8, 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.

## 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 then its consent to amend UN GTR No. 3.

### II. Introduction

2. One of the main purposes of UN GTR 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. UN GTR No. 3 provides clear and objective test procedures and requirements that can be easily followed and also addresses the development in current CBS and ABS technologies.

4. The objective of this proposal is to clarify the current text of UN 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. The proposal introduces the use of a representative vehicle based on the details given in UN Regulation No. 13-H.

### III. Justification of changes

7. 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.

8. This amendment clarifies the situation using the term "inoperable" for both the terms. The dictionary definition for "inoperable" is "incapable of being implemented or operated; unworkable".

9. Clarification of cross-references to ensure correct test is used for the right category of vehicles.

10. Clarification is given on what should be considered as a representative vehicle.

11. 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 ~~cycle fully~~ **be fully cycling** throughout each stop, down to 10 km/h."

12. This amendment updates the use of SI units and change in decimal points.

13. It has been noticed in testing that the brake application rate specified in section 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.

14. 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 4.8.2, could be misunderstood as the parking brake test being also relevant to category 3-1 and 3-3.

15. 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 for clarity and ease of reference especially if the K-method was updated.

16. The use of an representative vehicle with the specified tires is being proposed when the vehicle being used for type approval makes it difficult to undertake the PBC test due to possible rear-wheel lift during maximum braking or not getting into the wheel lock, because of brake performance (brake lever stroke reaches full stroke before wheel locking).

17. The K-method PBC test is not for the vehicles but for the test surface whereas according to the ASTM method the same specification tire should always be used. So from the point of view of control of test surface, using same vehicle (ASTM) which means same specification tire for PBC test is more appropriate.

18. Tests under taken during the initial grt development have shown correlation between K-method and ASTM method which support the use of an alternative vehicle with the specified tires.

## IV. Justifications for the proposed amendments

### A. Justification 1

Paragraph 3.1.4. Parking brake system:

Paragraph 4.1.1.4. Parking brake system tests:

(a) Currently in paragraph 3.1.4 Parking brake system following is described.

"If a parking brake system is fitted, it shall hold the vehicle stationary on the slope prescribed in paragraph 8.2."

And in "paragraph 4.8 in Annex 3"

"4.8. Parking brake system test – for vehicles equipped with parking brake

4.8.1. Vehicle condition:

- (a) The test is applicable to vehicle categories 3-2, 3-4 and 3-5;
- (b) Laden;
- (c) Engine disconnected.

4.8.2. Test conditions and procedure:

- (a) -----
- (b) -----"

Because "in paragraph 4.8.2" is described in paragraph 3.1.4., it can be jumped from paragraph 3.1.4. to paragraph 4.8.2.

In this case objective category described in paragraph 4.8.1. for parking brake test can be ignored, and it can be possible to misunderstand that category 3-1 and 3-3 are also objected for parking brake test.

This proposal is to prevent this misunderstanding.

In paragraph 5.2.6., Parking brake system test in "STATEMENT OF TECHNICAL RATIONALE AND JUSTIFICATION" of UN GTR No. 3, following is described.

"5.2.6. Parking brake system test

The purpose of the parking brake system requirement in the motorcycle brake systems gtr is to ensure that 3-wheeled motorcycles can remain stationary without rolling away when parked on an incline."

(b) Slope prescription in paragraph 4.1.1.4. is not enough for gradient.

## **B. Justification 2**

Paragraph 4.1.1.3. Measurement of PBC

*Insert new Paragraph 5.*

(a) Currently in 1.1.General in 4.1.1.3 the following is described.

"(a) The test is to establish a PBC for the vehicle type when being braked on the test surfaces described in 4.1.1.1. and 4.1.1.2."

The terms "for the vehicle type" infers that the vehicle used for PBC test should only be only the vehicle used for type approval. The PBC test in this instance is not for the vehicle but for the test surface. In method (a) (ASTM method) specifies that always the same specification tire should be used but from the point of view for control of test surface, using same vehicle, which means same specification tire, for PBC test is more appropriate.

(b) In some instances just before the wheel-locking condition for all-wheels during the PBC test, the following may happen to the vehicle for type approval:

- "(a) rear wheel lift due to maximum braking may cause difficulties in undertaking the PBC test.
- (b) vehicle not getting into the wheel lock, because of reduction in brake performance (brake lever stroke reaches full stroke before wheel locking).
- (c) For 3-wheeled motorcycles ( $L_2$ ,  $L_4$ ,  $L_5$ ), the PBC test is not described and it may understood that the PBC test is not possible for these vehicle types for type approvals."

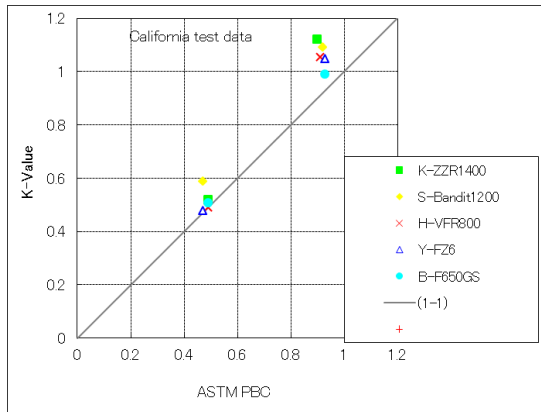
(c) During GTR3 discussion, correlation test between K-method and ASTM method had been done in California. The data from the test are shown in the below graph.

PBC values by K-method were for same course, and the following were recognized.

- PBC values were different by measuring motorcycle (tyre).
- Such level of difference should be permitted.

It was recognized that even for the same course PBC values were different for each motorcycle. It was noted that it is beneficial to measure the PBC values of the course using the same motorcycle to maintain the course PBC value condition.

The IMMA proposal includes a condition saying that when choosing the motorcycle, correlation level of the motorcycle for K-method to ASTM method should be confirmed. IMMA believes that the motorcycle with correlation level the same level as California test result can be a representative vehicle to be used for measuring PBC values of the course.



(d) BMW test results (friction coefficient tyre/road with different motorcycles and the same motorcycle but different tyres) showed on the same track (even on the same day with the same driver) following results:

These results show that tire different (also motorcycle different) makes PBC values of the course different and the difference are not so little.

This is the reason why measuring PBC value by a representative vehicle (always same motorcycle, same tire) is useful for maintaining PBC value of the course.

- BMW F800ST (tyre: Continental Sport Attack): 1.1
- BMW 1200 GS HP2 (tyre Michelin Annakee): 1.0
- BMW 1200 GS HP2 (tyre Metzeler Enduro 3): 0.83
- BMW 1200 GS HP2 (tyre Metzeler Karoo): 0.73



BMW F800ST



BMW HP2



Continental Sport Attack



Metzeler Karoo



Metzeler Enduro 3



Michelin Annakee

(e) In R13-H, paragraph 2.2. of the Annex6-Appendix4 "METHOD OF SELECTION OF THE LOW ADHESION SURFACE" saying that the calibration of the surface has to be carried out at least once a year with a representative vehicle to verify the stability of R.

Representative vehicle can be used in UN Regulation No. 13-H.

### C. Justification 3

Paragraph 4.9. ABS tests

(a) The clarification of the term "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.

(b) For consistency the term "cycle fully" has been replaced by "fully cycling" which is defined paragraph 4.9.1. The definition has been clarified so that it now allows for a wider range of modulations and is not limited to the traditional ABS cycles.

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

### D. Justification 4

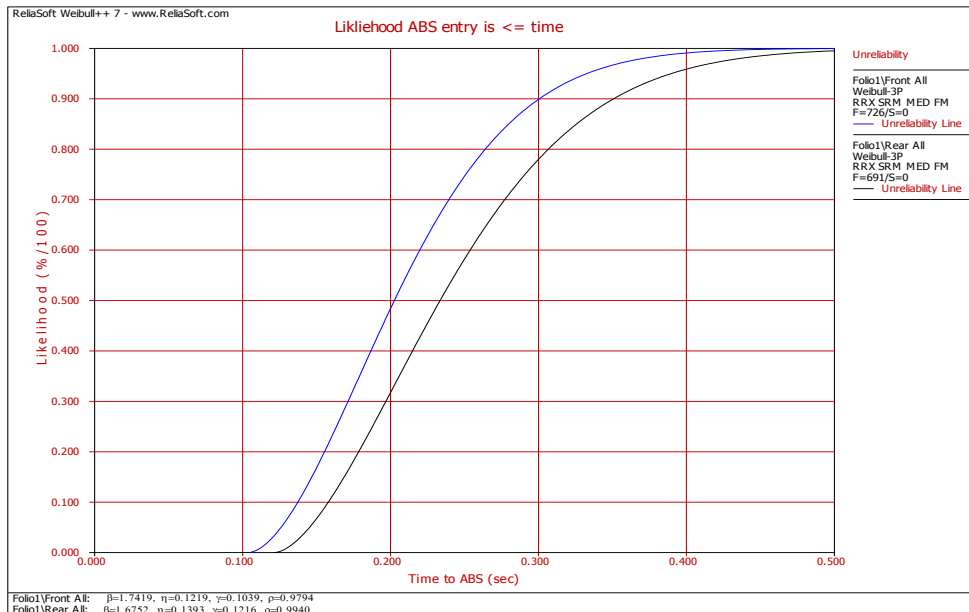
Paragraph 4.9. ABS tests

"4.9.5. ...

(f) Brake application rate:

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

It has been noticed in testing that the brake application rate specified in section 4.9.5.1 can result in a large number of test failures. It can be seen in the chart below that the 0.2 second lower limit shows a failure rate is between 30% and 50% of the time.



By reducing the lower limit to 0.1 seconds the test failure rate reduces to practically zero. 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.

## V. 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 ~~4.8.2~~ **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."**

*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 determined by the approval authority~~ using either:

- (a) the American Society for Testing and Materials (ASTM) E1136 standard reference test tyre, in accordance with ASTM Method E1337-90, at a speed of 40 mph ~~without water delivery~~; or
- (b) the method specified in the ~~appendix to Annex 4 paragraph 5. of UNECE Regulation No. 78, 01 series of amendments~~

**Note: A representative vehicle may be acceptable for PBC measurement by method (b) if that vehicle has shown the same nominal PBC on both high  $\mu$  and low  $\mu$  as previously determined by method (a).**

**PBC measurement of the surface shall be carried out at least once a year. PBC measurement shall be completed prior to testing if any major maintenance or alterations that may significantly modify the PBC have occurred since the last measurement.**

4.1.1.4. Parking brake system tests

The specified test slope ~~has~~ **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."

*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:

...

- (d) Brake actuation force:

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

*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 Peak Braking Coefficient (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 shall be inoperable 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 6.1. (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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