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Item 5(a) of the provisional agenda

Motorcycle braking – Regulation No. 78**Proposal for amendments to Regulation No. 78 (Uniform provisions concerning the approval of vehicles of categories L₁, L₂, L₃, L₄ and L₅ with regard to braking)****Submitted by the expert from International Motorcycles Manufacturers Association***

The text reproduced below was prepared by the experts from the International Motorcycles Manufacturers Association (IMMA) to introduce amendments clarifying the current text on the use of Combined Braking Systems (CBS) and some general text of the Regulation, based on document GRRF-76-45, as agreed at the seventy-sixth GRRF session. The modifications to the current text of the Regulation are marked in bold for new or strikethrough for deleted characters.

* 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.

I. Proposal

Paragraph 5.1.4., amend to read:

"5.1.4. Parking brake system

If a parking brake system is fitted, it shall hold the vehicle stationary on the slope prescribed in paragraph ~~8.2. of Annex 3~~ **1.1.4. of Annex 3.**

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 L₂, L₄ and L₅, the parking brake system shall be tested in accordance with paragraph 8. of Annex 3."

Paragraph 5.1.9., amend to read:

"5.1.9. In cases where two separate service brake systems are installed, the systems may share a common brake, ~~if a failure in one system does not affect the performance of the other~~ **a common transmission, or both if the requirements of Annex 3, paragraph 12. are met.**"

Annex 3,

Paragraphs 1.1.3. and 1.1.4., amend to read:

"1.1.3. Measurement of PBC

The PBC is measured as determined by the approval authority using either:

- (a) ~~The American Society for Testing and Materials~~ **An ASTM International** (ASTM) E1136-93 (Re-approved 2003) standard reference test tyre, in accordance with ASTM Method E1337-90 (Re-approved ~~2002~~ **2008**), at a speed of 40 mph; or
- (b) the method specified in the Appendix 1 to this ~~annex~~ **Annex**:

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 mass of the vehicle."

Paragraphs 9. to 9.7.1., amend to read:

"9. ABS tests

9.1. General:

- (a) The tests are only applicable to the ABS fitted on vehicle categories L₁ and L₃;
- (b) The tests are to confirm the performance of brake systems equipped with ABS and their performance in the event of ABS electrical failure;
- (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.

- ...
- 9.3. Stops on a high friction surface:
- 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.
- ...
- 9.5. Wheel lock checks on high and low friction surfaces:
- 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 ~~0.2~~ **0.1** – 0.5 secs.
- ...
- 9.6. Wheel lock check - high to low friction surface transition:
- 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.
- ...
- 9.7. Wheel lock check - low to high friction surface transition:
- 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.
- ..."

Paragraphs 4.2. (c), 5.2. (c), and 9.3.1. (c), amend to read:

"(c) Brake application:

Simultaneous actuation of both ~~service brake system controls, if so equipped,~~ **in the case of a vehicle with two service brake systems** or **actuation** of the single ~~service brake system~~ control in the case of a **vehicle with one** service brake system ~~that operates on all wheels."~~

Add a new paragraph 12., to read:

"12. CBS failure test

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.

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 3. in the laden condition. Other conditions to be observed are 3.1. (c) and 3.2. (a), (b), (d), (e) and (f). Instead of the provisions in section 3.2. (c), only apply the control for the brake not affected by the simulated failure.

12.3. Performance requirements

When the brakes are tested in accordance with the test procedure set out in paragraph 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		
L ₁	$S \leq 0.1 V + 0.0111 V^2$	$\geq 3.4 \text{ m/s}^2$
L ₂	$S \leq 0.1 V + 0.0143 V^2$	$\geq 2.7 \text{ m/s}^2$
L ₃	$S \leq 0.1 V + 0.0087 V^2$	$\geq 4.4 \text{ m/s}^2$
L ₄	$S \leq 0.1 V + 0.0105 V^2$	$\geq 3.6 \text{ m/s}^2$
L ₅	$S \leq 0.1 V + 0.0117 V^2$	$\geq 3.3 \text{ m/s}^2$
Rear wheel(s) braking only		
L ₁	$S \leq 0.1 V + 0.0143 V^2$	$\geq 2.7 \text{ m/s}^2$
L ₂	$S \leq 0.1 V + 0.0143 V^2$	$\geq 2.7 \text{ m/s}^2$
L ₃	$S \leq 0.1 V + 0.0133 V^2$	$\geq 2.9 \text{ m/s}^2$
L ₄	$S \leq 0.1 V + 0.0105 V^2$	$\geq 3.6 \text{ m/s}^2$
L ₅	$S \leq 0.1 V + 0.0117 V^2$	$\geq 3.3 \text{ m/s}^2$

Annex 3, Appendix 1, paragraphs 1.1. to 1.2., amend to read:

"1.1. General:

...

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

1.2. Vehicle condition:

(a) The test is applicable to vehicle categories L₁ and L₃.

- (b) The anti-lock system shall be either disconnected or inoperative (**ABS function disabled**), between 40 km/h and 20 km/h.
- (c) Lightly loaded.
- (d) Engine disconnected."

II. Justifications

A. Justification 1

1. Paragraph 5.1.4. Parking brake system:
Paragraph 1.1.4. of Annex 3, Parking brake system tests:
 - (a) Currently in paragraph 5.1.4. Parking Brake System is described as:
"If a parking brake system is fitted, it shall hold the vehicle stationary on the slope prescribed in paragraph 8.2."
2. And in "paragraph 8. in Annex 3":
 - "8. Parking brake system test – for vehicles equipped with parking brake
 - 8.1. Vehicle condition:
 - (a) The test is applicable to vehicle categories L₂, L₄ and L₅;
 - (b) Laden;
 - (c) Engine disconnected.
 - 8.2. Test conditions and procedure:
 - (a) -----
 - (b) -----"
3. As "in paragraph 8.2. of Annex 3" is referred to paragraph 8.1.4., there is a concern that users may miss the intervening requirements if they move from paragraph 5.1.4. to paragraph 8.2. of Annex 3.
4. In this case objective category described in paragraph 8.1. for parking brake test can be ignored, and it can be also misunderstood that categories L1 and L3 are also objected for parking brake test.
5. This proposal prevents this misunderstanding.
6. In paragraph 5.2.6., the Parking Brake System test defined in the "Statement of technical rationale and justification" section of UN GTR No. 3, is described as follows:
 - "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) The slope prescription in paragraph 8.2. (b) of Annex 3 is not enough for gradient.

B. Justification 2

7. Annex 3. Test conditions, procedures and performance requirements.

8. Paragraph 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 in paragraph 9.1. to this annex. 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.

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

C. Justification 3

10. Annex 3. Test conditions, procedures and performance requirements

11. Paragraph 9. ABS tests

"9.5. ...

(f) Brake application rate:

The brake control actuation force is applied in ~~0.2~~ 0.1 – 0.5 seconds."

12. 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 per cent and 50 per cent of the time.



13. 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.

D. Justification 4

14. Annex 3. Test conditions, procedures and performance requirements
15. Appendix 1. Alternative Method for the Determination of Peak Braking Coefficient (PBC)
 - 1.1. e) ...
 - 1) The level of accuracy is not necessary as all the other values are given to 2 decimal places.
 - 1.2. Vehicle condition:
 - 2) Concern had been raised about the possible confusion of the regulation caused by the interpretation of the terms "disconnected" and "inoperative". 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 during K-measurement, the braking pressure can be adjusted only to the lower range than ABS operating.
 - 3) This amendment clarifies the term "inoperative" by clearly stating that it refers to when the ABS function is disabled.

E. Justification 5

16. The proposed amendment to Annex 3 paragraphs 4.2. (c), 5.2. (c), and 9.3.1. (c) – brake application:
17. The intent of this paragraph in UN Regulation No. 78 is to ensure that systems with one service brake meet braking performance requirements using only that brake system. This prevents manufacturers from producing systems that rely on the secondary brake to meet primary braking performance requirements.
18. The text was not intended to prevent simultaneous actuation of controls where two service brake systems are present, even if one or both are CBS.
19. However, there was an interpretation by a type approval authority that for CBS with two service brake systems, actuating each single control must meet the requirements for simultaneous actuation of both controls on an independent system because that brake control operates on both wheels.
20. This creates significantly more stringent requirements for CBS than was intended by R78 and may have the effect of restricting CBS implementations. The result may be fewer CBS and more independent systems. As CBS provides more rider benefits this is not desirable.
21. To quantify how much more stringent the type approval authority's interpretation is; comparison to section 3, which defines the CBS performance requirements, can be used. The table below shows that with the type authority's interpretation CBS performance would have to be 20 to 30 percent greater than intended by UN Regulation No. 78.

	<i>Performance requirements</i>	
<i>R78, Annex 3 Paragraph</i>	<i>MFDD (m/s²)</i>	<i>Stopping distance (m)</i>
3	5.1	33.36
9.3	6.17	22.68
Difference	21%	32%

22. Direct comparisons to sections 4 and 5 are more difficult due to different test speed requirements, but a relative analysis shows that with the type authority's interpretation CBS performance would have to be 30-35% greater for section 4 and 10-15% greater for section 5.

23. CBS requirements are already more stringent than for Independent systems. Front CBS performance must be 15% greater than front Independent systems and rear CBS performance must be 75% greater than rear independent systems.

24. To avoid placing excessively stringent requirements on CBS and to clarify the intent of Regulation No. 78 the proposals is being made for sections 4.2 (c), 5.2. (c), and 9.3.1. (c).

25. To clarify to which parts of the braking system should be considered with respect to hydraulic and mechanical transmissions.

26. In the test conditions and procedure, there was a need to simulate a failure rather than producing a failure.
