Comments from India on Informal document Inf. 59-24 dated 3 February, 2006 on GTR for Motorcycle Braking

(Note : Comments are given in bold, italic, blue letters)

Sr. No.	Item No. of Section of B of Inf. doc 59-24	Proposed amendment	Justification
1.	**1.**	Following may be inserted in the Scope: "This GTR does not cover additional requirements for braking system fitted with electrical regenerative braking system"	The current draft GTR does not cover any of the additional requirements for electric regenerative braking. Considerable work is taking place in India for developing electric two and three wheelers which would use electrical regenerative braking system. The current Indian regulation incorporates additional requirements of these system to some extent. This regulation is being revised taking into account the features prescribed in ECE R13H. This work could be completed in about 6 months time. A proposal to this effect will be put up by India to incorporate regenerative braking requirements in the GTR.
2.	**2.18**	"Split service brake system (SSBS)" means a brake system that actuates the brakes on all wheels, consisting of two or more subsystems actuated by a single control, ***which may act on selected wheel(s) or all wheels***, 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.	There are various methods of sub-systems. The brake force transmission circuit may be split in such a way that: a) One circuit is connected to front wheel(s) and the other to rear wheel(s) or b) In the case of drum brakes with twin leading shoes, one circuit can be connected to one wheel cylinder per wheel on all wheels, and the other circuit to the second wheel cylinder of all wheels. The advantage of option b) is that achieving secondary brake performance is not related to the individual wheel reactions. This would be very useful in the case of three wheelers. The suggested amendment is to facilitate use of different options of sub-systems.
3.	**2.19**	"Stopping distance" 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. ***When tests are conducted with simultaneous application of two controls the control applied first shall be considered as the moment of application of the control.***	To clarify the situation when tests are conducted with two control applied, E.g Dry Stop Test – all service brake controls actuated (Item 4.4)

4.	**2.20**	"Test speed" means the vehicle speed measured at the moment of application of the brake control(s). ***When tests are conducted with simultaneous application of two controls, the control applied first shall be considered as the moment of application of the control.***	Same as for item 2.19
5.	**2.22**	"Vmax" means the speed attainable ~~by accelerating at a maximum rate from a standing start for a distance of 1.6 km on a level surface~~, ***when tested as per procedure given in ISO 7117,*** with the vehicle lightly loaded.	The method prescribed would require a very long test track. The measuring of the maximum speed as per ISO 7117 method can be done on a shorter test track. Moreover this method would be more repeatable.
6.	New clause for definition	***" Vehicle average deceleration " means the deceleration over the stopping distance , in metres calculated as under.*** ***$d_a = V^2/2S$;*** ***where V = test speed in m/s.*** ***S = stopping distance in metres*** ***d_a = vehicle average deceleration , in m/s².***	The document uses the expression "vehicle deceleration" in connection with instantaneous deceleration as well as average deceleration. India suggests the definition for " vehicle average deceleration" to be included for better clarity. Suggestions to change the expression to "vehicle average deceleration" have also been made at appropriate clauses of the document.
7.	3.1.10. a	have a sealed, covered, separate reservoir for each brake system. ***A single reservoir with partition for each sub-system with a sealed cover is permissible provided requirements of (b) and (c) below are met for each subsystem.***	A common reservoir with a partition separating the container is equally effective. Use of such containers is very common in India both for 3 wheelers and 4 wheelers. Typical pictures of such a reservoir is attached at **Annexure - A**. The amendment is suggested to permit use of such reservoirs. India had suggested this earlier also and agreed to review the same in the next meeting and amend it accordingly.
8.	3.1.11. (a)	Vehicles that are equipped with a split service brake system shall be fitted with a red warning lamp, that is mounted in ***the*** view of the rider and which shall be activated, when there is a hydraulic failure on the application of a force of ≤ 90 N on the control,	It is felt that in the case of category 3-4 vehicles, where the split system is as commonly used as in the case of four – wheeled passenger vehicles, it is not necessary to make the conditions more stringent than that of the four wheeled passenger vehicles. It may be noted that FMVSS 571.135 and draft GTR for passenger vehicle braking, (Document PV GTR 2005 – 1) prescribes this option . India had made a suggestion earlier that this requirement may be made applicable for vehicle with Vmax > 60
	(b)	without actuation of the brake control, when the brake fluid level in the master cylinder reservoir falls below the greater of: (1) the level specified by the manufacturer; and (2) the level less than or equal to half of the fluid reservoir capacity.	

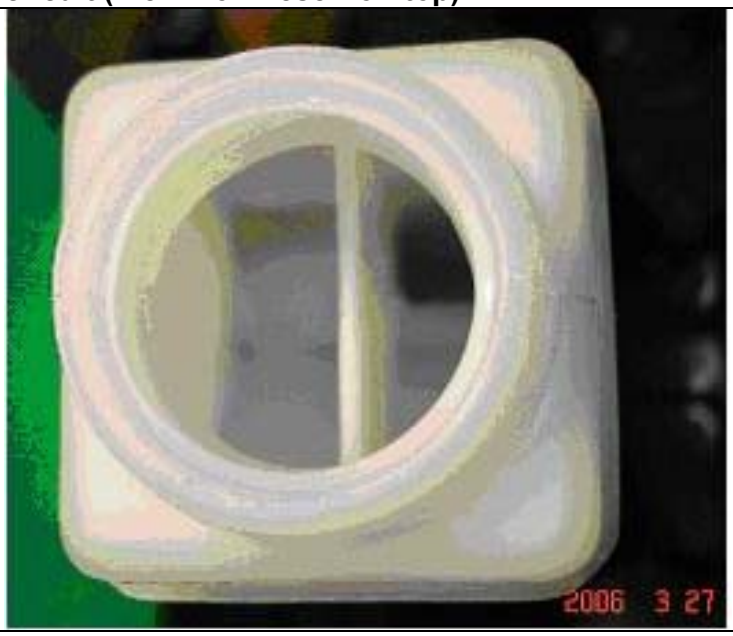
	(c)	***In the case of vehicles of category 3-4, the warning lamp may be activated whenever any one of the conditions given in (a) or (b) above occur, (chosen at the option of the manufacturer)***	km/h which was not accepted. It is felt that the requirements for three wheelers need not be made more stringent than passenger cars.
9.	4.2.5	Burnishing procedure : The vehicle brakes must be burnished prior to evaluating performance. This procedure may be completed by the manufacturer. - Vehicle lightly loaded. - Engine disconnected. - Test speed : Initial speed : ≥ 50 km/h for vehicle categories 3-3, 3-4, and 3-5. ≥ 0.8 Vmax for vehicle categories 3-1and 3-2. Final speed = 5 to 10km/h. - Brake application : Each service brake system control applied separately for vehicles with two controls. - Vehicle average deceleration : Single front brake system only : ~~3.0-3.5 m/s2 for vehicle categories 3 - 3, 3 -4 and 3 - 5.~~ 2.5 - 3.0 m/s2 for vehicle categories 3 –3. 2.0 - 2.5 m/s2 for vehicle category 3 – 5. 1.5 - 2.0 m/s2 for vehicle categories 3 –1 and 3 – 2. Single rear brake system only : 1.5 – 2.0 m/s^2 CBS or split service brake system : 2.7 – 3.2 m/s^2 ***for catogories 3-1 and 3-2*** ***3.2 – 3.7 m/s2 for catogories 3-3 and 3-4*** ***3.5 – 4.0 m/s2 for catogories 3-5.*** - Number of decelerations : 100 per brake system. - Initial brake temperature before each application ≤ 100 ° C - For the first stop, accelerate the vehicle to the initial speed and	• The burnishing procedure given in FMVSS 571.122 is based on the average deceleration and not MFDD. Therefore we presume that the GTR document preserves average deceleration and hence our suggestion to change the words "vehicle deceleration" to "vehicle average deceleration". • FMVSS specifies that burnishing should be carried with both front and rear brakes applied simultaneously. The declaration specified is 12 ft/s^2 which works out 3.7 m/s^2 and carrying out burnishing at deceleration levels of 3.0 – 3.5 m/s^2 for only front brake alone is not practical. • The deceleration at which burnishing is to be carried out cannot be higher (or even equal to) than the decelerations specified for performance after burnishing. • Comparison of the average deceleration is given in attached **Annexure - B.** • The proposal from India, is to rationalize the performance requirements with the burnishing deceleration for all the vehicle categories. • In the case of category 3-4, burnishing the front brake alone does not arise, as only combined barking system is permitted as per Clause 3.1.8.2 of the GTR document.

		then actuate the brake control under the conditions specified until the final speed is reached. Then reaccelerate the initial 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 specified. Repeat this procedure for the number of specified decelerations.	
10.	4.4.	4.4 Dry Stop Test – all service brake controls actuated [as originally – not parking] 4.4.1 Vehicle condition: - The test is applicable to vehicle categories 3-3, 3-4 and 3-5 ***wiith two service brake controls and Vmax more than 50 km/h of*** - Lightly loaded. - Engine disconnected 4.4.2. Test conditions and procedure - Initial brake temperature: ≥ 55 °C and ≤ 100 °C. - Test speed: 100 km/h or 0.9 Vmax, whichever is the lower. - Brake application : Simultaneous application of both service brake system controls, ~~if so equipped, or of the single service brake control in the case of a service brake system that operates on all wheels~~. - Brake actuation force: Hand control: ≤ 250 N Foot control: ≤ 400 N for vehicle categories 3-3 and 3-5 ≤ 500 N for vehicle category 3-4 - Number of stops : until the vehicle meets the performance requirements, with a maximum of 6 stops - For each stop, accelerate the vehicle to the test speed and then apply the brake controls under the	• It is felt that the design requirements for braking system is more stringent for low speed vehicles than high speed vehicles. • Different stopping distances with respect to test speeds above and below 80.5 km/h may cause confusion. We suggest the classification with a cut off of 125 km/h similar to the high speed test. • The change in the stopping distance requirement suggested by India would take care of the above two points. • There are two separate requirements specified for vehicles with CBS system. • The vehicles with Vmax less than 50 km/h should be exempted from testing with all service brakes actuated since individual brake tests for front and rear is separately carried out. All the above points are clarified in the enclosed Annexure –C.

		conditions specified in this paragraph. 4.4.3. Performance requirements : When the brakes are tested in accordance with the test procedure set out in paragraph 4.4.2, the stopping distance (S) shall be: ~~(a) For test speeds < 80.5 km/h, S ≤ 0.0055 V^2~~ ~~(b) For test speeds ≥ 80.5 km/h, S ≤ 0.0060 V^2~~ ~~(where V is the specified test speed in km/h and S is the required stopping~~ distance in ~~metres)~~ ***(a) S ≤ 0.1V + 0.0067V2 for vehicle with VMax ≤ 125 km/h*** ***(b) S ≤ 0.0060 V2 for vehicle with VMax > 125 km/h***	
11.	4.6.3.1	In the first bullet, change "vehicle deceleration of 2.5 – 3.0 m/s2" to "vehicle ***average*** deceleration of 2.5 – 3.0 m/s2"	Same as explained in Sr. No. 6
12.	4.7.3.2	In the fourth bullet, change "vehicle deceleration of 3.0 – 3.5 m/s2" to "vehicle ***average*** deceleration of 3.0 – 3.5 m/s2"	Same as explained in Sr. No. 6

Annexure A

Brake fluid Reservoir for Split service brake system

Brake fluid Reservoir	Partition wall for front and rear brake hydraulic circuit (View from reservoir top)
	
Cut Sections of brake fluid reservoir	
	

Annexure – B

Category	V (km/h) as per clause 4.3	MFDD (m/s^2) requirement prescribed in Clause 4.3	Stopping distance (m) calculated from table in clause 4.3	Average deceleration (m/s^2) for compliance 4.3 D_{per}	Deceleration (m/s^2) specified in the draft for burnishing $D_{bur-gtr}$	Percentage of $D_{bur-gtr}$ to D_{per}	Deceleration (m/s^2) proposed by India for burnishing $D_{bur-Ind}$	Percentage of $D_{bur-Ind}$ to D_{per}
	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Single brake system, front wheel (s) braking only								
3-1	40	≥3.4 m/s^2	21.76	2.84	1.5 - 2	53 - 71	1.5 - 2	53 - 71
3-2	40	≥2.7 m/s^2	26.88	2.30	1.5 - 2	65 - 87	1.5 - 2	65 - 87
3-3	60	≥4.4 m/s^2	37.32	3.72	3 - 3.5	81 - 94	***2.5 – 3.0***	***67 - 81***
3-4	60	Not applicable						
3-5	60	≥3.6 m/s^2	43.80	3.17	3 - 3.5	95 - 110	***2.0-2.5***	***63 - 79***
Single brake system, rear wheel (s) braking only								
3-1	40	≥2.7 m/s^2	26.88	2.30	1.5 - 2	65 - 87	1.5 - 2	65 - 87
3-2	40	≥2.7 m/s^2	26.88	2.30	1.5 - 2	65 - 87	1.5 - 2	65 - 87
3-3	60	≥2.9 m/s^2	53.88	2.58	1.5 - 2	58 - 78	1.5 - 2	58 - 78
3-4	60	Not applicable						
3-5	60	≥3.6 m/s^2	43.80	3.17	1.5 - 2	47 - 63	1.5 - 2	47 - 63
Vehicles with Combined Braking System (CBS)								
3-1	40	≥4.4 m/s^2	17.92	3.44	3.5 - 4	102 - 116	***2.7 – 3.2***	***78 - 93***
3-2	40	≥4.4 m/s^2	17.92	3.44	3.5 - 4	102 - 116	***2.7 – 3.2***	***78 - 93***
3-3	60	≥5.1 m/s^2	33.36	4.16	3.5 - 4	84 - 96	***3.2 – 3.7***	***77 - 89***
3-4	60	≥5.0 m/s^2	33.72	4.12	3.5 - 4	85 - 97	***3.2 – 3.7***	***78 - 90***
3-5	60	≥5.4 m/s^2	31.56	4.40	3.5 - 4	80 - 91	***3.5 - 4***	***80 - 91***

Explanation :

- Column (3) is the prescribed MFDD as per Clause 4.3 of the GTR.
- Column (4) is the Stopping Distance calculated from 0.1 V + X V^2, where X is the co-efficient specified in Clause 4.3 of the GTR.
- Column (4) is the average deceleration calculated for (2) and (4).

Annexure - C

Detailed note on changes proposed to Item 4.4 Dry Stop Test – all service brake controls actuated

1. It is felt that the design requirements for braking system is more stringent for low speed vehicles than high speed vehicles. The explanation is given below:

1.1 The deceleration of the vehicle provided by the braking system is limited by:

- The braking torque developed by the brakes when the limited control force is applied
- Rolling radius of tyre
- Coefficient of adhesion of the test track and tyre.

The above parameters put together results in the MFDD of the vehicle.

Stopping distance is a function of:

- MFDD of the braking system as explained above
- Test Speed
- Total reaction time from the instant brake control is actuated till the deceleration achieves the stabilized value.

1.2 The average deceleration is calculated from the test speed and stopping distance.

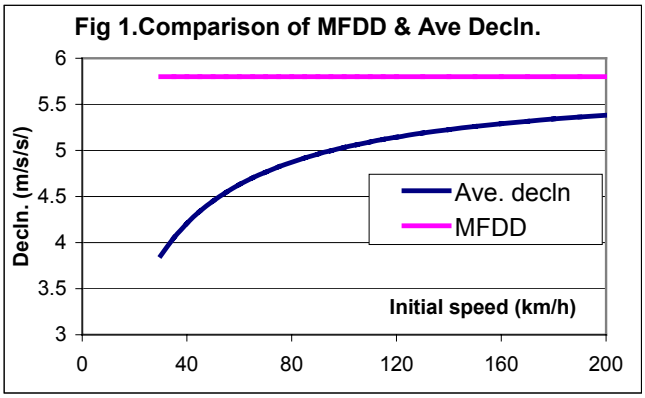
1.3 MFDD gives the true picture of the design capability of the vehicle braking system. However stopping distance is equally significant method of evaluation, if nor more, as it is the requirement the rider is looking for.

1.4 The value of average deceleration, would always be less than the MFDD. To the extent it is less is decided by the distance travelled by the vehicle during the reaction time (which has an approximate linear relation to test speed) and distance travelled by vehicle when the deceleration is saturated (which has an approximately linear relation with the square of the test speed.) Hence the difference between average deceleration and MFDD reduces as the test speed increases.

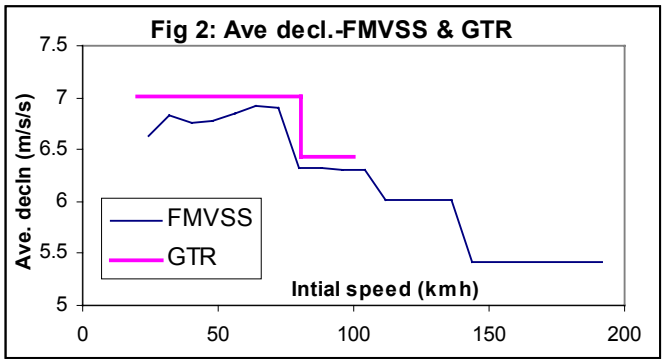
Figure 1 illustrates this. For plotting this graph:

- Stopping distance has been calculated as per ECE formula corresponding to MFDD of 5.8 m/s^2 for various test speeds.
- Average deceleration is calculated from the stopping distance.

This graph also shows that for same MFDD, the average deceleration increases with the test speed.



1.5 Figure 2 shows the average deceleration calculated from the stopping distances prescribed in FMVSS.

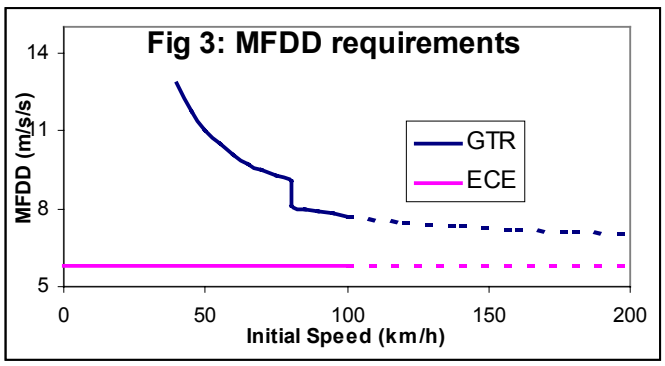


1.6 The expected average deceleration in both cases reduces with the increase in test speed, which is against the basic principles of braking. In practice these limits mean that the brake design has to be superior in the case of vehicles tested at higher speeds as it has to provide a higher braking torque to achieve the higher average deceleration.
It can also be seen that the GTR requirements are more stringent than FMVSS. Also the increase in stringency is more at lower test speeds.

1.7 The increase in the stringency is highlighted if the MFDD for which the brake system has to be designed. The required MFDD has been calculated from the stopping distance using the ECE formula and is shown in Figure 3.

1.8 It may be noted that, the formulae for stopping distance prescribed in FMVSS 571.135, Braking System for Passenger car, is a second order polynomial similar to ECE formulae.

1.9 Values of stopping distance observed during testing depend on the type of instrument used. The elapsed time between actuation of control and starting of measuring the stopping distance reduces the observed stopping distance considerably. Till recent past, the conventional instruments (e.g. solenoid operated pellet gun) used for testing of two and three wheelers this time could be as high as 0.3 second. This used to camouflage the severity of the stopping distance requirement. Now-a-days the tests are conducted with state-of-the-art instruments (e.g. Optical sensing devices – Correvit, Satellite based (GRPS) based systems) which starts counting the stopping distance immediately after actuation of control.



2 Different stopping distances with respect to test speeds above and below 80.5km/h causes confusion:

2.1 The stopping distances for test speed of 80.5 km/h are 36.6 and 38.9 meters using the two different coefficients. Desired test speed of 80.5 km/h translates to a Vmax of 89.44 km/h. It is felt that accuracy of measurement of V_{max} does not warrant a classification based on such a fine value. It would be more appropriate to distinguish with a V_{max}, which is based on a proper logical

number.

125 km/h is suggested as this value is used for classification for high-speed tests.

3 Suggestion on the stopping distance:

3.1 It is proposed that the following formula may be incorporated for the stopping distance requirement;

For vehicles with Vmax $\leq$ 125 km/h, $S= 0.1\ V + 0.0067V^2$ (Inline with the requirements specified in R 78, when tested with both controls activated , reference to foot note (2) of Clause 2.1.2.1)

For vehicles with Vmax > 125 km/h, $S= 0.0060V^2$

4 There are two separate requirements specified for vehicles with CBS system:

4.1 Item 4.3 prescribes requirements to be complied with for dry stop test with application of single control. The Table, which is part of item 4.3.3, specifies the requirements of stopping distance and MFDD for vehicles with CBS or split service brake systems for laden and lightly loaded conditions. These are as per ECE and are acceptable.

4.2 However, item 4.4.2, in the bullet point on brake application states that "Simultaneous application of both service brake system controls, if so equipped, or of the single service brake control in the case of a service brake system that operates on all wheels".

The words " or of the single service brake control in the case of a service brake system that operates on all wheels" should be deleted.

4.3 The test for CBS or split brake system with actuation of the single control is already covered in 4.3 for both laden and lightly loaded conditions. Same test is to be carried out again as per 4.4.2 with a different test speed and different stopping distance.

4.4 The additional test in FMVSS, as compared to ECE, is only the test with actuation of both the controls. This is also clear from Para 5.2.2 of part A of the document.

5 Vehicles with Vmax less than 50 km/h should be exempted.

Exemption of Category 3-1 and 3-2 is based on the test speeds being low. It is possible that there would be vehicles in India in category 3-3 and 3-4, where the Vmax is less than 50 km/h but engine swept volume is more than 50cc.