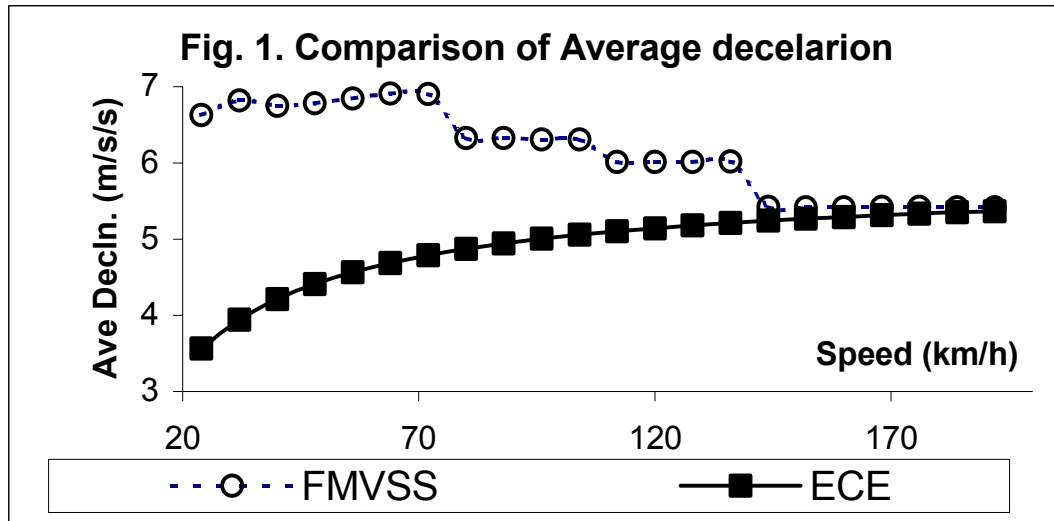
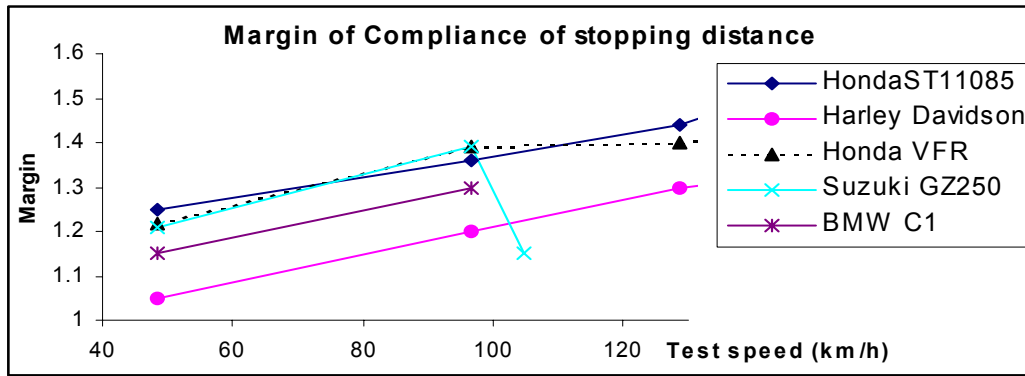


Comments from India

The comments on the proposed GTR for motorcycle brakes, based on the Document
“Appendix A :Regulation Comparison table “ of the Working paper “1-GTRBR-04”

Item Reference	Subject and Comments
Item No. 1 of Appendix A-	Scope:
	India prefers that two and three wheelers may be included in the scope of the GTR, as is the case of both FMVSS 122 and ECE R78.
Item No. 2 of Appendix A-	Definitions:
	No comments at this stage. Depending on the final decisions on the technical requirements, the definitions can be reviewed at a later date
Item No. 3 of Appendix A-	Requirements:
	<p>a) Method of specifying the Stopping distance:</p> <p>Stopping distances are specified in:</p> <ul style="list-style-type: none"> • FMVSS 122 in a table form. • ECE R78 in the form of binomial equation of speed. <p>Annex A of the report summarised the ECE R78 procedure as “<i>Performance based on stopping distance, determined either by measruing the stopping distance or the mean fully developed deceleration</i>”.</p> <p>However, the para 1.1.1 of Annex 3 of R78 as amended vide Supplement 3 to the 02 series of amendments - Date of entry into force: 7 December 2002, reads as under,</p> <p><i>“The performance prescribed for braking devices shall be based on the stopping distance and/or the mean fully developed deceleration. The performance of a braking device shall be determined by measuring the stopping distance in relation to the initial speed of the vehicle and/or measuring the mean fully developed deceleration during the test.”</i></p> <p>Our understanding of this amendment is that, it is necessary to check both the stopping distance and MFDD for establishing compliance. We request the advice of the experts whether our understanding is right.</p> <p>We prefer ECE R78 method for the following reasons:</p> <ul style="list-style-type: none"> • As per the table prescribed in FMVSS, 122 the average deceleration requirements decrease with an increase in test speed. This is evident from Figure 1, which shows the comparisons of the average deceleration calculated from the stopping distance values specified in FMVSS 122 and ECE R78. Figure 2, based on the test results quoted in the Annex B of the report, also indicate that the margin of compliance is lower at low speeds. Specifying more stringent deceleration requirements at lower speeds is not logical. The only exception found was in the case Suzuki motorcycle. • ECE R78 method is based on a minimum requirement of MFDD, which is the actual design performance of the brake system, while prescribing a correction for the reaction time during the testing. • In the case of passenger cars, FMVSS 135 already specifies the method of binomial equation. • As most of the Indian two wheelers are the low speed type, it is desired that the brake design need not be made more stringent than that for high-speed motor cycles. • If MFDD is used, it should be based on the deceleration and averaging the area under the stabilised portion of the deceleration -time graph.



b) Load condition of the vehicle:

FMVSS 122 prescribes vehicle to be tested in a condition representing a single rider situation. No tests are prescribed for the GVW condition.

ECE R78 prescribes tests in GVW condition and also in the single rider situation. The stopping distance and MFDD requirements in the GVW condition are more stringent than those for the single rider condition.

In India, operation of two and three wheeler in the GVW condition is predominant. Therefore, we feel that the performance requirements should be specified in the GVW condition. As the single rider situation is also important, it is suggested that the practice of ECE R78 of having both the conditions be incorporated in the GTR.

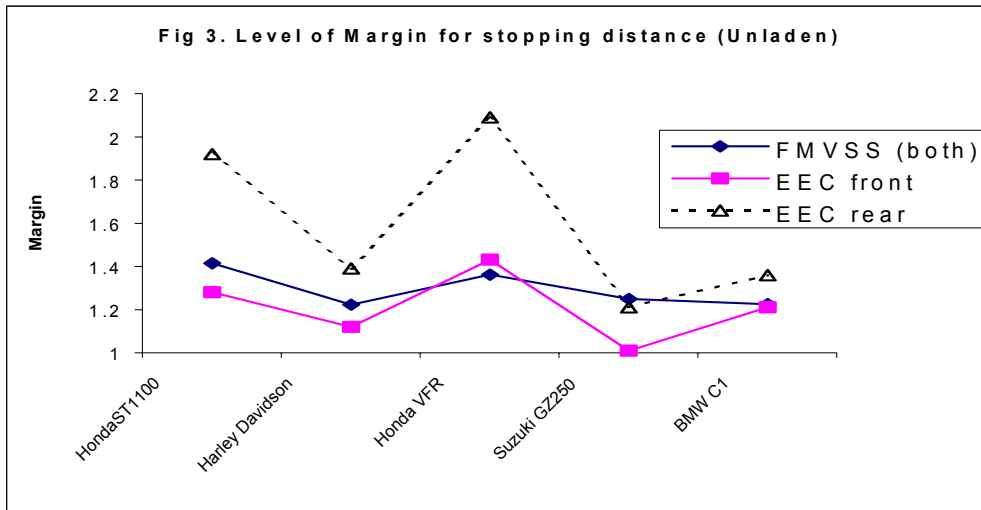
However, it is noticed that ECE R78 does not prescribe the test for solo condition in the case of two wheelers with a combined brake system. We feel that appropriate values may be incorporated for this condition also. The Experts may consider the feasibility of this suggestion.

As ECE R78 does not prescribe the requirements with both the brakes applied in the unladen condition with engine disconnected, it is not possible to compare the norms.

The margin of compliance on stopping distance for unladen tests from Appendix B is

plotted below in Figure 3:

The margin of compliance for front brake requirements of ECE R78 and both brakes for FVMSS are of the same order. The cases where a predominantly higher margin for the rear brake requirements of ECE R78 has been observed in the case of Honda VFR and HondaST1100, both of which have ABS and fairly large dry weight. It therefore appears logical to incorporate the ECE R78 requirements for the unladen conditions in the GTR. Though, we have no experience with ABS brakes for two and three wheelers, from the test results, it appears that a tighter norms can be laid down for rear brake on motorcycles with ABS, especially when the unladen weights are higher. The experts may like to review this.



c) Testing of performance :

FMVSS 122 prescribes test to be conducted with both the brakes applied, whereas in ECE R78, the stress is on the individual brakes meeting the requirements. Testing both the brakes together is applicable only if the individual brake requirement can not be met due to lack of adhesion.

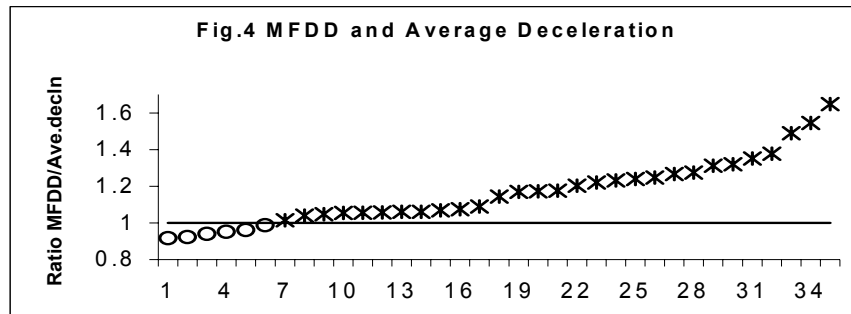
Brake tests with application of two controls simultaneously are likely to have more experimental variation and repeatability would be much less and India would prefer the ECE R78 practice.

d) Specifying the performance :

The report has rightly covered the advantages of the MFDD as a parameter for judging the vehicle performance in para 2.1.3. The definition of MFDD as given in ECE R78 as the vehicle deceleration calculated between 10 and 80 percent of the vehicle initial speed would not cover possible variations of the initial brake build up time. The report also has recognized this, as it states that *“an alternate method was utilized to calculate the vehicle deceleration based on the same principles used to calculate MFDD and MSD. This was achieved by way of a logical gate that determines the best fit curve for the vehicle deceleration, thus isolating the motorcycle braking performance from variables such as the rider’s reaction time.”*

As per the definition of MFDD, the value of MFDD can not be higher than the value of average deceleration calculated from the stopping distance.

The ratio of MFDD and average deceleration quoted in Appendix B calculated from stopping distance for the 35 test results is plotted in Fig.4. In 6 cases this ratio is less than 1, which indicates that even the refined method of estimating the MFDD still has some inaccuracies.



Item No. 4 of Appendix A-	<p>Type of service braking system :</p> <p>In the case of two wheelers, the system prescribed in both FMVSS 122 and ECE R78 are practically same, even though the ECE R78 language is more elaborate. However, in the case of bigger 3 wheelers (L5) the requirement of the combined brake system in ECE R78 is more logical and may be incorporated in the GTR.</p>
Item No. 5 of Appendix A-	<p>Mechanical Service Brake System :</p> <p>Requirements in FMVSS 122 and ECE R78 are practically same and either of them may be incorporated in GTR.</p>
Item No. 6 of Appendix A-	<p>Hydraulic Service Brake System :</p> <p>The basic requirements in FMVSS 122 and ECE R78 are practically same and either of them may be incorporated in GTR. Comments on clauses S5.1.2.1 and S5.1.2.2 of FMVSS 122 are given separately at Sl. no. 7 and 8</p>
Item No. 7 of Appendix A-	<p>Master Cylinder reservoirs :</p> <p>The requirements given in the first para of S5.1.2.1 of FMVSS 122 that there should be two separate reservoirs for each brake circuit with each of them having filler cover and seal is not logical in case of split system with tandem master cylinder..</p> <p>For all practical purposes it is sufficient, in case of a master cylinder serving both the circuits by actuating one control (E.g. a tandem master cylinder) to have a common reservoir with a partition to ensure that in case of failure in one circuit, sufficient brake fluid is available to the other circuit. This requirement is already implied in both FMVSS 122 (S5.1.2) and ECE R78 (5.2.1.1). This requirement can be explicitly spelt out in the GTR..</p> <p>Our understanding is that the Clause 5.2.7.2 of ECE R78 quoted under this heading is applicable to all braking systems and not to the reservoir capacity. In any case the condition must be prescribed in the GTR.</p> <p>We feel that it is desirable to incorporate the requirements given in the second para of S5.1.2.1 of FMVSS 122 regarding the capacity of the reservoir in the GTR.</p>
Item No. 8 of Appendix A-	<p>Reservoir Labelling:</p> <p>As different grades of brake fluids are available, it would be appropriate for the label to have the marking of the recommended brake fluid. All the other requirements specified in FMVSS 122 appears to be too elaborate to be considered for the GTR.</p>
Item No. 9 and 10 of Appendix A-	<p>Additional requirements for split system- Failure indicator lamps :</p> <p>FMVSS 122 prescribes an elaborate warning system for indicating any brake failure. It is felt that a warning lamp to light up when the level of brake fluid in any of the reservoirs / compartments has become dangerously low, is sufficient. The tell-tale for this warning lamp should be part of the GTR for tell tale symbols and controls.</p>
Item No. 11 of	<p>Parking Brake:</p>

Appendix A-	We feel that, it is necessary to mandate parking brake only for three wheeled vehicles and not necessary for two wheelers with side car.
Item No. 12 of Appendix A-	<p>Visual Inspection:</p> <p>Providing an opening for inspection would make way for water ingress and dirt ingress into the brakes and therefore it is preferred not to have this feature prescribed in the GTR.</p>
Item No. 13 and 14 of Appendix A-	<p>Pre-burnish effectiveness and burnish procedure :</p> <p>The effect of burnishing is basically to improve the contact area of the lining and drum. With the production techniques followed, generally the number of stops needed for ensuring proper contact is much less than the burnishing procedure prescribed in FMVSS 122. It is therefore suggested that:</p> <ul style="list-style-type: none"> • The first effectiveness test prescribed in FMVSS 122 need not be considered. It may also be noted that in the case of passenger cars, as per FMVSS 135 a similar requirement does not exist. • The performance test need to be carried out only after ensuring that the bedding in is carried out prescribed by the manufacturer. • Prior to test , a check point be added in the GTR to ensure proper bedding – in of the liners by visual inspection. <p>We are also of the opinion that this would increase the time involved in the type approval process. If desired by the experts that it has to be included in the GTR, then the same may be kept at a different level of stringency.</p>
Item No. 15 of Appendix A-	<p>Dry Stop tests:</p> <p>Comments on the general specification have already been given as comments for item 3 In addition, we would like to point out the following:</p> <ul style="list-style-type: none"> • We prefer the definition of the cold brake as given in ECE R78, as the temperature is measured outside and there is no need to prepare the brake shoe specifically for this. • With the current type of brake linings available, it may not be necessary to carry out engine disconnected test at two different speeds. • We have no specific comments about the test speed for the engine-disconnected test. As the maximum speed capability of the Indian motorcycles are generally much lower, a qualifying condition that “or X% of maximum design speed of the vehicle, whichever is lower should be specified.. • In our experience, we recommend that the tests be conducted at 80% of the design maximum speed considering the fact that the tests are to be conducted in the fully laden i.e the GVW condition. This would make it convenient to attain the test speed consistently. • Checking for the maximum achievable speed in a mile, as prescribed in FMVSS 122, may not be necessary. If at all maximums speed is to be measured, one of the standard procedures, such as ISO may be used. • FMVSS 122 prescribes the tests to be conducted 6 times. ECE R78 is silent on this issue. We feel that one test is not adequate. In India, we are carrying out the test four times, and the average of the results is considered. The Indian standard also prescribes the variation allowed between these readings, for them to be considered valid. • For averaging the stopping distance, it is necessary to bring them to common base • speed by applying a marginal correction. The method of correction used in the Indian • standard is quoted below for your reference.

	<p>“ The stopping distance measured shall be corrected to the condition of specified initial speed by the following formula. $S_c = (S_m - 0.1V_m) X (V_s/V_m)^2 + 0.1 V$ Where S_c = stopping distance corrected to condition of specified speed (m), V_s = specified initial speed (km/h) V_m = measured initial speed (km/h) S_m = measured stopping distance (m) “</p> <p>It is recommended that a similar procedure may be adopted in GTR.</p> <ul style="list-style-type: none"> • Loading the vehicle to the exact GVW is practically difficult and a tolerance is required for this. As this affects the test results considerably, Indian standard has adopted a correction method for stopping distance and MFDD, which is shown below: <p>“If actual weight of the vehicle at the time of test is different from required values, the stopping distance or the mean fully developed deceleration shall be corrected to the condition of the specified mass by the following formula.</p> $S = (S_c - 0.1 V_s) \times M_s / M_m + 0.1 V_s$ $d_m = d_{ms} \times M_m / M_s$ <p>where</p> <p>S= stopping distance corrected to specified initial speed and mass (m). M_s= specified mass (kg), M_m = actual mass at the test condition (kg) d_m= mean fully developed declaration corrected to specified mass m/s^2, and d_{ms} = measured mean fully developed declaration m/s^2</p> <p>It is recommended that a similar procedure may be adopted in GTR</p>
<p>Item No. 16 of Appendix A-</p>	<p>Fade and Recovery:</p> <p>We request the experts to consider the following: FMVSS 122 prescribes the fade and recovery test to be conducted with both brakes actuated simultaneously. Maintaining consistency during the test is difficult. It would be better to carry out the tests independently for each brake when the controls are different. The tests should be done in the laden condition, as the heating condition would be more severe than in the solo condition. As the report reveals that margin of compliance is lower in the ECE R78 method, ECE R78 method may be incorporated in GTR. However we suggest to retain an alternative of carrying out the heating stops with the engine disconnected if so opted by the manufacturer. Theoretically, this is slightly more severe than that prescribed in ECE R78, but would avoid re-testing of the vehicle for approval of changes in the specification such as a change in gear box ratio or type of engine where the contribution of engine friction reduces. This is the current practice followed in India.</p>
<p>Item No. 17 Appendix A-</p>	<p>Final Effectiveness test</p> <p>The practical use of this test, prescribed in FMVSS 122 is doubtful. The deterioration of the brake lining during the fade test is expected to be only on the surface, which would be removed in burnishing. It may also be noted that a similar procedure is not included in FMVSS 135 for passenger cars.</p>
<p>Item No. 18</p>	<p>Partial failure test</p>

<p>Appendix A-</p>	<p>This requirement is not covered for two wheelers both in FMVSS 122 and ECE R78. It is felt that it is essential to prescribe minimum performance to be achieved in case of a failure of one of the circuits in case of CBS. The stopping distance/performance requirement may be worked out using the requirements for front and rear brakes specified in EEC R78 for two control systems and those for secondary braking for three wheelers. Moreover some experimental data is also available in the Appendix B of the report.</p>
<p>Item No. 19 Appendix A-</p>	<p>Parking Brake:</p> <p><i>“In case suitable specified gradient is not available, the test may be carried out on the nearest available gradient as per the following procedure.</i></p> <p><i>Carry out the test on the nearest available higher gradient, as per procedure given above and if the vehicle meets the requirements of being held, the vehicle shall be deemed to comply with the requirements of this standard for parking brake.</i></p> <p><i>If nearest higher gradient is not available or the vehicle fails to meet requirement with nearest higher gradient with the specified weight, establish maximum mass of vehicle, which the parking brake is capable of holding the vehicle stationary.</i></p> <p><i>The maximum mass of vehicle M_m that can be held stationary by the parking brake on specified gradient shall be calculated as :</i></p> $M_m = \frac{MT (R\cos\theta_t + \text{Sin}\theta_t)}{(R\cos\theta_s + \text{Sin}\theta_s)}$ <p><i>where,</i></p> <p><i>M_m = maximum weight of vehicle that can be held on the specified gradient in kg.</i></p> <p><i>MT = maximum weight of vehicle that was held and the test gradient in kg.</i></p> <p><i>R= co-efficient of rolling resistance = 0.02</i></p> <p><i>$\theta_t = \tan^{-1} (G_t/100)$.</i></p> <p><i>G_t = parent gradient on which the test was carried out.</i></p> <p><i>$\theta_s = \tan^{-1} (G_s/100)$.</i></p> <p><i>G_s = specified gradient”</i></p> <p><i>The experts may consider inclusion of the above in the GTR.</i></p> <p><i>If the calculated M_m is not less than the maximum recommended mass for the vehicle or the combination as the case may be, the vehicle shall be deemed to comply with the requirements of this standard for parking brake. IF the test is carried out on the nearest higher gradient and the parking brake is capable of holding the vehicle stationary with the maximum recommended mass, the vehicle is deemed to comply with the requirements of the parking brake.</i></p> <p>It is requested that Experts may consider incorporation this in the GTR.</p>

<p>Item No. 20 Appendix A-</p>	<p>Wet braking:</p> <p>The report rightly points out that the ECE R78 method simulates rain conditions and the FMVSS 122 simulates the condition of wading of the motor cycle through water. It may also be noted that there is no wet test prescribed for passenger cars in FMVSS 135.</p> <p>The Indian standard prescribes the ECE R78 method. We have not faced any difficulties in the operation, even though the two wheelers do have to frequently wade through water in the monsoon season.</p> <p>Moreover the following practical difficulties are faced in the procedure prescribed in FMVSS 122</p> <ul style="list-style-type: none"> • Carrying out the test with both controls actuated simultaneously increases the test variations. • Immersing the brakes in water completely without water getting into the engine or wetting the electrical circuits is very difficult to achieve. <p>In view of the above, it is suggested that wet braking procedure of ECE R78 be adopted in GTR.</p>
<p>Item No. 21 Appendix A-</p>	<p>Design durability:</p> <p>The requirement prescribed in FMVSS 122 gives an impression that the life of brake system also gets proven during the type approval test. That the brakes get applied hundreds of times during the type approval testing reinforces this feeling. We would prefer the general clause prescribed in ECE R78 to be retained in GTR.</p>
<p>Item No. 22 Appendix A-</p>	<p>Vehicle Weight:</p> <p>We would prefer the ECE R78 logic that mass shall be as prescribed for each test. However in the definition of the unladen mass, it would be desirable to incorporate a quantitative value for weight of driver and test equipment. In our standards this value is considered as 75kg.</p>
<p>Item No. 23 Appendix A-</p>	<p>Tyre pressure:</p> <p>ECE R78 stipulation is more precise than that given in FMVSS 122.</p>
<p>Item No. 24 Appendix A-</p>	<p>Transmission:</p> <p>We suggest adoption of the method specified in ECE R78 .</p>
<p>Item No. 25 Appendix A-</p>	<p>Engine condition:</p> <p>We suggest adoption of the method specified in ECE R78 .</p>
<p>Item No. 26 & 27 Appendix A-</p>	<p>Ambient Temperature and Wind velocity:</p> <p>The test track in India is located at a place where the minimum and maximum temperatures vary from about 5-7°C to 42-45°C during the year and no substantial effect on the brake tests have been observed. The condition of zero wind velocity can not be achieved. Therefore it is suggested that only the ECE R78 condition of the wind may be retained.</p>

<p>Item No. 28 Appendix A-</p>	<p>Road Surface:</p> <p>Our comments are as follows :</p> <ul style="list-style-type: none"> • There is no need to specify the minimum width of the track • Minimum skid number of 81 may be prescribed for normal testing. The requirement for ABS may be covered separately. • Any surface with the minimum skid number should be adequate and need not specify only the concrete surface. <p>Therefore we recommend the procedure specified in ECE R78 in addition to the above.</p>
<p>Item No. 29 Appendix A-</p>	<p>Vehicle position and wheel lock:</p> <p>Our comments are as follows :</p> <ul style="list-style-type: none"> • Aligning of the motorcycle to centre of the test track does not add any special benefit. If at all the deviation of the vehicle from the straight line need to be checked it can be done from the initial position of the vehicle. It may also be noted that unlike in case of four wheelers with a diagonal split of the brake system, there is no major problem of a two or three wheeler deviating from the straight line, on a test track of good adhesion. However if the requirements of not deviating from the lane is to be built in, it is preferable to define the lane width in line with the FMVSS 122 standard. • The Indian standard also prescribes that there shall not be any wheel lock and that wheel lock during the last meter of stop is permitted. This may be incorporated. However, instead of the “last meter” Japanese standard requirement of 15km/h is also acceptable. • Requirements for ABS need to be built in appropriately.
<p>Item No. 30 Appendix A-</p>	<p>Thermocouples:</p> <p>We feel that the measurement of temperature outside as prescribed in ECE R78 is adequate.</p>
<p>Item No. 31 Appendix A-</p>	<p>Brake Actuation forces:</p> <p>We have not faced any difficulties in following the ECE R78 practices</p>
<p>Item No. 32 Appendix A-</p>	<p>Antilock system:</p> <p>We have no experience in this field. However, it is felt that basic requirements should be retained as for the normal brake system and only the additional requirements and tests should be incorporated.</p>

Additional points	Additional points :												
	<p>We would request the experts to consider inclusion of the following details in the GTR:</p> <p>Test instruments: <i>The least count and accuracy of the test instruments to be used. The details covered in the Indian Standard are quoted below for information of the experts.</i></p> <p>Contactless electronic speed and distance measuring instruments (commonly known as 'corevit') or speed measuring system using an additional wheel (commonly known as fifth wheel) when used, shall meet following least count and accuracy requirements :</p> <table border="1" data-bbox="440 466 1278 646"> <thead> <tr> <th>Parameter</th> <th>Least Count</th> <th>Accuracy</th> </tr> </thead> <tbody> <tr> <td>Speed</td> <td>0.1 km/h</td> <td>0.1km/h</td> </tr> <tr> <td>Distance</td> <td>0.1 m</td> <td>0.1 m</td> </tr> <tr> <td>Time</td> <td>0.01s</td> <td>---</td> </tr> </tbody> </table> <p>Parameters for extension of approval for changes:</p> <p>When different models use same or similar brake system, or when a particular model has options of more than one type of brake system, it may not be necessary to test all the combinations. Similarly after the vehicle is type approved, when there is a change in any of the parameters related to brake system, it will not be necessary to carry out a retest in all cases. In the European type approval system, these details are worked out by the Technical Services. While preparing the Indian standards, we have found such details published by VCA of UK as an extremely good reference material.</p> <p>To cover such details in GTR would be helpful in ensuring different technical services and certifying agencies, including the vehicle manufactures where a self-certification procedure is accepted, to follow a uniform practice.</p> <p>The details covered in the Indian Standard are as given in the enclosed Annexure which may be considered by the experts for inclusion in the GTR.</p> <p>It may be noted that the Indian makes of standard covers the use of inertia dynamometer for approval of alternate liners. In such cases the test track test data is kept as a bench mark for comparing the results of the inertia dynamometer test. We have used the details given in ECE R90 for preparing our standards. We would request the experts to consider a similar method.</p>	Parameter	Least Count	Accuracy	Speed	0.1 km/h	0.1km/h	Distance	0.1 m	0.1 m	Time	0.01s	---
Parameter	Least Count	Accuracy											
Speed	0.1 km/h	0.1km/h											
Distance	0.1 m	0.1 m											
Time	0.01s	---											
Braking in a turn	Braking in a turn : Since we have no experience of conducting brake test on turns we have no comments on this.												

ANNEX B

(Clause 6.2)

GUIDELINES FOR DECIDING TESTS FOR EXTENSION OF TYPE APPROVAL

B-1 This Annex gives factor to be considered while selecting a vehicle to represent a range of variants for testing the vehicle for type approval as per this standard and the extension of type approval certificate of one model to changes in technical specifications/ its variant(s).

B-2 In general, when changes in technical specifications of vehicle do not affect the brake performance adversely, and is still within the stipulated limits, the type approval certificate can be extended. If the changes affect some of the performance parameter, test shall be carried out only for those parameters.

B-3 The changes in parameters that affect the brake performance adversely and the tests to be conducted, if any, for extending the type approval are listed in Table 5.

B-4 If during the type approval test, Type F test has been carried out as per 13.3.4 and the vehicle complies with the requirements stipulated for F test, then no additional tests are needed for changes in engine and drive line transmission ratio as listed in SI No. (v) and (vi) of Table 5.

B-5 Increase in brake torque can be demonstrated by the design calculation submitted by the manufacturer. If calculations are not conclusive, a comparative test can be conducted on inertia dynamometer as per IS 13453.

B-6 If the performance of brake lining for which type approval is to be extended, established on inertia dynamometer as per the procedure given in IS 13453, is not less than that of the lining already type approved on vehicle trials as established on inertia dynamometer by 15 percent, the type approval certificate can be extended without any vehicle trials.

Table 5 Parameters for Deciding Tests for Extension of Type Approval
(Clauses B-3, B-4 and B-6)

Sl No.	Parameter	Changes	Tests to Carried Out for Extending the Type Approval
i)	Maximum recommended weight	Any decrease	No additional test needed
ii)	do	Any increase, 1) Which is less than 25 kg for two wheelers from the actual mass used at the time of testing the model and 10 percent for three wheelers 2) Increase is more than that indicated above	The brake performance shall be calculated from the test results using the formulae given in 12.14(1)(b). If this calculated performance complies with the requirements, no additional test need to be carried out. If these calculated performances are not within the limits stipulated, only P type test need be carried out and where applicable parking brake tests are carried out P and F type tests and where applicable parking brake test shall be carried out
iii)	Wheel base	1) Any decrease by 10 percent or any increase 2) Decrease by more than 10 percent	No test need to be carried out P type test to be carried out
iv)	Maximum speed	1) Decrease 2) Increase	No test need to be carried out If the increase in maximum speed does not cause the initial speed for Type P test to be increased by more than 10 percent of the initial speed used in the testing no further tests need to be carried out. Otherwise Type P and F tests to be carried out
v)	Engine		If change of engine leads to a change from vehicle category 1 to category 2, all dynamic tests to be carried out. If change is from vehicle category 2 to category 1, no tests are needed. If changes in the engine, such as increase in swept volume, increase in compression ratio 2 stroke to 4 stroke, petrol to diesel, etc, which increases the engine braking effects and other change which does not contribute to a decrease in the engine braking effect, no tests need carried out. Any changes that contribute to a decrease in engine braking effect, only Type F test need be conducted (see B-4)
vi)	Drive line transmission ratio		If the change in transmission ratio that increases the engine rpm corresponding to the gear and initial speed of vehicle for Type P test, no further test need to be carried out. Otherwise Type F test needs to be conducted (see B-4)
vii)	Drive line transmission	1) Manual or automatic with a manual disengagement provision to fully automatic 2) Fully automatic to manual or automatic with a manual disengagement provision	No test need to be conducted P and F type tests to be carried out
viii)	Tyre size		If the design overall diameter of tyre increased by more than 6 percent, P and F type tests need to be carried out. Otherwise no test need be carried out
ix)	Brakes	1) Changes which cause a change in brake torque 2) Changes in configuration such as disc type to drum type or vice-versa 3) Change to configuration which materially increase the chance of ingress of water on brake	No test need be conducted if torque increases (see B-5). Otherwise P Type test and where applicable parking brake test to be carried out All P and F Type tests and where applicable parking brake test to be carried out Type W test to be carried out in the case of two wheelers
x)	Brake lining	Change of material	Either, 1) All applicable dynamic tests on vehicle, or 2) Verification inertia dynamometer as per B-6