28 October 2011

Global registry

Created on 18 November 2004, pursuant to Article 6 of the Agreement concerning the establishing of global technical regulations for wheeled vehicles, equipment and parts which can be fitted and/or be used on wheeled vehicles (ECE/TRANS/132 and Corr.1) done at Geneva on 25 June 1998

Addendum 2: Global technical regulation No. 2

Measurement procedure for two-wheeled motorcycles equipped with a positive or compression ignition engine with regard to the emission of gaseous pollutants, CO_2 emissions and fuel consumption

Amendment 2 - Appendix 1

Proposal and report pursuant to Article 6, paragraph 6.3.7. of the Agreement

- Proposal to amend global technical regulation No. 2 (Worldwide harmonized motorcycle emission test cycle) (ECE/TRANS/WP.29/AC.3/19).
- Report on draft Amendment 2 to global technical regulation No. 2 (Worldwide harmonized motorcycle emission test cycle) (ECE/TRANS/WP.29/2009/133).

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Proposal to amend global technical regulation No. 2 (Worldwide harmonized motorcycle emission test cycle)

I. Objective of the proposal

1. After the establishment into the Global Registry of gtr No. 2 in June 2005, the work on Stage 2 of the World-wide harmonized motorcycle emission test cycle (WMTC) started. AC.3 was informed about the continuation of the activities of the WMTC informal group (ECE/TRANS/WP.29/1039, para. 97; ECE/TRANS/WP.29/1041, para. 100). The following five issues will be considered in Stage 2 of WMTC:

A. Amendments of test cycle modules and classification in relation to additional in use data (e.g. India)

2. India is one of the biggest markets for motorized two wheelers in the world. The special situation in India (traffic, vehicles) leads to problems with the application of the existing WMTC cycle in gtr No. 2. WMTC doesn't reflect the Indian driving behaviour, and the current classification leads to problems with cycle-traceability for some of the Indian vehicle types.

3. Three reports are available from ARAI, TÜV Nord and JARI/IMMA. On this basis, the WMTC informal group considered the technical aspects and various possibilities. The outcome of the very intensive discussion was that a solution that meets the needs of all parties seems possible, taking the following principles into account:

(a) Avoid options in the gtr, if possible.

(b) Avoid fundamental differences to the existing cycles in gtr No. 2, if possible.

(c) Focus on reduced speed parts of the existing cycle in gtr No. 2 for changes.

(d) Identification of best possible distinguishing technical parameters for vehicle classification.

4. The Working Party on Pollution and Energy (GRPE) agreed at its fifty-third session to the proposal of the WMTC informal group, to introduce small modifications to some of the test cycle modules and classification (informal document Nos. GRPE-53-11 and GRPE-53-12). The adoption of these amendments of gtr No. 2 are an important condition to conduct further measurements for the collection of test data as basis for the discussion on performance requirements. The proposal was submitted with document ECE/TRANS/WP.29/GRPE/2007/9 to GRPE for adoption at the fifty-fourth GRPE session in June 2007.

B. Improvement of the gearshift procedure

5. Experience with the gearshift procedure of gtr No. 2 shows that some modifications and additional rules are required to avoid unrealistic gearshift sequences. They will improve driveability of the test significantly. The proposed amendments are included in document ECE/TRANS/WP.29/GRPE/2007/9.

C. Performance requirements

6. WMTC was adopted as gtr No. 2 without performance requirements in Stage 1. For Stage 2, the WMTC group was mandated to collect data and prepare information as a basis for the discussion about the introduction of performance requirements in gtr No. 2.

7. The WMTC informal group recommends focusing on only limit values in Stage 2. The discussion about the worldwide harmonization of other performance requirements like durability, off cycle emissions or evaporative emissions should be postponed to a subsequent Stage 3.

8. In line with the 1998 Agreement, Contracting Parties are preparing proposals for the introduction of gtr No. 2 as an alternative to the existing national/regional legislation. This set of limit values will be the basic information about the current legal situation regarding WMTC application. In parallel, IMMA has already collected comparative data and test results for a correlation study, based on technology and regulations that will be in use/force in 2006-08. This can be the basis for further discussion by Contracting Parties of a possible harmonization of limit values, aiming on a timeframe of 2010 – 2012.

9. For further progress in this field it is important to get additional correlation data from Contracting Parties and political guidance on exactly how individual Contracting Parties intend to act.

D. Introduction of a family concept

10. Some legislation of Contracting Parties already includes a family concept (e.g. United States of America) or the extension of type approval (e.g. the European Union (EU)). The introduction of a family concept in gtr No. 2 is proposed by IMMA. An engine or vehicle family is characterized by design parameters. These shall be common to all vehicles within the family. The engine manufacturer may decide which vehicles belong to a family, as long as the membership criteria are respected. The engine family shall be approved by the type approval or certification authority.

E. Further improvement of gtr No. 2

11. Continued inventory of corrections/amendments to gtr No. 2 and to Appendix 1 (Technical Report).

II. Timeline of Stage 2

12. The work started in 2005, three meetings of the WMTC informal group took place in April 2006, November 2006 and January 2007.

13. The proposal to amend some of the test cycle modules and classification regarding in use data of countries with special traffic situation (e.g. India) is ready for adoption by AC.3 in November 2007, if GRPE adopts the proposal of document ECE/TRANS/WP.29/GRPE/2007/9 at its June 2007 session.

14. A proposal introducing the family concept will be prepared during 2007.

15. A first report on the introduction of performance requirements into gtr No. 2 will be presented to GRPE and AC.3 in 2008.

Report on draft Amendment 2 to global technical regulation No. 2 (Worldwide harmonized motorcycle emission test cycle)

I. Introduction

1. After the establishment into the Global Registry of global technical regulation (gtr) No. 2 in June 2005, the work on Stage 2 of the World-wide harmonized Motorcycle emission Test Cycle (WMTC) started. One of the issues for consideration in Stage 2 of WMTC was the introduction of performance requirements. The informal group was mandated by AC.3 (ECE/TRANS/WP.29/AC.3/19) to collect data and prepare information as a basis for the discussion.

2. With the status report (informal document No. GRPE-52-6) to the Working Party on Pollution and Energy (GRPE) in June 2006, the WMTC informal group recommends focusing on only limit values in Stage 2. The discussion about the worldwide harmonization of other performance requirements like durability, off cycle emissions or evaporative emissions, should be postponed to a subsequent Stage 3.

3. In line with the 1998 Agreement, Contracting Parties are preparing proposals for the introduction of gtr No. 2 as an alternative to the existing national/regional legislation. This set of limit values is the basic information about the current legal situation regarding WMTC application. In parallel, the International Motorcycle Manufacturers Association (IMMA) has collected comparative data and test results for a correlation study, based on technology and regulations that will be in use/force in August 2006. This can be the basis for further discussion by Contracting Parties of a possible harmonization of limit values, aiming on a timeframe of 2010 – 2012.

II. Existing national / regional legislation (pollutant emissions) for motorcycles

4. The following tables give only a rough summary of the limit values. More detailed information about some of the national legislation can be found in the annex of informal document No. GRPE-56-11. The tables below do not include mopeds (< 50 ccm), so "all" means > 50 ccm.

A. China

Cycle	*Classification*	*Stage (year/month)*	*CO g/km*	*HC g/km*	*NOx g/km*	*HC+NOx g/km*
ECE R40	all	2004	5.5	1.2	0.3	
ECE R40 (cold)	< 150 ccm	2007/8	2.0	0.8	0.15	
ECE R40 + EUDC (max. 90 km/h)	> 150	2007/8	2.0	0.3	0.15	

Note: "ECE R40" means according to UNECE Regulation No. 40.

B. European Union (EU)

Cycle	*Classification*	*Stage (year/month)*	*CO g/km*	*HC g/km*	*NOx g/km*	*HC+NOx g/km*
ECE R40	< 150 ccm	2003/4	5.5	1.2	0.3	
ECE R40	> 150 ccm	2003/4	5.5	1.0	0.3	
ECE R40 (cold)	< 150 ccm	2006/7	2.0	0.8	0.15	
ECE R40 + EUDC	> 150 ccm	2006/7	2.0	0.3	0.15	

C. India

Cycle	*Classification*	*Stage (year/month)*	*CO g/km*	*HC g/km*	*NOx g/km*	*HC+NOx g/km*
IDC	all	2005	1.5			1.5
IDC	all	2008/10	1.0			1.0

Note: Durability factor of 1.2 is applicable on above norms for CO and HC+NOx

D. Japan

Cycle	*Classification*	*Stage*	*CO g/km*	*HC g/km*	*NOx g/km*	*HC+NOx g/km*
TRIAS/ECE R40	all / 2stroke	1999	8.0	3.0	0.1	
TRIAS/ECE R40	all / 4stroke	1999	13.0	2.0	0.3	
TRIAS/ECE R40	< 125 ccm	2008	2.0	0.5	0.15	
TRIAS/ECE R40	> 125 ccm	2008	2.0	0.3	0.15	

E. Korea

Cycle	*Classification*	*Stage (year/month)*	*CO g/km*	*HC g/km*	*NOx g/km*	*HC+NOx g/km*
ECE R40	< 150 ccm	2006/1	5.5	1.2	0.3	
ECE R40	> 150 ccm	2006/1	5.5	1.0	0.3	
ECE R40 (cold)	< 150 ccm	2008/1	2.0	0.8	0.15	
ECE R40 + EUDC	> 150 ccm	2008/1	2.0	0.3	0.15	

F. United States of America (USA)

Cycle	*Classification*	*Stage*	*CO g/km*	*HC g/km*	*NOx g/km*	*HC+NOx g/km*
FTP	< 170 ccm	2006	12.0	1.0		
FTP	170 - 279	2006	12.0	1.0		
FTP	> 280	2006	12.0			1.4
FTP	> 280	2010	12.0			0.8

III Status of transposition of gtr No. 2 into national / regional legislation

A. European Union

5. With directive 2006/72/EC, the EU transposed gtr No. 2 into directive 97/24/EC. Equivalent to Euro 3 (see above paragraph 2.2. above), manufacturers can optionally choose, for type approval purposes, the following limits:

Table
WMTC limits correlated to Euro 3 stage

Cycle	*Classification*	*CO g/km*	*HC g/km*	*NOx g/km*
WMTC-old (stage 1)	vmax < 130 km/h	2.62	0.75	0.17
WMTC-old (stage 1)	vmax $\geq$ 130 km/h	2.62	0.33	0.22

B. Japan

6. Based on emissions tests with motorcycles meeting the latest emission legislation, Japan will establish equivalent limits on WMTC within 2008. Then the procedures for transposition of gtr No. 2 as an option will be started. It can be expected, that the WMTC based limit values are on a similar level as in paragraph 3.1.

C. China

7. China is estimated to follow the EU approach.

D. United States of America

8. The USA expects to introduce the WMTC as an alternative to the Federal Test Protocol (FTP) with equivalent limits to the present USA emission regulations. After a period of time (which would be determined through the USA rulemaking process), the USA intends to phase out the FTP option and ultimately rely exclusively on the WMTC for motorcycle certification purposes. The timing of USA regulatory action is currently not determined.

E. India

9. In India, consideration for introducing WMTC as alternative to existing Indian regulation is under discussion. According to the 1998 Agreement, article 4, section 4.2., it is stated, that "A global technical regulation may specify alternative non-global levels of stringency or performance, and appropriate test procedures, where needed to facilitate the regulatory activities of certain countries, in particular developing countries". It seems that operating conditions vary from one country to another while some countries focus on commuting and fuel efficiency to provide an economical mode of transport for daily needs, others focus on high acceleration and power (nature of sportive vehicles). Addressing these differing target segments results in a wide variation in engine and drive train design parameters which in turn results in different levels of pollutant emissions under different driving conditions. In view of the above, an option to chose an alternate set of parameters suited best to the driving conditions prevalent in a country is provided for in article 4, section 4.2. The current proposal with application from 2010 is as follows:

Table
India approach (standstill values) with a special cycle application for class 2.1

Classification	*CO g/km*	*HC + NOx g/km*
class 1 & subclass 2-1 */	2.14	1.32
subclass 2-2	2.62	0.92
class 3	2.62	0.55

* Following gtr No. 2, vehicles of subclass 2-1 have to run cycle part 1 reduced (cold) and part 2 reduced (hot). Differing from that provision, the Indian approach defines that vehicles of subclass 2-1 have to run cycle part 1 reduced (cold) and part 1 reduced (hot).

IV. Data and test results

A. Test data

10. A more detailed description and documentation of the data and test results can be found in informal document No. GRPE-56-11. 134 test data sets allow a comparison of the results based on WMTC test cycles and other existing national test cycles. The evaluation resulted in a set of so-called "standstill limit values", which are the values based on the WMTC cycles in order to obtain the same level of severity as the existing national limit values when measured with the existing test cycle.

11. It should be taken into account that already two versions of WMTC test cycles and classification exist. The version "WMTC-stage 1" is the basis, adopted as gtr No. 2 in 2005. With Amendment 1 to gtr No. 2, slight modifications of the classification (classes 1, 2-1) and the test cycles (part 1, 2 alternatives) had been introduced in 2007 (version "WMTC-stage 2").

12. Most of the data concern class 3 vehicles and come from the EU Joint Research Centre (JRC) data. For this class, the results are relatively homogenous.

13. Class 1 and 2 data are more spread around the world. Furthermore, due to differences in market, legislation and technology, one might assume that the test results may vary a lot according to the region. This is why rough data of class 1 and class 2 vehicles were analysed by region. Informal document No. GRPE-56-11 shows figures with results distinct for vehicles and regions for class 1 and for class 2 vehicles.

14. For class 1 vehicles, the updated database contains 47 class 1 motorcycles. For 26 of these motorcycles, measurement values are available for the Euro 3 cycle as well as for the WMTC cycle.

The vehicle numbers are chosen in such a way that the regions of China, Japan, India and Europe appear in different colours.

15. The class 2 vehicle database is still smaller than for the other classes, even if some new vehicles have been added. The whole sample consists of 29 vehicles, 16 of them belonging to class 2-1 and 13 belonging to class 2-2. For all of them, results for the WMTC cycle exist, but for the Euro 3 cycle results are available for 20 vehicles. Concerning the regions, it must be mentioned that European data is completely missing and that class 2-2 consists of 4 Japanese and 3 Indian vehicles only and 3 vehicles from Europe.

B. Evaluation of the test results - standstill limit values

B.1 Explanation of the standstill limit values

16. When changing from one test cycle to another, the first question to be resolved when thinking about new limit values is: "What would the existing limits look like if adjusted to fit the new test cycle?" The answer to this question is the "standstill value".

17. Assuming that tests are done with the same vehicle under the same general test conditions, the standstill value is calculated with the following formula:

$$L_{wmtc} = \frac{L_e \text{ x } R_{wmtc}}{R_e}$$

where:

L_{wmtc} = the limit value for the WMTC test cycle
L_e = the limit value with the existing cycle
R_{wmtc} = the test result with the WMTC cycle
R_e = the test result with the existing test cycle

18. How the resulting data cloud is analysed depends on the objectives. There are many statistical methods for finding out the standstill ratio. For example, the JRC uses the method of taking the average of the ratios for each vehicle tested. In what follows, the IMMA analysis uses a regression line to establish the trend. Such an approach means that some vehicles that would pass the existing test and limit values would not do so with the new limit values. The linear regression method assumes that there is a linear relationship between the emission results of the two cycles. Where such a relation does not exist, the results obtained will be illogical tending to be irrational. Whether the linear relationship exists or not can easily be made out by comparing the coefficient of regression (R^2), which should be more than about 0.85.

19. The most important determinant of the comparison is the sample that is used to carry out the study. For example, IMMA's analysis imposed a filter on the data in order to eliminate vehicles with a technology that would not be useable for a future reduction in limit values. The data of vehicles on Euro 3 cycle exceeding the Euro 2 limits were discarded. A different basis for the comparison has been used by past and ongoing regional/national studies, such as that carried out by the EU.

20. Factors that will influence the results include:

(a) The proportion of the different classes of vehicle in the sample: e.g. a sample with a high concentration of class 3 vehicles will not necessarily adequately reflect the situation for class 1 vehicles,

(b) The design concept prevalent in the different markets will make it difficult to combine the results, e.g. a design based on fuel economy will not combine well with a design based on sports performance,

(c) The reference fuel used.

21. All these factors should be taken into account when considering the results and standstill values presented below.

Table B2
IMMA Study on standstill limit values

Country / Region	*China*				*EU*				*India*		*Japan*				*USA*		
Stage (current)	*CHN-2*				*EU-3*				*BS-II*		*JPN-2*				*EPA-Tier1*		
Limit values (g/km)	*CO*	*HC*		*NOx*	*CO*	*HC*		*NOx*	*CO*	*HC + NOx*	*CO*	*HC*		*NOx*	*CO*	*HC+ NOx*	
		<150 ccm	≥150 ccm			<150 ccm	≥150 ccm					<125 ccm	≥125 ccm			<170 ccm	≥170 ccm
	5.5	1.2	1.0	0.30	2.0	0.8	0.3	0.15	1.5	1.5	2.0	0.5	0.3	0.15	12	1.0	1.4
Step-1. 2004 data	-	-	-	-	2.42	0.79	0.34	0.20	-	-	3.29	0.47	0.35	0.31	17.0	1.27	1.77
Step-2. All data	4.48	0.60	0.54	0.29	2.82	0.63	0.37	0.18	2.65	1.80	2.54	0.39	0.27	0.31	19.3	1.29	1.77
Step-2. EU-2 filter	5.55	0.76	0.65	0.34	2.43	0.68	0.29	0.18	-3.17	2.02	1.88	0.42	0.25	0.21	22.9	1.43	2.00

Table B3

B.3 India study - class wise - standstill limit values

Correlation	Data source	Classes	Data considered	No of data points	CO		THC		Nox		HC + Nox	
					R square	SS (g/km)	R square	SS (g/km)	R square	SS (g/km)	R square	SS (g/km)
EU3 - vs WMTC	All regions combined	All class together	All data	111	0.660	2.824	0.610	0.626*	0.798	0.180		
								0.367**				
			EURO 2 filter	59	0.504	2.432	0.742	0.683*	0.712	0.176		
								0.290**				
		CLASS 1	All data	43	0.769	2.307	0.804	0.494	0.841	0.147		
			with EURO filter	26	0.764	2.021	0.842	0.574	0.753	0.156		
		Class 2-1	All data	10	0.394	3.206	0.829	0.409*	0.957	0.207		
								0.257**				
			with EURO filter	5	0.162	4.413	0.654	0.543*	0.914	0.184		
								0.250**				
		Class 2-2	All data	10	0.750	2.860	0.895	0.589*	0.635	0.186		
								0.298**				
			with EURO filter	4	regression not possisble		0.960	0.476*	0.698	0.189		
								0.225**				
		CLASS 3	All	48	0.910	2.542	0.892	0.350	0.833	0.214		
			with EURO filter	24	0.839	2.416	0.824	0.333	0.726	0.199		
	INDIA	All class together	All data	17	0.290	2.307	0.950	0.714*	0.766	0.198		
								0.281**				
			EURO 2 filter	8	0.019	1.832	0.657	0.599	0.188	0.254		
		CLASS 1	All	11	0.740	1.829	0.995	0.717	0.915	0.201		
			with EURO filter	6	0.588	1.788	0.895	0.685	0.527	0.232		
		Class 2-1	All data	3	regression not possisble		1.000	0.929*	0.891	0.217		
								0.273**				
			with EURO filter	1	regression not possisble							
		Class 2-2	All data	3	0.593	3.069	regression not possisble		0.479	0.205		
			with EURO filter	1	regression not possisble							
		CLASS 3	All	1	regression not possisble							
	ACEM	All class together	All data	38	0.887	2.559	0.860	0.783*	0.804	0.227		
								0.323**				
			EURO 2 filter	15	0.759	2.483	0.835	0.748*	0.659	0.209		
								0.282**				
		CLASS 1	All	1	regression not possisble							
			with EURO filter	1	regression not possisble							
		Class 2-1	All data	0	regression not possisble							
			with EURO filter		regression not possisble							
		Class 2-2	All data	3	regression not possible		0.795	0.443	regression not possible			
			with EURO filter	0	regression not possisble							
		CLASS 3	All	34	0.903	2.632	0.906	0.300	0.809	0.230		
			with EURO filter	14	0.803	2.529	0.829	0.320	0.622	0.208		
EU3 - vs WMTC	CHINA	All class together	All data	31	0.717	3.037	0.889	0.480*	0.720	0.143		
								0.326*				
			EURO 2 filter	14	0.477	2.138	0.837	0.557*	0.485	0.141		
								0.280**				
		CLASS 1	All	26	0.730	3.003	0.905	0.495	0.760	0.136		
			with EURO filter	14	0.477	2.138	0.837	0.558	0.485	0.141		
		Class 2-1	All data	5	0.656	2.755	0.873	0.406*	0.616	0.177		
								0.260**				
			with EURO filter	1	regression not possisble							
		Class 2-2	All data	0								
			with EURO filter	0								
		CLASS 3	All	0								
			with EURO filter	0								
	JAPAN	All class together	All data	18	0.837	2.351	0.769	1.019*	0.885	0.162		
								0.358**				
			EURO 2 filter	16	0.860	2.429	0.860	0.497*	0.770	0.165		
								0.338**				
		CLASS 1	All	5	0.885	2.453	0.982	0.578	0.982	0.136		
			with EURO filter	5	0.885	2.453	0.982	0.578	0.982	0.136		
		Class 2-1	All data	2	regression not possisble							
			with EURO filter	2	regression not possisble							
		Class 2-2	All data	4	0.968	2.368	0.957	0.328	0.894	0.149		
			with EURO filter	NR			0.393	0.382	0.991	0.102		
		CLASS 3	All	8	0.828	2.684	0.775	0.418	0.884	0.177		
			with EURO filter	6	0.917	2.402	0.930	0.378	0.854	0.194		
	US	All class together	All data	6	0.962	2.094	0.981	0.159	0.979	0.143		
			EURO 2 filter	4	0.859	2.070	0.911	0.372	0.980	0.184		
		Class 1		0								
		Class 2-1		0								
		Class 2-2		0								
		CLASS 3	All	6	0.962	2.094	0.981	0.159	0.979	0.143		
			with EURO filter	4	0.859	2.070	0.911	0.372	0.980	0.184		
INDIA vs WMTC	INDIA	All class together		23	Regression not possible						Regression not possible	
		Class 1		11	0.378	2.957	No separate norm		No separate norm		0.492	2.019
		Class 2-1		8			No separate norm		No separate norm		0.709	1.513
		Class 2-2		3			No separate norm		No separate norm		Regression not possible	
		Class 3		1								
JAPAN vs WMTC	JAMA	ALL		48	0.601	2.543	0.876	0.270	0.398	0.310		
		class 1		9	0.845	2.236	0.962	0.471*	0.717	0.126		
								0.274**				
		class 2-1		2	Regression not possible		Regression not possible		Regression not possible			
		CLASS 2-2		7	0.759	3.088	0.984	0.413*	0.974	0.222		
								0.259**				
		CLASS 3		30	0.539	2.770	0.848	0.290	0.326	0.354		
US		ALL		19	0.920	19.288	0.929	1.266	No separate norm		0.846	1.773

*: ≤ 150cc
**: > 150cc

More background information can be found in informal document No. GRPE-56-11 (Annex G).

22. The Indian analysis has been carried out separately for each class and for each region. In the case of Euro 3-WMTC correlation, the analysis has been carried out with all data, and also applying Euro 2 filter.

23. Comments from India:

(a) Euro-WMTC data points of 111 available include India's 18 and Chinese 31 vehicles, which do not reflect proper correlation, as these vehicles are not tuned for compliance to Euro 3. Indian data is based on Indian drive Cycle (IDC). Relating this data from IDC to Euro 3 norms and then equating to WMTC equivalent values does not reflect a correct correlation.

(b) The analysis of data on Indian motorcycles of Class 2-1, show abnormally high standstill values for CO, which are not justifiable. India had expressed these reservations in the Fundamental Element Group (FEG) meeting, held in Ann Arbor on 20-21 November 2007, while accepting the compromise formula. Indian experts are now convinced that Part 2 (reduced speed) cycle is not suitable for India and similar countries, as the operating conditions in such regions focus on commuting and fuel efficiency, rather than high acceleration and power.

(c) Comparative emission traces highlight the abnormal increase of CO emissions, when the same motorcycle is tested on part 2 (reduced speed) cycle compared to part 1 (reduced speed) cycle. This explains the reason for the abnormal CO values.

V. Comments and conclusions

24. In some of the WMTC classes (e.g. class 2-1) the database is poor because of the low number of tests conducted. The results should not be taken as exact figures, but can show trends.

25. A difference in national / regional legislation exists concerning NOx and HC. In some cases, the limits are separated and sometimes combined (see paragraph 2.). The reason for separate limits may be a focus on NOx controlling. Countries like India, focussing more on fuel consumption and CO2 emissions, prefer a combined limit value. The United States of America also follows a combined HC+NOx.

26. Harmonization of reference fuel is an important condition for the introduction of harmonized limit values, because of the influence on the results of emission tests.

27. A comparison of the level of limit values from national / regional legislation is limited because of the following reasons:

(a) Different classification,

(b) Motorcycles may be designed for different purposes, like high performance or low fuel consumption,

(c) Engines are designed to meet the existing limit values under the special test conditions like cycle, cold/warm-start, reference fuel.