Transmitted by the informal group on WMTC

Informal document No. **GRPE-56-11**
(56th GRPE, 3-6 June 2008,
agenda item 4)

Report on data collection as a basis for the discussion about the introduction of performance requirements in GTR No. 2 (World-wide harmonized motorcycle emission test cycle (WMTC))

1. Introduction

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. One of 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.

With the status report to GRPE in June 2006 (inf doc No. GRPE-52-6) 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.

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, IMMA has 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.

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

The following tables gives only a rough summary of the limit values. More detailed information about some of the the national legislation can be found in the ANNEX. The tables below don't include mopeds (< 50 ccm), so "all" means > 50 ccm.

2.1. China

cycle	classification	stage	CO g/km	HC g/km	NOx g/km	HC+NOx g/km
ECE R 40	all	2004	5,5	1,2	0,3	-
ECE R 40 (cold)	< 150 ccm	2007/8	2,0	0,8	0,15	-
ECE R 40 + EUDC (max. 90 km/h)	> 150	2007/8	2,0	0,3	0,15	-

2.2. EU

cycle	classification	stage	CO g/km	HC g/km	NOx g/km	HC+NOx g/km
ECE R 40	< 150 ccm	2003/4	5,5	1,2	0,3	-
ECE R 40	> 150 ccm	2003/4	5,5	1,0	0,3	-
ECE R 40 (cold)	< 150 ccm	2006/7	2,0	0,8	0,15	-
ECE R 40 + EUDC	> 150 ccm	2006/7	2,0	0,3	0,15	-

2.3. India

cycle	classification	stage	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 & HC+NOx

2.4. Japan

cycle	classification	stage	CO g/km	HC g/km	NOx g/km	HC+NOx g/km
TRIAS/LA4	all / 2stroke	1999	8,0	3,0	0,1	-
TRIAS/LA4	all / 4stroke	1999	13,0	2,0	0,33	-
TRIAS/LA4	< 125 ccm	2008	2,0	0,3	0,15	-
TRIAS/LA4	> 125 ccm	2008	2,0	0,5	0,15	

2.5. Korea

cycle	classification	stage	CO g/km	HC g/km	NOx g/km	HC+NOx g/km
ECE R 40	all	-	8,0	4,0	0,1	-

2.6. US

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

3. Status of transposition of GTR No. 2 into national / regional legislation

3.1. EU

With directive 2006/72/EC the EU transposed GTR No 2 into directive 97/24/EC. Equivalent to Euro 3 (see above 2.2.) manufacturers optional can choose for type approval 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 ≥ 130 km/h	2,62	0,33	0,22

3.2. Japan

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 3.1..

3.3. China

China is estimated to follow the EU approach.

3.4. US

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

3.5. India

In India, consideration for introducing WMTC as alternative to existing Indian regulation is under discussion. Various issues such as class wise stand still values & combined HC+NOx are being debated in conjunction with fuel consumption & CO_2 emissions. Date for the implementation is presently not decided.

4. Data and test results

4.1. Test data

The test data is tabled in Annex D. It should be taken into account that already two versions of WMTC test cycles and classification exists. The version "WMTC-stage 1" is the basis, adopted as GTR No. 2 in 2005. With amendment 1 of GTR no. 2 slight modifications of the classification (classes 1, 2-1) and the test cycles (part 1, 2 alternative) had been introduced in 2007 (version "WMTC-stage 2").

Most of the data concern Class 3 vehicles and come from the JRC data. So for this class, the results are relatively homogenous.

Class 1 and 2 data are more spread around the world. Furthermore due to market differences, legislation and technology used, 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. Annex B shows figures with the results separated for vehicles and regions for class 1 and Annex C shows the results for class 2 vehicles.

4.2. Emission results separated for different cycles, vehicles and regions

4.2.1. Class 1 vehicles (Figures in ANNEX E)

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 figures in ANNEX E show the emission results for the Euro 3 cycle and the WMTC cycle for CO, THC, NOx and CO_2. The vehicle numbers are chosen in that way that the regions China, Japan, India and Europe can clearly separated by different colours.

Figure E-1 shows the CO emissions for the Euro 3 cycle. The Chinese results range between 2,1 and 5,4 g/km, the 2 European vehicles form a similar bandwidth. The Japanese data range between 0,3 and 1,7 g/km, the Indian data is in the same range but slightly higher.

Figure E-2 shows the corresponding results for the WMTC cycle. Ranking and ranges are almost the same as for the Euro 3 cycle. Only the results for the 2 European vehicles are closer together.
Figure E-4 and Figure E-5 show the results for the THC emissions. The overall range is 0,096 to 1,07 g/km for the Euro 3 cycle and 0,068 to 0,68 g/km for the WMTC cycle. The highest variation is shown for the Chinese data and the Euro 3 cycle. In each region vehicles with 0,2 g/km or even lower emissions can be found.

The NOx emissions are shown in Figure E-7 and Figure E-8. For the Euro 3 cycle the NOx emissions are on average higher for the Chinese data and the Indian data than for the Japanese and European data, but 2 of the Chinese vehicles and 1 of the Indian vehicles have results within the Japanese/European range. The results for the WMTC cycle have a wider spread for the Chinese and the European data than for the Euro 3 cycle. In all regions except Japan some vehicles can be found for which the WMTC results are significantly higher than for the Euro 3 cycle. For both cycles the average emissions of the Chinese and Indian vehicles are more than 2 times higher than the average emissions of the Japanese vehicles. Nevertheless and even for the WMTC cycle some Chinese vehicles have NOx emissions within the variation range of the Japanese vehicles.

The CO2 emissions are shown in Figure E-10 and Figure E-11. At first can be noticed that the emission values for the different regions are closer together than for the pollutant emissions, except for the 2 European vehicles that have significantly higher CO2 emissions than the rest. The average CO2 emissions have the following rank order in rising order: India, China, Japan, Europe. The WMTC cycle results are always lower than the Euro 3 cycle results.

Figures E-3, E-6, E-9 and E-12 show comparisons of the results for the Euro 3 and WMTC cycle for CO, THC, NOx and CO2. The 2 European vehicles are coloured in light blue, 5 Chinese vehicles with extremely lower CO2 emissions for the WMTC cycle than for the Euro 3 cycle are highlighted in yellow. The CO emissions follow a one by one trend, the THC emissions are close to that for the major part of the vehicle sample. Also the NOx emissions are close to a one by one trend for most of the vehicles but with an additional tendency to higher values for the WMTC. The average CO2 emissions of the WMTC cycle is 86% of the Euro 3 cycle, if the European and the 5 highlighted Chinese vehicles are disregarded.

4.2.2. Class 2 vehicles (Figures in ANNEX F)

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, results for the Euro 3 cycle are available for 20 vehicles. Concerning the regions must be mentioned that European data is completely missing and that class 2-2 consists of 4 Japanese and 3 Indian vehicle only and 3 vehicles from Europe. Corresponding figures as shown for the class 1 sample were drawn and are shown in ANNEX F.

The CO emissions for the 2 cycles are shown in Figure F-13and Figure F-14. The highest scatter is found for the Chinese vehicles. For some vehicles the WMTC cycle shows significantly higher results than the Euro 3 cycle. One extreme example is one Indian class 2-1 vehicle where the CO emission for the WMTC is 5,3 times higher than for the Euro 3 cycle. On the other hand there is one Chinese vehicle for which the CO emissions for the WMTC cycle is only 50% of the emission for the Euro 3 cycle.
The THC emissions are shown in Figure F-16and Figure F-17. The WMTC cycle results have a lower variation range than the Euro 3 cycle. For both cycles the lowest values are found for the Japanese vehicles.

The NOx emissions are shown in Figure F-19and Figure F-20. The results show a high variation range, especially for the WMTC cycle. The Japanese vehicles determine the lower end of the bandwidth for both cycles. But 1 Chinese and 1 Indian vehicle have comparably low NOx emissions than the Japanese vehicles for the WMTC cycle.

The CO2 emissions are shown in Figure F-22and Figure F-23. The emissions for the WMTC cycle are always lower than for the Euro 3 cycle but with high individual differences. The WMTC cycle emissions are between 49% and 94% of the Euro 3 cycle emissions. For the pollutant emissions no significant difference between class 2-1 and class 2-2 was found. The CO2 emissions of the Japanese class 2-2 vehicles are significantly higher than the rest and the lower envelope of the range is performed by Chinese and Indian class 2-1 vehicles. But there is also 1 Japanese class 2-1 vehicle with the same low emission.

Figures F-15, F-18, F-21 and F-24 show comparisons of the results for the two cycles. No clear trend can be seen for the CO emissions. The THC emissions follow a one by one trend for low values but increasingly lower values for the WMTC cycle compared to the Euro 3 cycle for increasing THC values. For NOx emissions the trend is nearly the same for low emission values and almost the opposite for high values. As already stated the CO2 emissions of the WMTC cycle are always lower than for the Euro 3 cycle, but CO2 emission values of 49% to 61% of the Euro 3 cycle for the WMTC cycle can hardly be imagined.

4.3. Evaluation of the test results - standstill limit values

4.3.1. Explanation of the standstill limit values

When changing from one test cycle to another, the first question to be resolved in 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”.

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

$$Lwmtc = \frac{Le \times Rwmtc}{Re}$$

where:
Lwmtc = the limit value for the WMTC test cycle
Le = the Limit value with the existing cycle
Rwmtc = the test result with the WMTC cycle
Re = the test result with the existing test cycle

How the resulting data cloud is analysed depends on the objectives. There are many statistical methods for finding out the stand still ratio. E.g. JRC used the method of taking the average of the ratios for each vehicle tested. In what follows, the IMMA analysis, for example, used 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 relation ship between the emission results of the two cycles. Where such a relation does not exist, the results arrived 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.

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 European Union.

Factors that will influence the results include:

- the proportion of the different classes of vehicle in the sample: eg a sample with a high concentration of Class 3 vehicles will not necessarily adequately reflect the situation for Class 1 vehicles
- the design concept prevalent in the different markets will make it difficult to combine the results, eg a design based on fuel economy will not combine well with a design based on sports performance
- the reference fuel used

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

4.3.2. IMMA Study on standstill limit values

Country /Region	**CHINA**				**EU**				**INDIA**		**JPN**				**US**		
Stage (current)	CHN-2				EU-3				BS-II		JPN-2				EPA-Tier1		
Limit values (g/km)	CO	HC <150 cc	HC ≥150 cc	NOx	CO	HC <150 cc	HC ≥150 cc	NOx	CO	HC+ NOx	CO	HC <125 cc	HC ≥125 cc	NOx	CO	HC+ NOx <170 cc	HC+ NOx ≥170 cc
	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

Comment [d1]: Explain what are the data concerned

4.3.3. India study - class wise - standstill limit values

More background information regarding the class wise evaluation is tabled in ANNEX G

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

Indian Analysis has been carried out separately for each class and for each region. In the case of EURO3-WMTC correlation, analysis has been carried out with all data, and also applying EURO 2 filter.

Comments from India:

- 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.

- The analysis of data on Indian motorcycles of Class 2-1, show abnormally high SS values for CO, which are not justifiable. India had expressed these reservations in the FEG meeting held in Ann Arbor on 20/21st Nov '07, while accepting the compromise formula. We 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.

- Comparative Emission traces, highlights 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.

- India suggests that, the provision may be made in the GTR in such a way that, Class 2.1 vehicles may also be allowed to be tested on Part 1 Reduced speed cycle.

5. Comments and conclusions

- In some of the WMTC classes (e.g. 2-1) the data base is poor because of the low no. of tests conducted. The results should not be taken as exact figures, but can show trends.

- A difference in national / regional legislation exists concerning NOx and HC. In some cases the limits are seperated, sometimes combined (see 2.). The reason for seperated limits maybe a focus on NOx controlling. Countries like India, focussing more on fuel consumption and CO2 emissions, prefer a combined limit value. USA also follows a combined HC+NOx.

- Harmonisation of reference fuel is an important condition for the introduction of harmonised limit values, because on the influence on the results of emission tests.

- A comparison of the level of limit values from national / regional legislation is limited because of the following reasons:
  -- different classification,
  -- motorcycles maybe designed for different purposes, like high performance or low fuel consumption,
  -- engines are designed to meet the existing limit values under the special test conditions like cycle, cold/warm-start, reference fuel.

- Concerning the suggestion made by India above, the WMTC informal group recommends to avoid any additional amendment of the test cycles and classification in GTR No. 2 for the time being. Special situations in Contracting Parties can be taken into account by exemptions in the transposition of GTR No. 2 into national legislation.

ANNEX A - Chinese legislation

The Chinese national exhaust emission legislation for motorcycles, tricycles and mopeds is modelled on the corresponding EU Directives and is summarised in the table below.

Table: Summary of Motorcycle Emission Standards of China

Stage	Vehicle Type	Displacement	Standard Title	Test Method	Limit （g/km）			Implementation Date	Remarks
					CO	THC	NOx		
II (current)	Two-wheeled motorcycle	/	GB14622-2002	ECE 40	5.5	1.2	0.3	2004.01.01	- Equivalent to 97/24/EC C5。
	Tricycle				7.0	1.5	0.4		
	Two-wheeled moped	/	GB18176-2002	ECE 47	1	1.2		2005.01.01	
	Three - wheeled moped				3.5	1.2			
III	Two-wheeled motorcycle	≦150	GB14622-2007	UDC	2.0	0.8	0.15	2008.07.01	Compared to the latest EU directive, the main amendment is as follow: - Dual idle test in the type test shall be canceled; - The requirements for motorcycles use the gas fuel shall be added; - the maximum speed for the extra-urban driving cycle will be restricted to **90 km/h**; - Requirement for the durability test of the pollution control devices shall be added; - The calculation method of the dilution coefficient, standard condition and density of the emission calculation equation shall be changed; - Technical requirements of the reference fuel used in the test shall be changed.
		>150		UDC+ EUDC	2.0	0.3	0.15		
	Tricycle	/		UDC	4.0				
	Two-wheeled moped	/	GB18176-2007	ECE 47	1	1.2		2008.07.01	Compared to the latest EU directive, the main amendment is as follow: - The requirements for motorcycles use the gas fuel shall be added; - 4 test cycle shall be added; - Dual idle test in the type test shall be canceled; - Analysis and measurement procedure shall be changed; - The calculation method of the dilution coefficient, standard condition and density of the emission calculation equation shall be changed; - Requirement for the durability test of the pollution control devices shall be added; - COP Inspection requirements shall be added; - Technical requirements of the reference fuel used in the test shall be changed.

ANNEX B - Indian legislation

Indian emission test and norms were made applicable from 1991. Test cycle was based on the data collections in major cities in 1988, which was representative of the driving pattern in the cities. The Indian driving cycle is consisting of the series of phases idling, cruising, acceleration & deceleration. The distance of one cycle is 0.658km and period of time 108sec. The overall cycle consists of combination of 6 such cycles. The total distance covered during the emission test is 3.948 km, average speed is 29.93 km/hr & maximum speed is 42 km/hr. Maximum acceleration is 0.65 m/sec seq & deceleration is 0.56 m/sec seq. India’s current & proposed regulations are based on combining HC & Nox for better fuel consumption & less CO2 emission. Controlling of NOx independent of HC has an adverse effect on the fuel consumption and CO2 emission. Motorcycles in India are specifically earmarked for introduction of CO2/ Fuel consumption regulation due to the large number of vehicles operating on Indian roads (74% of total fleet of vehicles).

In view of the above, India recommends that an option of a combined HC + NOx limit value should be included.

Existing / Proposed Indian legislation for motorcycles:

Regulation	Vehicle Type	Effective Date	CO (gm/km)	HC+NOx (g/km)
India BSII	All 2 W	2005	1.5	1.5
India BSIII	All 2 W	2010	1.0	1.0

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

ANNEX C - US legislation

The emissions test procedure used by the United States for motorcycle emission testing is known as the Federal Test Procedure (FTP). The FTP was designed to measure a vehicle's tailpipe emissions under urban driving conditions. The driving cycle used for the FTP was developed in the mid-1960's to represent home-to-work commuting in Los Angeles, California. The FTP includes a series of accelerations, decelerations, and idling (such as at stop lights). It also includes starting the vehicle after it has been parked for an extended period of time (called a “cold start”), as well as a start on a warmed-up engine (called a “hot start”). The total distance covered by the FTP is about 11 miles and the average speed is about 21 mph, with a maximum speed of about 56 mph. The maximum acceleration rate is a relatively mild 3.3 mph/sec, which is due to the limitations of the dynamometer technology at the time the test was developed.

Federal regulations currently define a motorcycle as “any motor vehicle with a headlight, taillight, and stoplight and having: two wheels, or three wheels and a curb mass less than or equal to 793 kilograms (1749 pounds)” (see 40 CFR 86.402-98). Note that any motorcycle or motorcycle-like vehicle that falls outside that definition would be considered a nonroad vehicle and be subject to different requirements.

Table: Current U.S. Motorcycle Exhaust Emission Standards

Class	**Engine Size (cc)**	**Model Year Effective Date**	**HC (g/km)**	**HC+NOx (g/km)**	**CO (g/km)**
I	Less than 170	2006	1.0	--	12.0
II	170-279	2006	1.0	--	12.0
III	280 and greater	2006	--	1.4	12.0
		2010	--	0.8	12.0

In addition to the exhaust emission standards described above, EPA also regulates evaporative emissions from motorcycles with requirements that limit the permeation of gasoline through the walls of fuel hoses and fuel tanks.

ANNEX D Test Data - total 134 units: 82 (stage 1 (2004)) + 52 (stage 2 (2007/8))

Collect ed in	data source	E_capa (cc)	WMTC Class	Moto	JPN-2 (6UDC) CO	JPN-2 (6UDC) THC	JPN-2 (6UDC) NOx	JPN-2 (6UDC) CO2	EURO 3 CO	EURO 3 THC	EURO 3 NOx	EURO 3 CO2	US/FTP CO	US/FTP THC	US/FTP NOx	US/FTP HC+NOx	US/FTP CO2	WMTC CO	WMTC THC	WMTC NOx	WMTC CO2	BS-II (INDIA) CO	BS-II (INDIA) THC	BS-II (INDIA) NOx	BS-II (INDIA) HC+NOx	BS-II (INDIA) CO2
2004	ACEM	200	2	RUNNER 200 4	4.86	0.660	0.179	85.9	6.34	0.501	0.286	75.4	4.90	0.424	0.210	0.634	65.8	7.07	0.486	0.260	64.8					
2004	JRC	200	2	MT006-C2-200	7.38	1.219	0.224	86.0	7.38	1.219	0.224	86.0						5.63	0.984	0.390	67.1					
2004	JRC	223	2	WR2-C2-223					4.85	1.575	0.149	60.5						6.69	0.909	0.285	44.6					
2004	JAPN	249	2	H15-C23-249 4T	5.95	0.307	0.204	77.1	9.66	0.294	0.258	64.0						8.13	0.321	0.317	60.1					
2004	JAPN	250	2	H13-C2'-250 4T 6MT									8.77	0.470	0.170	0.640	58.0	13.42	0.563	0.151	55.1					
2004	JAPN	250	2	H16-C24-250 4T	1.30	0.145	0.033	111.6	1.43	0.092	0.032	99.6	0.86	0.060	0.029	0.089	85.0	1.42	0.090	0.033	81.5					
2004	JRC	250	3	MT023-C3-250					18.20	0.770	0.230	67.9						20.03	0.650	0.308	59.6					
2004	JAPN	399	3	H14-C3-399 4T 6MT									11.10	1.260	0.090	1.350	90.8	20.10	1.425	0.128	89.4					
2004	JAPN	400	3	H13-C3'-400 4T 5MT									9.53	0.850	0.480	1.330	80.3	17.52	0.938	0.490	81.6					
2004	JRC	400	3	MT024-C3-400					10.80	0.560	0.180	74.2						14.65	0.590	0.235	69.8					
2004	JRC	400	3	W26-C3-400					13.21	0.737	0.451	91.3						17.53	0.937	0.490	81.6					
2004	JRC	500	3	MT007-C3-500	10.04	1.146	0.472	128.6	10.78	0.949	0.607	106.6						11.94	1.169	0.721	97.4					
2004	JRC	500	3	MT016-C3-500	4.65	0.287	0.144	136.0	5.62	0.269	0.243	108.6						7.31	0.374	0.351	104.1					
2004	JAPN	599	3	H16-C32-599 4T	2.18	0.580	0.090	176.0	1.50	0.393	0.155	141.0	1.46	0.378	0.081	0.458	132.2	2.39	0.461	0.138	127.9					
2004	JRC	599	3	W39-C3-599					3.19	0.453	0.082	137.4						5.91	0.630	0.080	116.0					
2004	JRC	600	3	MT011-C3-600	2.36	1.427	0.154	122.0	2.06	0.865	0.335	101.4						3.06	1.028	0.418	92.9					
2004	JRC	600	3	MT011-C3-600-	6.10	3.248	0.226	110.3	4.90	1.942	0.551	93.5						5.68	1.734	0.781	86.1					
2004	JRC	600	3	MT018-C3-600	13.29	2.329	0.157	192.3	6.60	1.406	0.345	147.9						7.20	1.344	0.500	131.1					
2004	US	600	3	Kawasaki ZX6R	7.85	1.166	0.057	156.8	11.98	0.910	0.049	127.4	7.45	0.752	0.054	0.805	117.9	16.55	1.311	0.051	121.6					
2004	JAPN	645	3	H15-C32-645 4T	1.95	0.247	0.149	137.0	2.58	0.278	0.301	109.2						5.14	0.670	0.313	96.4					
2004	JAPN	748	3	H15-C32-748 4T	4.59	0.791	0.086	165.3	3.15	0.564	0.200	132.4						3.12	0.912	0.297	120.9					
2004	JRC	781	3	W64-C3-781					1.70	0.391	0.183	137.8						1.48	0.514	0.128	126.0					
2004	JRC	782	3	D2-C3-782					1.66	0.374	0.092	167.9						1.67	0.268	0.129	145.4					
2004	JAPN	800	3	H13-C3'-800 4T 6MT									1.53	0.400	0.170	0.570	130.8	1.49	0.488	0.220	127.8					
2004	JRC	800	3	MT019-C3-800-	15.66	1.567	0.136	160.2	7.36	0.552	0.427	120.6						5.26	0.479	0.635	114.3					
2004	JRC	800	3	MT026-C3-800					2.50	0.930	0.160	136.6						2.30	0.853	0.310	124.1					
2004	JRC	900	3	MT025-C3-900					10.30	1.200	0.170	146.8						12.73	1.220	0.265	123.0					
2004	JRC	953	3	D3-C3-953					4.35	0.947	0.093	165.3						5.16	0.992	0.137	138.1					
2004	US	954	3	Honda CBR954	18.61	1.678	0.087	181.8	16.07	1.201	0.140	137.6	13.04	1.080	0.108	1.188	132.7	16.71	1.467	0.184	110.7					
2004	JRC	955	3	D6-C3-955					4.73	0.712	0.152	137.3						5.57	0.565	0.193	118.5					
2004	JRC	955	3	MT017-C3-955	19.22	1.519	0.095	158.4	9.75	0.756	0.200	122.5						9.01	0.728	0.289	111.0					
2004	JRC	996	3	D4-C3-996					5.64	0.684	0.113	144.7						10.06	0.793	0.111	117.8					
2004	JAPN	1000	3	H16-C32-1000 4	2.00	0.795	0.115	188.9	1.81	0.498	0.125	149.4	0.92	0.527	0.158	0.685	124.3	1.51	0.583	0.182	130.5					
2004	JRC	1000	3	MT010-C3-1000	2.29	1.738	0.152	160.4	2.69	1.043	0.219	126.0						4.71	1.136	0.469	106.4					
2004	JRC	1000	3	MT010-C3-1000	6.21	3.663	0.166	144.4	5.96	2.214	0.412	114.7						8.48	2.499	0.671	99.2					
2004	US	1000	3	H-D FLHTCUI	2.42	0.334	0.123	262.6	1.38	0.175	0.173	191.4	0.75	0.105	0.138	0.243	178.7	1.20	0.131	0.192	148.4					
2004	US	1000	3	H-D FLSTF	2.90	0.179	0.132	258.7	2.65	0.117	0.216	188.9	2.20	0.149	0.166	0.315	176.2	2.64	0.181	0.275	159.5					
2004	JRC	1064	3	W68-C3-1064					0.35	0.075	0.016	153.7						0.27	0.065	0.039	130.6					
2004	JRC	1130	3	D1-C3-1130					1.11	0.350	0.136	157.9						1.06	0.278	0.273	139.0					
2004	JRC	1130	3	W32-C3-1130					4.32	0.503	0.090	163.5						4.95	0.501	0.101	136.6					
2004	JRC	1150	3	MT008-C3-1150	10.15	0.987	0.079	184.3	5.21	0.506	0.090	145.3						5.18	0.690	0.133	124.9					
2004	JRC	1157	3	D5-C3-1157					5.20	1.215	0.221	152.9						6.63	0.913	0.359	137.5					
2004	JRC	1170	3	W38-C3-1170					6.63	0.421	0.104	129.2						6.91	0.474	0.160	107.8					
2004	JRC	1171	3	W66-C3-1171					1.68	0.493	0.519	137.3						1.84	0.474	0.632	131.8					
2004	ACEM	1200	3	R 1200 GS	1.73	0.480	0.040	172.7	0.93	0.270	0.370	136.8	0.69	0.230	0.180	0.410	134.2	0.76	0.200	0.960	120.5					
2004	JRC	1200	3	MT009-C3-1200	7.43	1.832	0.207	164.5	4.08	1.005	0.396	128.3						5.51	1.356	0.534	112.2					
2004	JRC	1295	3	W40-C3-1298					1.18	0.366	0.181	152.4						1.21	0.287	0.249	129.0					
2004	JAPN	1298	3	H15-C32-1298 4	6.13	0.794	0.028	182.8	4.81	0.579	0.086	139.9						6.24	0.750	0.119	127.6					
2004	JRC	1298	3	D7-C3-1298					1.27	0.525	0.158	166.0						1.70	0.399	0.245	142.9					
2004	JRC	1449	3	WR3-C3-1449					9.83	1.174	0.730	131.5						7.26	0.869	0.749	107.0					
2004	ACEM	1600	3	Triumph rocket	2.01	0.147	0.120	310.5	1.47	0.090	0.110	223.6	3.55	0.268	0.073	0.341	185.7	3.17	0.188	0.175	164.2					
2004	JRC	1800	3	MT027-C3-1800					1.80	0.220	0.040	158.8						3.35	0.283	0.058	140.3					
2007	ACEM	125	1	ACEM-1					4.96	0.230	0.050	101.6						4.07	0.150	0.030	85.2					
2007	CHINA	96.2	1	CHINA-CN-4					1.88	0.560	0.490	55.2						1.61	0.510	0.460	50.2					
2007	CHINA	102	1	CHINA-CN-10					3.88	0.216	0.215	42.3						3.83	0.220	0.224	38.4					
2007	CHINA	102	1	CHINA-CN-2					2.90	0.500	0.310	45.5						1.90	0.330	0.200	27.6					
2007	CHINA	108.9	1	CHINA-CN-8					5.36	0.216	0.104	46.3						5.43	0.228	0.118	39.5					
2007	CHINA	123.7	1	CHINA-CN-11					4.32	0.183	0.169	54.7						4.00	0.176	0.186	45.4					
2007	CHINA	124	1	CHINA-CN-1					3.72	0.670	0.280	49.9						5.36	0.680	0.310	40.9					
2007	CHINA	124	1	CHINA-CN-15					2.37	0.213	0.192	53.5						2.65	0.221	0.213	42.3					
2007	CHINA	124	1	CHINA-CN-3					6.59	0.640	0.200	65.8						6.72	0.550	0.200	57.6					
2007	CHINA	124	1	CHINA-CN-6					7.00	0.660	0.200	56.7						8.59	0.580	0.140	38.8					
2007	CHINA	124.1	1	CHINA-CN-13					2.14	0.163	0.183	51.5						2.33	0.147	0.189	42.2					
2007	CHINA	124.6	1	CHINA-CN-12					3.82	0.347	0.215	58.9						4.22	0.296	0.226	52.6					
2007	CHINA	124.6	1	CHINA-CN-5					10.28	0.990	0.140	47.9						11.58	0.630	0.110	44.5					
2007	CHINA	124.6	1	CHINA-CN-9					2.86	0.326	0.168	58.4						3.12	0.358	0.182	54.3					
2007	CHINA	124.8	1	CHINA-CN-7					3.15	0.421	0.215	46.8						3.16	0.428	0.236	36.3					
2007	CHINA	196	2-1	CHINA-CN-14					5.92	0.316	0.145	56.1						6.62	0.226	0.155	46.6					
2007	CHINA	97.0	1	CHINA-EU-5					5.73	0.820	0.170	46.5						3.64	0.570	0.120	25.5					
2007	CHINA	107.0	1	CHINA-EU-10					3.48	0.917	0.209	43.9						2.85	0.580	0.140	23.5					
2007	CHINA	107.0	1	CHINA-EU-6					2.19	0.750	0.220	49.0						1.68	0.560	0.360	28.2					
2007	CHINA	124.0	1	CHINA-EU-8					6.41	0.630	0.110	57.9						3.68	0.447	0.103	33.4					
2007	CHINA	124.1	1	CHINA-EU-14					2.50	0.723	0.143	65.1						1.82	0.500	0.110	33.8					
2007	CHINA	124.1	1	CHINA-EU-15					10.97	1.222	0.059	53.7						5.12	0.540	0.050	36.1					
2007	CHINA	124.1	1	CHINA-EU-3					5.97	1.170	0.110	55.6						5.06	0.730	0.050	28.7					
2007	CHINA	124.4	1	CHINA-EU-16					35.70	5.067	0.030	43.8						16.65	1.740	0.020	29.1					
2007	CHINA	124.6	1	CHINA-EU-1					3.74	0.250	0.210	68.7						2.16	0.190	0.190	44.7					
2007	CHINA	124.6	1	CHINA-EU-2					10.73	0.510	0.250	52.4						6.28	0.320	0.220	35.5					
2007	CHINA	149.0	1	CHINA-EU-11					2.88	1.070	0.184	76.5						4.91	0.601	0.072	40.4					
2007	CHINA	149.0	1	CHINA-EU-4					20.68	1.820	0.070	64.3						7.36	0.820	0.030	26.5					
2007	CHINA	193.2	2.1	CHINA-EU-12					7.03	0.902	0.214	68.9						5.40	0.350	0.290	42.5					
2007	CHINA	193.2	2.1	CHINA-EU-13					2.31	0.606	0.115	83.9						1.78	0.340	0.080	41.0					
2007	CHINA	196.9	2.1	CHINA-EU-9					13.73	0.780	0.101	62.8						6.33	0.540	0.180	46.7					
2007	CHINA	199.1	2.1	CHINA-EU-7					14.08	2.270	0.150	67.3						11.19	0.830	0.150	41.3					
2007	INDIA	69.90	1	SIAM-1					1.64	1.540	0.050	39.0						1.75	1.380	0.090	38.0	0.91	0.80	0.02	0.82	31.0
2007	INDIA	87.80	1	SIAM-2					1.38	0.620	0.360	41.0						1.43	0.550	0.360	39.1	0.72	0.44	0.23	0.67	34.2
2007	INDIA	94.87	1	SIAM-3					2.09	0.450	0.290	42.2						2.49	0.380	0.280	38.9	0.45	0.29	0.24	0.53	33.1
2007	INDIA	99.27	1	SIAM-6					0.46	0.480	0.280	45.8						0.77	0.410	0.300	35.7	0.40	0.30	0.20	0.50	28.5
2007	INDIA	99.70	1	SIAM-7					0.65	0.240	0.230	42.4						0.83	0.230	0.310	33.1	0.27	0.27	0.42	0.69	27.6
2007	INDIA	102.00	1	SIAM-4					0.40	0.240	0.340	54.7						0.44	0.200	0.340	52.2	0.25	0.17	0.24	0.41	45.0
2007	INDIA	102.00	1	SIAM-5					0.77	0.220	0.340	51.1						0.88	0.200	0.340	49.1	0.31	0.14	0.22	0.36	41.3
2007	INDIA	124.70	1	SIAM-10					1.60	0.450	0.210	38.8						1.85	0.410	0.240	34.5	0.81	0.29	0.34	0.63	30.8
2007	INDIA	124.70	1	SIAM-9					2.38	0.500	0.140	49.0						1.53	0.430	0.210	38.5	0.41	0.29	0.31	0.60	31.9
2007	INDIA	124.80	1	SIAM-11					0.57	0.280	0.430	36.5						0.46	0.290	0.440	32.4	0.20	0.21	0.42	0.63	26.2
2007	INDIA	125.00	1	SIAM-12					1.97	0.460	0.220	47.0						1.48	0.460	0.300	38.3	0.31	0.32	0.35	0.67	31.3
2007	INDIA	147.50	2-1	SIAM-14					0.36	0.290	0.260	59.6						1.13	0.260	0.450	47.6	0.16	0.31	0.27	0.58	36.2
2007	INDIA	149.00	2-2	SIAM-17					0.55	0.550	0.200	60.3						3.64	0.350	0.360	51.8	0.18	0.36	0.27	0.63	39.8
2007	INDIA	149.20	2-1	SIAM-15					1.81	0.450	0.100	53.7						9.50	0.470	0.100	40.8	0.36	0.21	0.23	0.44	37.1
2007	INDIA	198.80	2-2	SIAM-18					4.39	0.350	0.340	60.1						1.94	0.320	0.380	51.8	0.58	0.38	0.16	0.54	43.2
2007	INDIA	220.00	3-1	SIAM-20					7.02	0.380	0.260	59.8						4.71	0.420	0.400	56.6	1.16	0.34	0.12	0.46	44.8
2007	INDIA	223.00	2-2	SIAM-19					9.34	0.330	0.170	61.6						8.78	0.470	0.140	55.0	0.57	0.25	0.25	0.50	47.2
2007	INDIA	346.00	2-1	SIAM-16					6.73	0.290	0.470	61.3						2.11	0.260	0.580	57.3	0.65	0.36	0.41	0.77	43.7
2007	JAMA	125	2.1	US_J1									1.62	0.232	0.109	0.341	56.7	2.19	0.317	0.186	58.2					
2007	JAMA	250	2-2	US_J2									2.96	0.122	0.118	0.240	82.8	3.93	0.137	0.101	78.7					
2007	JAMA	805	3-2	US_J3									3.80	0.462	0.549	1.011	100.2	3.16	0.764	0.852	105.1					
2007	JARI	49	1	J1	0.58	0.342	0.098	49.2	0.90	0.421	0.109	50.2						0.54	0.303	0.093	48.1					
2007	JARI	49	1	J2	0.60	0.350	0.115	47.2	0.86	0.410	0.126	48.3						0.54	0.305	0.119	45.1					
2007	JARI	115	1	J5	1.14	0.080	0.052	62.3	1.03	0.096	0.057	63.9						1.23	0.068	0.056	57.5					
2007	JARI	124	1	J4	1.87	0.186	0.030	47.5	1.75	0.185	0.041	58.8						2.20	0.168	0.037	46.5					
2007	JARI	135	2-1	J6	0.95	0.163	0.076	49.6	0.95	0.175	0.088	52.2						2.00	0.132	0.083	46.0					
2007	JARI	399	3-2	J3	1.45	0.182	0.066	139.4	0.81	0.114	0.050	118.1						1.25	0.084	0.030	108.6					
2007	JARI	650	3-2	J7	1.73	0.215	0.068	149.5	0.99	0.119	0.081	121.2						1.19	0.166	0.088	106.2					
2007	US	1584	3-2	H-D FLHTCU					1.65	0.130	0.090	161.4	1.32	0.130	0.060	0.190	150.6	2.13	0.180	0.120	143.1					
2007	US	1250	3-3	H-D VRSCB					1.08	0.170	0.030	171.1	0.62	0.120	0.040	0.160	162.3	1.01	0.150	0.040	153.0					
2008	JAMA	107	1	JP19	0.385	0.162	0.042	57.6	0.343	0.161	0.072	60.5						0.288	0.122	0.064	54.1					
2008	JAMA	156	2-1	CP1111 Pro	1.356	0.178	0.018	83.7	1.196	0.137	0.044	75.1						1.250	0.142	0.030	66.5					
2008	JAMA	249	2-2	KLX250 Pro	0.390	0.112	0.090	92.8	1.423	0.122	0.169	86.2						1.653	0.144	0.115	75.1					
2008	JAMA	249	2-2	G373E Pro	1.751	0.139	0.067	110.7	1.223	0.099	0.077	94.0						2.563	0.148	0.053	80.6					
2008	JAMA	49	1	d2(49)	1.32	0.19	0.1	45.7										1.01	0.16	0.07	43.9					
2008	JAMA	49	1	c2(49)	0.95	0.25	0.09	44.4										1.36	0.22	0.08	42.3					
2008	JAMA	125	1	b1'(125)	0.84	0.33	0.09	55.60										1.18	0.35	0.06	51.74					
2008	JAMA	125	1	c1'(125)	0.53	0.17	0.05	39.9										0.65	0.16	0.07	39.8					
2008	JAMA	990	3-2	d3(990)	0.88	0.21	0.12	228.1										1.02	0.09	0.09	159.9					
2008	JAMA	250	2-2	b3(250)	1.22	0.18	0.08	111.0										2.79	0.15	0.07	85.4					
2008	JAMA	582	3-2	c3(583)	0.87	0.11	0.07	155.2										1.40	0.11	0.04	125.2					
2008	JAMA	649	3-2	a2(649)	1.49	0.37	0.06	144.1										1.46	0.25	0.12	105.6					
2008	JAMA	650	3-2	b2(650)	0.55	0.19	0.07	193.1										0.52	0.12	0.18	117.5					
2008	JAMA	1000	3-2	a1'(1000)	1.48	0.28	0.06	207.1										1.52	0.23	0.05	139.7					
2008	JAMA	1250	3-2	d1'(1250)	0.55	0.21	0.05	232.6										0.74	0.08	0.04	158.7					
2008	SIAM 21		2-1															7.03	0.34	0.20	36.94	0.17	0.26	0.25	0.51	36.45
2008	SIAM 22		2-1															6.01	0.37	0.14	40.57	0.26	0.20	0.24	0.44	37.68
2008	SIAM 23		2-1															8.05	0.34	0.12	40.33	0.37	0.25	0.26	0.51	34.75
2008	SIAM 24		2-1															7.13	0.37	0.14	41.62	0.31	0.22	0.31	0.53	35.8
2008	SIAM 25		2-1															6.18	0.38	0.24	48.2	0.17	0.38	0.25	0.63	36.19

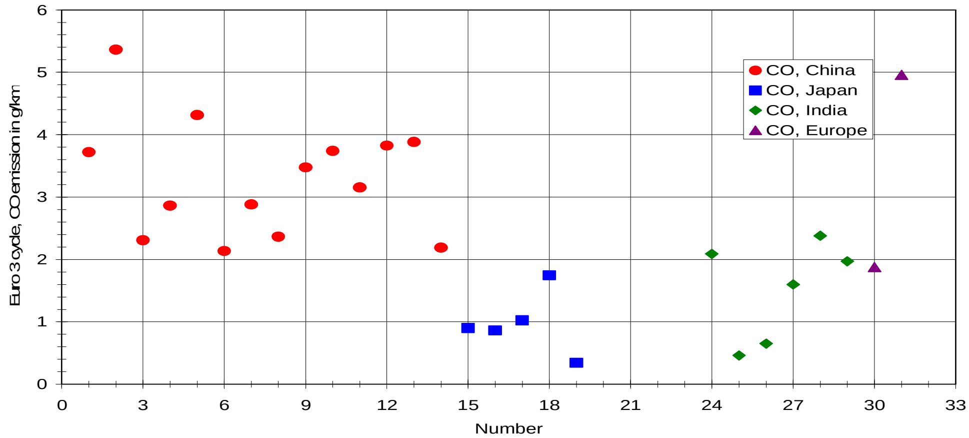

Figure E-1: CO emissions of class 1 motorcycles in different regions for Euro 3 cycle

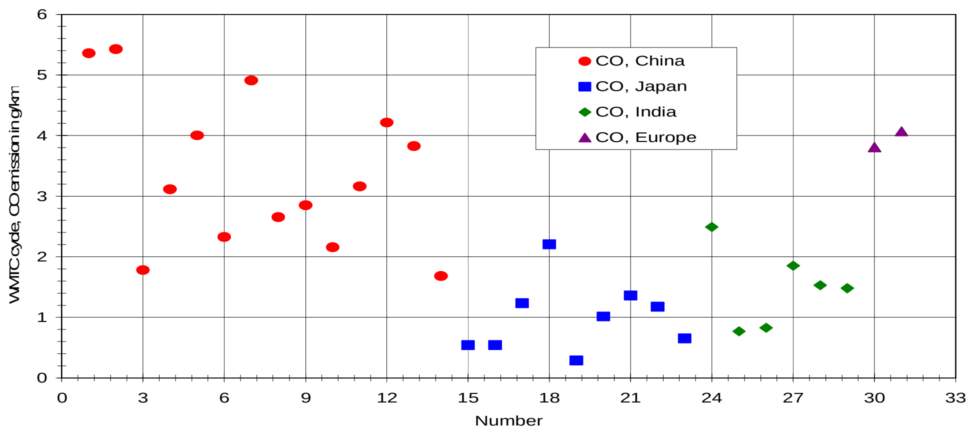

Figure E-2: CO emissions of class 1 motorcycles in different regions for WMTC cycle

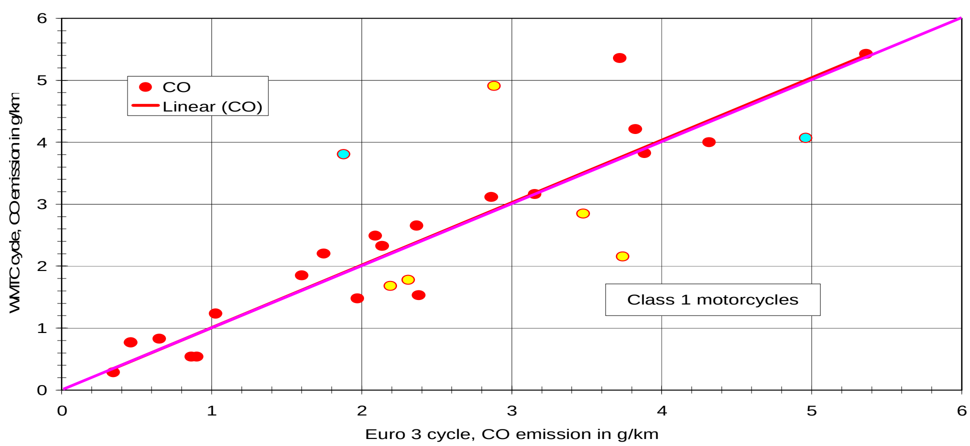

Figure E-3: Class 1 vehicles, WMTC cycle versus Euro 3 cycle results, CO emissions

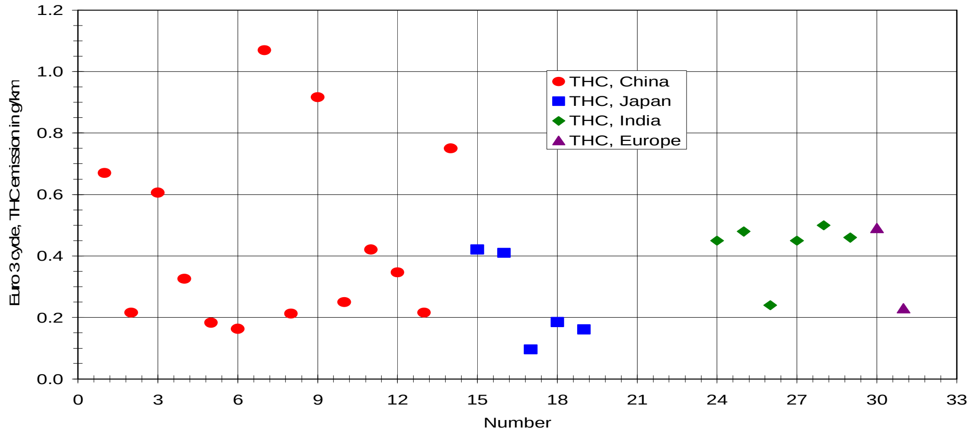

Figure E-4: THC emissions of class 1 motorcycles in different regions for Euro 3 cycle

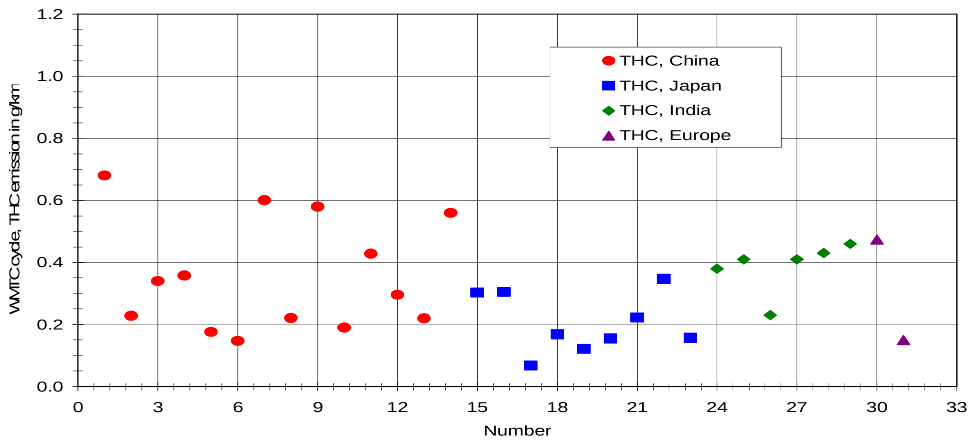

Figure E-5: THC emissions of class 1 motorcycles in different regions for WMTC cycle

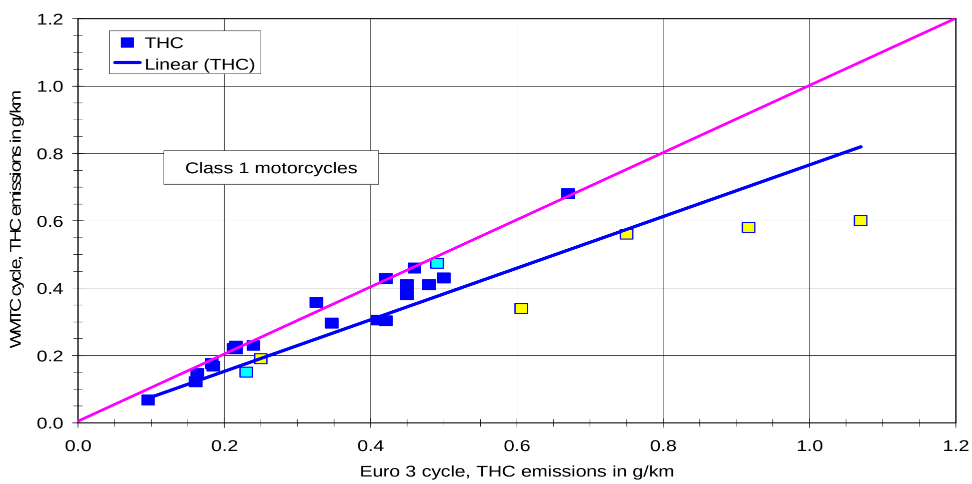

Figure E-6: Class 1 vehicles, WMTC cycle versus Euro 3 cycle results, THC emissions

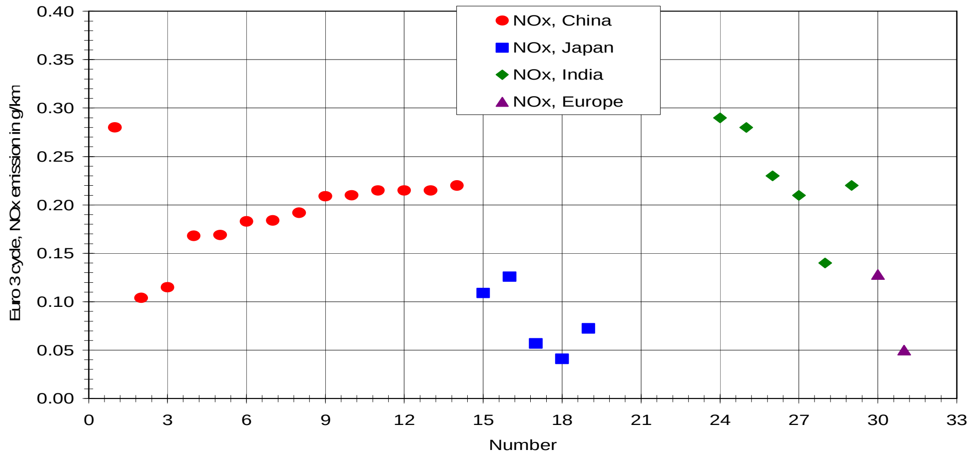

Figure E-7: NOx emissions of class 1 motorcycles in different regions for Euro 3 cycle

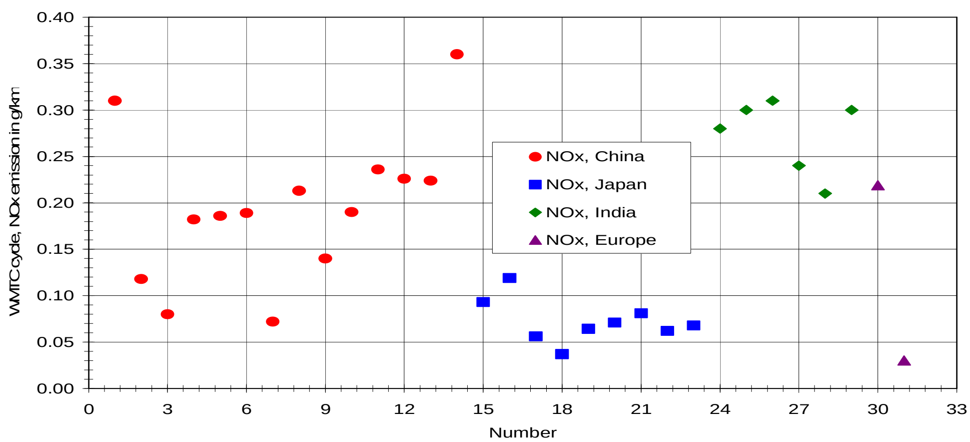

Figure E-8: NOx emissions of class 1 motorcycles in different regions for WMTC cycle

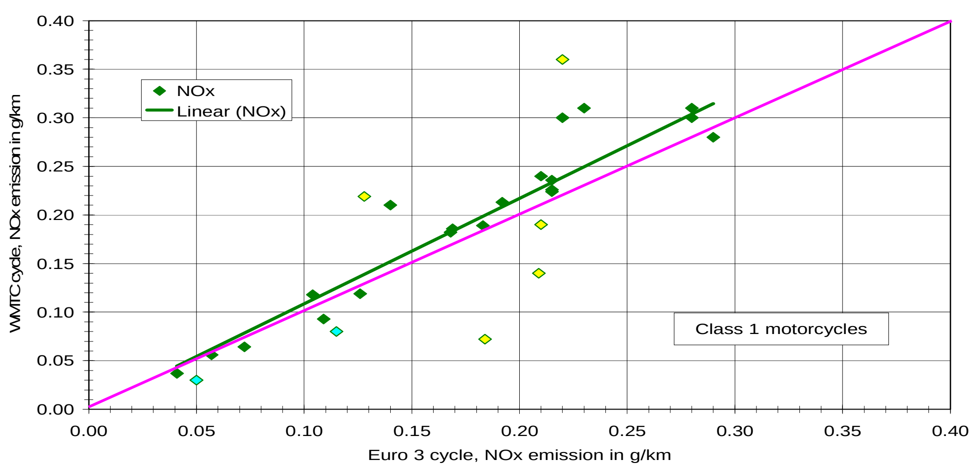

Figure E-9: Class 1 vehicles, WMTC cycle versus Euro 3 cycle results, NOx emissions

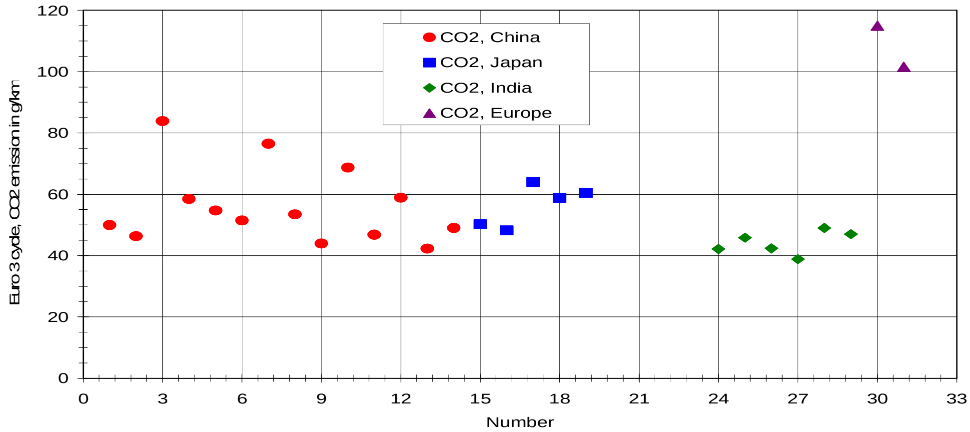

Figure E-10: CO2 emissions of class 1 motorcycles in different regions for Euro 3 cycle

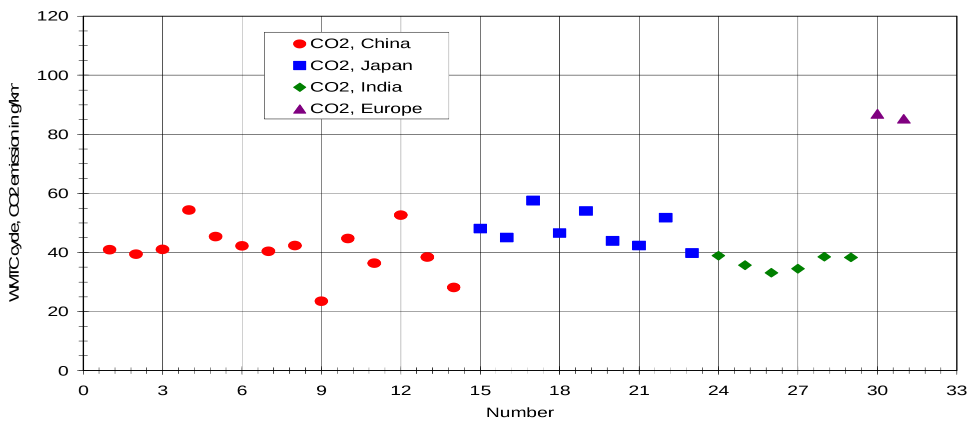

Figure E-11: CO2 emissions of class 1 motorcycles in different regions for WMTC cycle

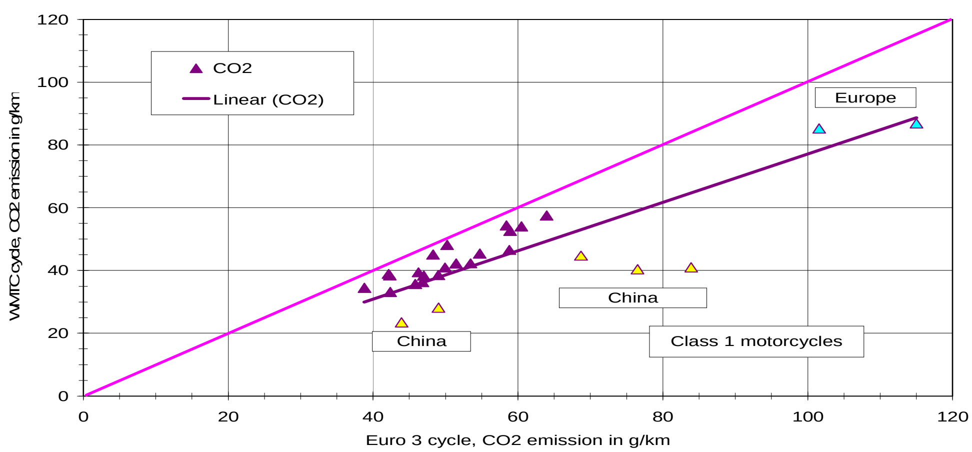

Figure E-12: Class 1 vehicles, WMTC cycle versus Euro 3 cycle results, CO2 emissions

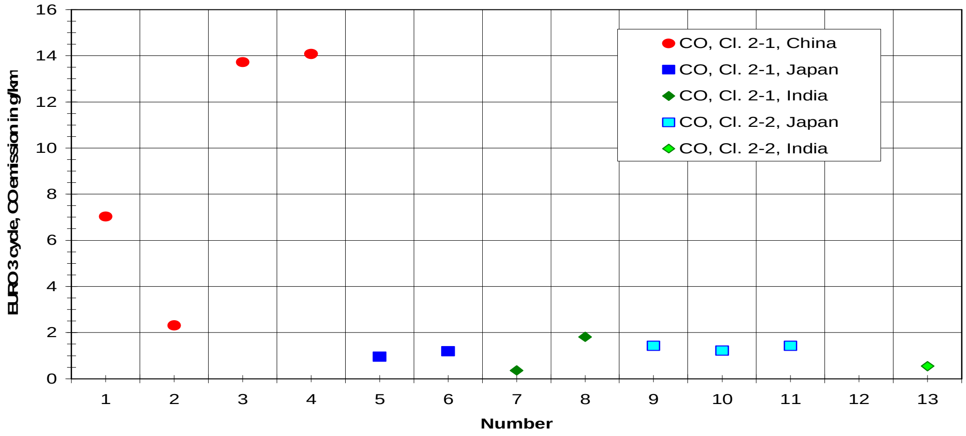

Figure F-13: CO emissions of class 2 motorcycles in different regions for Euro 3 cycle

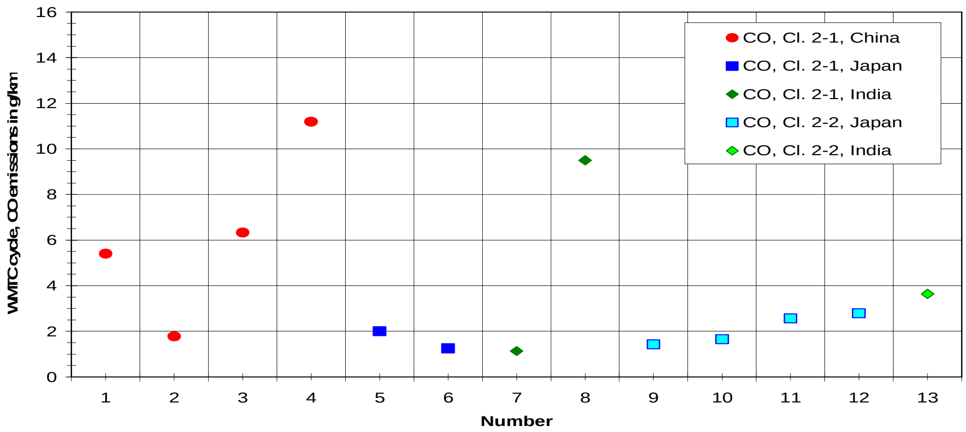

Figure F-14: CO emissions of class 2 motorcycles in different regions for WMTC cycle

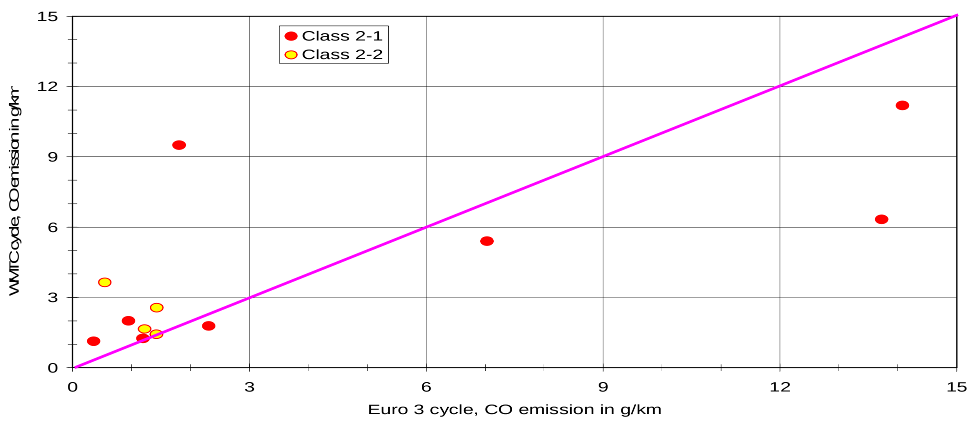

Figure F-15: Class 2 vehicles, WMTC cycle versus Euro 3 cycle results, CO emissions

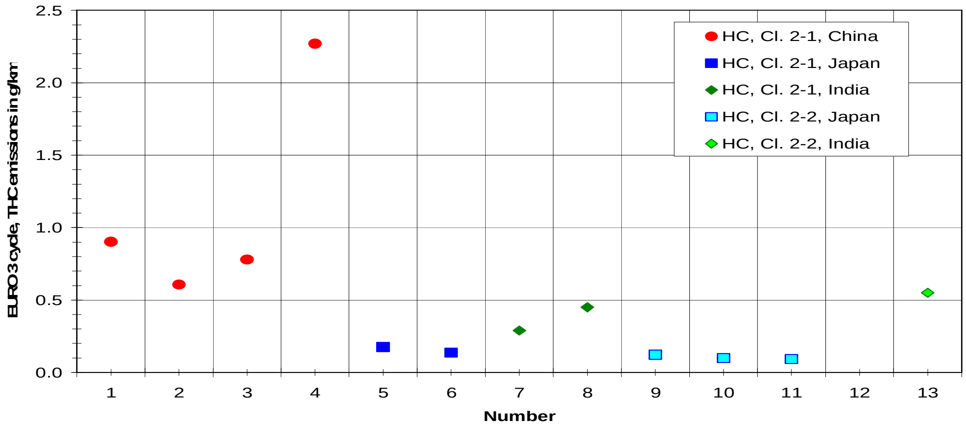

Figure F-16: THC emissions of class 2 motorcycles in different regions for Euro 3 cycle

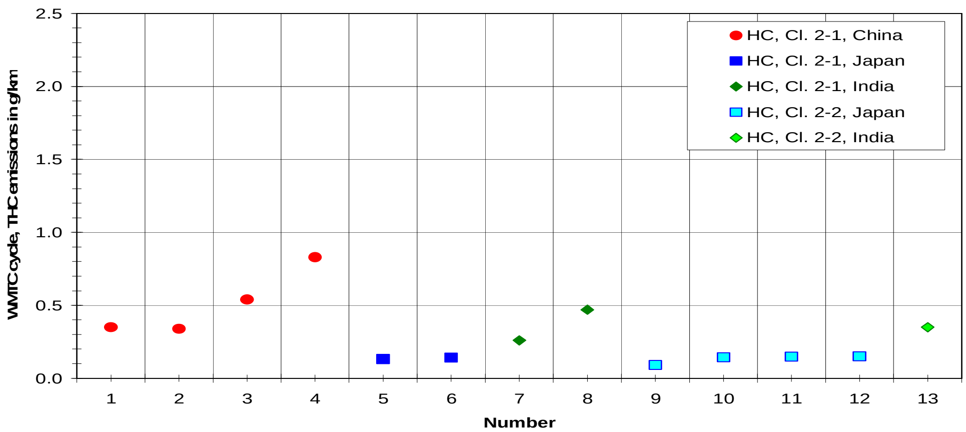

Figure F-17: THC emissions of class 2 motorcycles in different regions for WMTC cycle

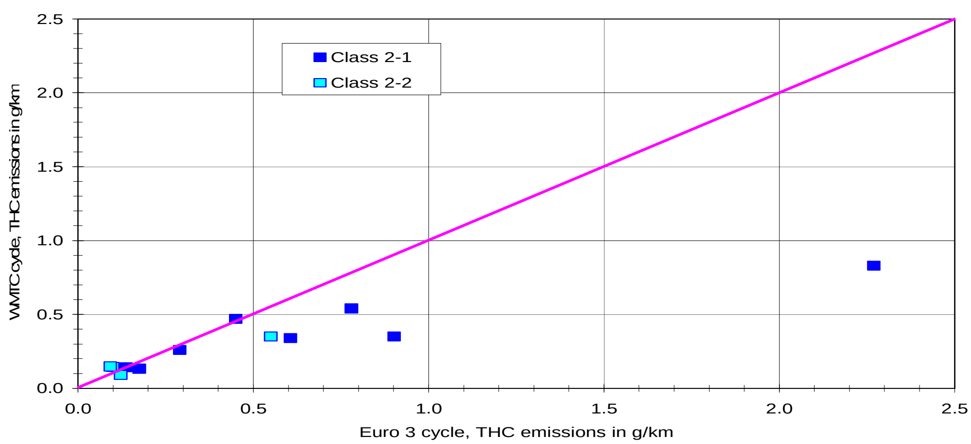

Figure F-18: Class 2 vehicles, WMTC cycle versus Euro 3 cycle results, THC emissions

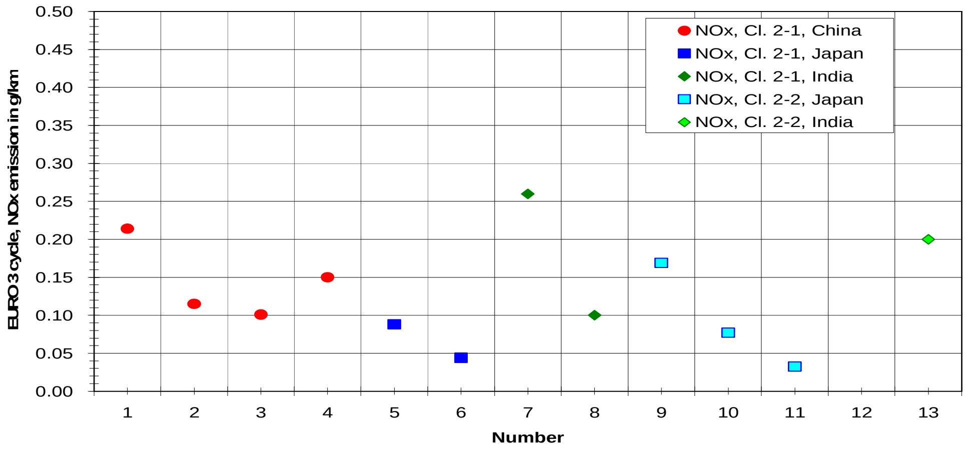

Figure F-19: NOx emissions of class 2 motorcycles in different regions for Euro 3 cycle

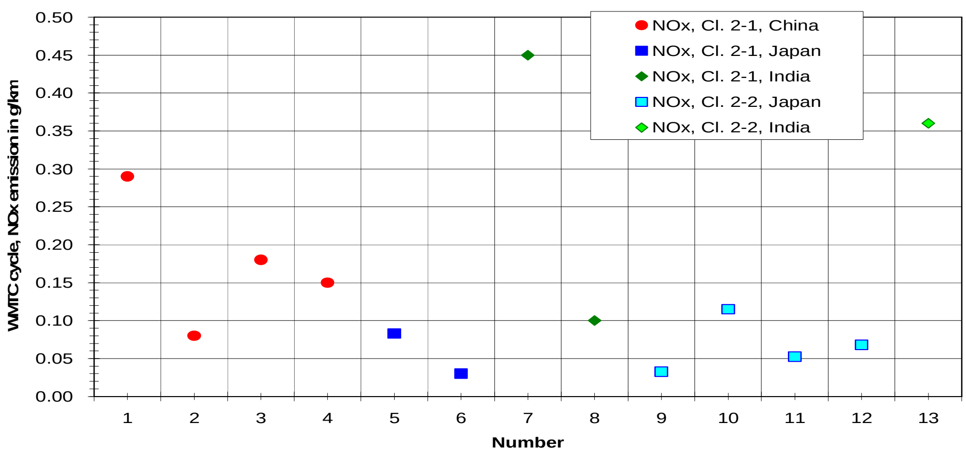

Figure F-20: NOx emissions of class 2 motorcycles in different regions for WMTC cycle

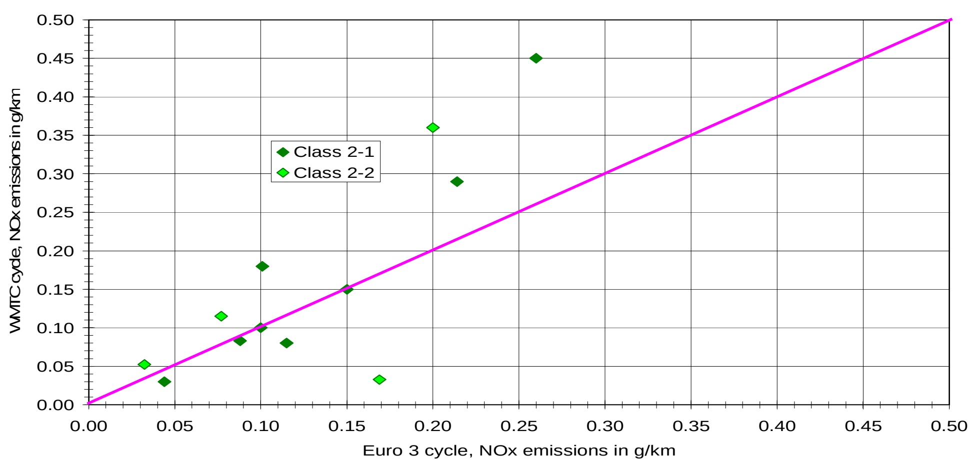

Figure F-21: Class 2 vehicles, WMTC cycle versus Euro 3 cycle results, NOx emissions

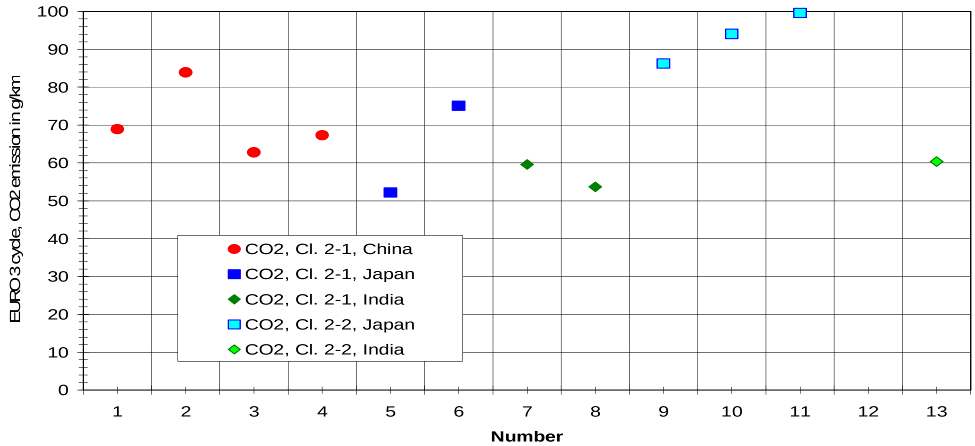

Figure F-22: CO2 emissions of class 2 motorcycles in different regions for Euro 3 cycle

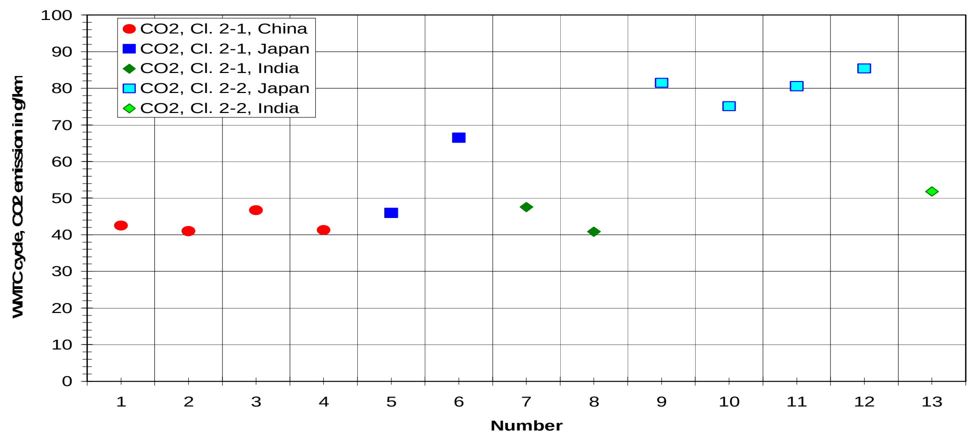

Figure F-23: CO2 emissions of class 2 motorcycles in different regions for WMTC cycle

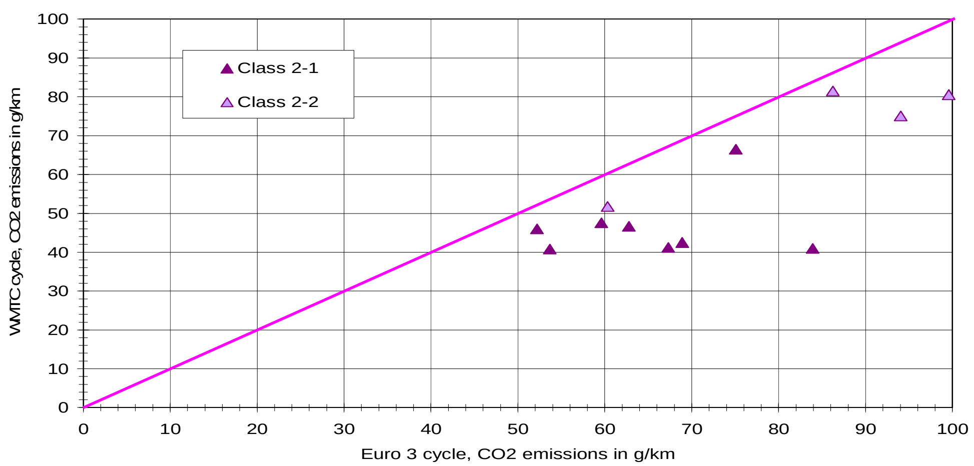

Figure F-24: Class 2 vehicles, WMTC cycle versus Euro 3 cycle results, CO2 emissions

Tables Detailing Class Wise, Region Wise Number of Vehicles Subjected for Tests

Step 2 Data (2004+ 2007) + (2008)	No. Of vehicles			Total	
	2004	2007	2008	Number	%
All Data	52	62	20	134	100
Class 1 :	0	42	5	47	35.1
Class 2.1 :	0	10	6	16	11.9
Class 2.2 :	6	4	3	13	9.7
Class 3 :	46	6	6	58	43.3
Class 2-1 and class2-2 have only 20% share of the data.					

Table-2:

Distribution of vehicles subjected to EURO 3 & WMTC tests

Table 2.1 Class wise

	All data		After applying Euro 2 filter	
	No. of vehicles	%	No. of vehicles	%
All Data	111	100	59	100
Class 1 :	43	38.7	26	44.1
Class 2.1 :	10	9.0	5	8.5
Class 2.2 :	10	9.0	4	6.8
Class 3 :	48	43.2	24	40.7

Table 2. 2: Region wise (in numbers)

	ACEM/JRC	China	India	Japan	US	Total	
						Number	%
All data							
class 1	1	26	11	5	0	43	38.7
class2-1	0	5	3	2	0	10	9.0
class2-2	3		3	4	0	10	9.0
class 3	34		1	7	6	48	43.2
Total	38	31	18	18	6	111	100
After applying Euro 2 filter							
class 1	1	14	6	5	0	26	43.3
class2-1	1	1	1	2	0	5	8.3
class2-2	0	0	1	3	0	4	6.7
class 3	14	0	1	6	4	25	41.7
Total	16	15	9	16	4	60	100

Analysis combining all the classes will not be influenced by Class 2-1 and class2-2 data, as they have only 18% share of the total data15% of Euro2 filtered data

Table 2.3 Region wise (in % age)

	class 1	class2-1	class2-2	class 3
All data				
ACEM/JRC	2.3	0.0	30.0	70.8
China	60.5	50.0	0	0
India	25.6	30.0	30.0	2.1
Japan	11.6	20.0	40.0	14.6
US	0	0	0	12.5
Total	100	100	100	100
After applying Euro 2 filter				
ACEM/JRC	3.8	20	0	56
China	53.8	20	0	0
India	23.1	20	25	4
Japan	19.2	40	75	24
US	0	0	0	16
Total	100	100	100	100
1. Class 1 analysis will be heavily influenced by data from China, on which there is still clarity required. 2. Class 2-1- & 2-2 analysis will not be influenced by data from EU 3. Class 3 analysis will be influenced by data from EU				

Table 3 : **Distribution of vehicles Class wise subjected to Japan & WMTC tests**

Step 2 Data (2004+ 2007) + (2008)	Total	
	Number	%
All Data	48	(100)
Class 1 :	9	18.8
Class 2.1 :	2	4.2
Class 2.2 :	7	14.6
Class 3 :	30	62.5

Table 4 : **Distribution of vehicles Class wise subjected to Indian IDC & WMTC tests**

Step 2 Data (2004+ 2007) + (2008)	Total	
	Number	%
All Data	23	100
Class 1 :	11	47.8
Class 2.1 :	8	34.8
Class 2.2 :	3	13.0
Class 3 :	1	4.3

Table 5: **Distribution of Vehicles Class wise subjected to USA & WMTC Tests**

	Number	%
All Data	19	100
Class 1	0	0
Class 2.1	1	5.3
Class 2.2	4	21.1
Class 3	14	73.7

- - - - -