



BRIEF SUMMARY OF THE 2008 AECC MOTORCYCLE TEST PROGRAM

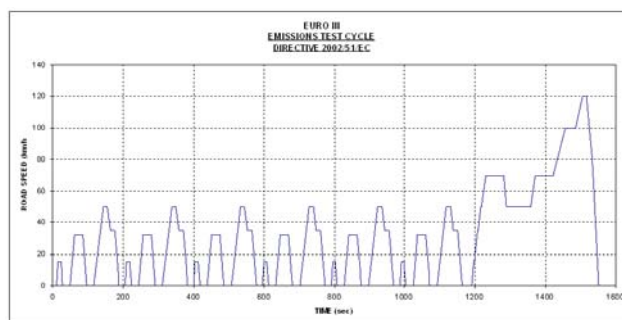
In September 2008, AECC completed a Motorcycle test program evaluating current bikes' emissions performance. Four Euro 3 and one Indian bikes were selected and evaluated on Euro 3 and world harmonized WMTC test cycles for regulated and unregulated pollutants. One of the Euro 3 bikes was then chosen to conduct a 30000km durability evaluation.

Selected Motorcycles:

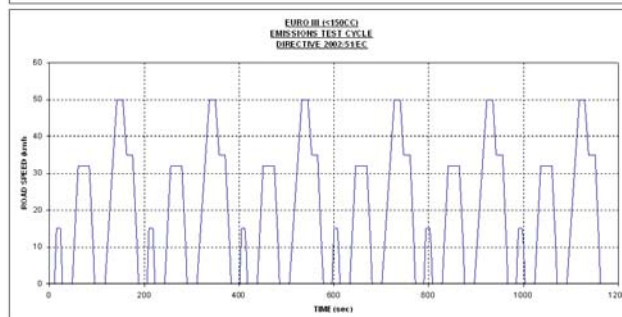
Motorcycle	Engine	Electronic Fuel Injection	Open/Closed Loop Control	Secondary Air Injection	Catalyst	Emissions Specification
Honda VFR800i	800cc V4	y	Closed	y	y	Euro 3
BMW F800S	800cc in line 2-cyl.	y	Closed	n	y	Euro 3
Yamaha FJR1300	1300cc in line 4-cyl.	y	Closed	y	y	Euro 3
Kymco Xciting 500i	500cc 1-cyl.	y	Closed	y	y	Euro 3
Honda Unicorn 150	149cc 1-cyl.	n	N/A	y	y	Indian spec.

Tested Drive Cycles:

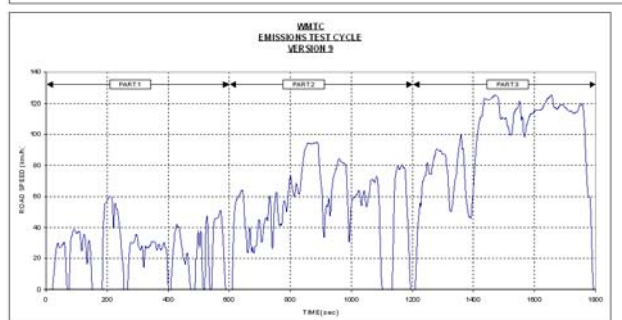
Euro 3 drive cycle (cold start) for Honda VFR800i, BMW F800S, Yamaha FJR1300 and Kymco Xciting 500i: 6 ECE + 1 EUDC.



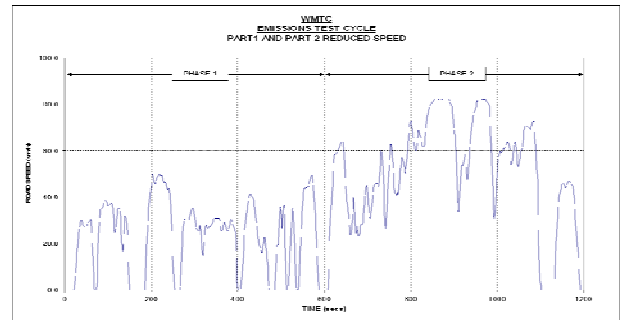
Euro 3 drive cycle (cold start) for Honda Unicorn 150: 6 ECE.



WMTC drive cycle (cold start) for Honda VFR800i, BMW F800S, Yamaha FJR1300 and Kymco Xciting 500i.



WMTC phase 1 and phase 2 reduced speed drive cycle (cold start) for Honda Unicorn 150.



Summary of Overall Mass Emissions Results:

(AVERAGE OF THREE TESTS IN EACH CASE)

TEST NAME	CO	CO2	HC	NOX	PARTS	FC
	(g/km)					(l/100km)
YAMAHA FJR1300						
EURO 3	0.340	152.6	0.109	0.076	0.000947	6.535
WMTC	0.509	135.5	0.092	0.082	0.000900	5.813
HONDA VFR 800						
EURO 3	1.276	158.8	0.194	0.129	0.001049	6.872
WMTC	1.574	131.9	0.198	0.141	0.000883	5.748
BMW F800						
EURO 3	1.102	109.0	0.085	0.049	0.001143	4.724
WMTC	1.420	100.6	0.100	0.059	0.002150	4.391
HONDA UNICORN 150						
EURO 3	0.832	51.2	0.309	0.214	0.001822	2.276
WMTC	1.262	41.4	0.225	0.447	0.000974	1.877
KYMCO XCITING 500						
EURO 3	1.278	112.0	0.078	0.097	0.000607	4.896
WMTC	1.623	106.0	0.077	0.192	0.000557	5.748

Note: Due to filter handling restrictions in the motorcycle emissions facility only 1 filter was used to sample the entire cycle. As a result, the particulate mass results for WMTC are not weighted as per regulations.

EURO 3 Test Cycle

The Yamaha FJR1300 and the BMW F800S passed Euro 3 limits with considerable margins, with particularly low levels of CO for the Yamaha.

The Honda VFR800 comfortably passed CO and HC however was very close to the limit for NOx. This bike was not new and had covered 8000km at the time of the tests; nevertheless, it had been serviced in accordance with the manufacturer’s recommendations.

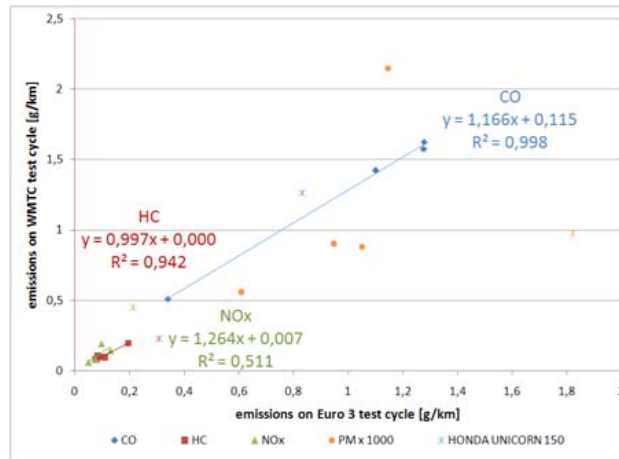
The Honda Unicorn passed with less than 50% of CO and HC limit but failed NOx despite only running the lower speed UDC part of the Euro 3 cycle. This supported the AFR data showing the bike was running very lean, which seems to be typical for an Indian bike optimized for fuel economy.

WMTC Test Cycle

In most cases, the general trends were similar for Euro 3 and WMTC test cycles and the vehicles compared equally well tested to either procedure. The exception to this was the Honda Unicorn. In this case HC and CO showed slight improvements compared to the limit; however this was offset by a large negative shift in NOx.

The WMTC cycle generally exhibited better repeatability compared to the Euro 3 cycle.

Correlation between Euro 3 and WMTC:



Linear regressions only use Euro 3 bikes results (excl. Honda Unicorn)

The 2008 WMTC emissions results correlate to Euro 3 measurements so that emissions limits can be extrapolated.

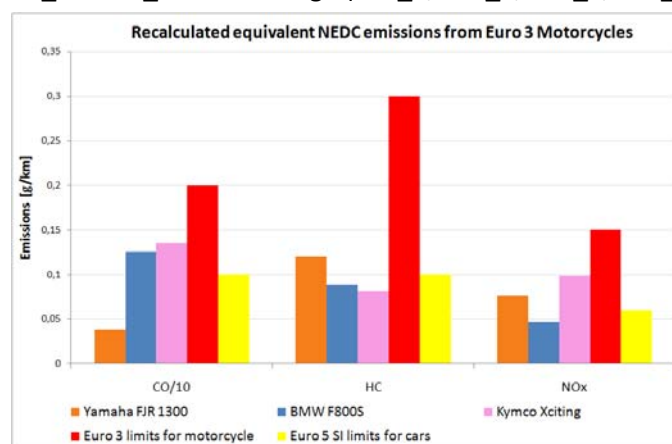
In 2004, AECC had already run a similar test program, to examine the equivalence of Euro 3 and WMTC cycles using Euro 2 motorcycles. Possible WMTC limits had been extrapolated by multiplying Euro 3 limits by the average WMTC/Euro 3 emissions ratio for each pollutant. Extrapolations of WMTC limits are shown in the table below; they confirm the WMTC limits and are in line with previous findings.

[g/km]	2004 AECC Test Program Extrapolation (5 bikes data set)	WMTC Limits	2008 AECC Test Program Extrapolation (4 bikes data set)
HC	0.256	0.33	0.299
CO	2.038	2.62	2.447
NOx	0.217	0.22	0.197

Euro 3 Motorcycles Results vs. Euro 5 Car Limits:

The 6 ECE and the EUDC mass emissions were used to recalculate an “NECD equivalent” and allow comparison to passenger cars emissions limits.

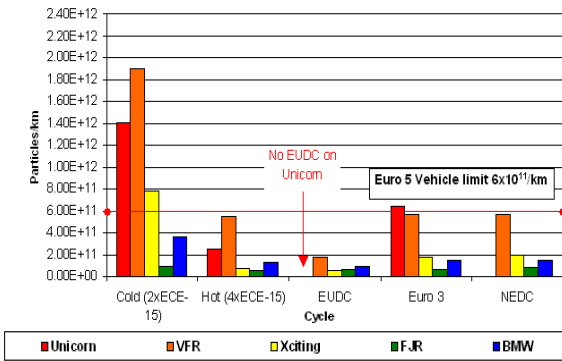
$$\text{NEDC} = \text{ECE}_1 + \text{ECE}_2 + 2 * \text{average} (\text{ECE}_3, \text{ECE}_4, \text{ECE}_5, \text{ECE}_6) + \text{EUDC}$$



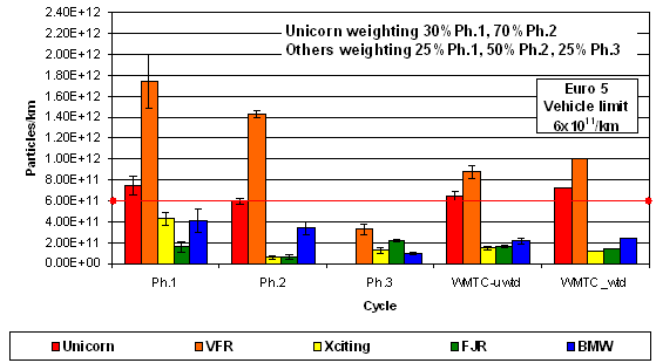
Note: phase details of mass emissions not available for Honda VFR did not allow recalculating for NEDC equivalent emissions.

Even though Euro 5 passenger cars limits are much lower than Euro 3 for motorcycles, some bikes almost met SI passenger cars Euro 5 limits.

Particulate Number Measurements according to PMP:
On European cycles



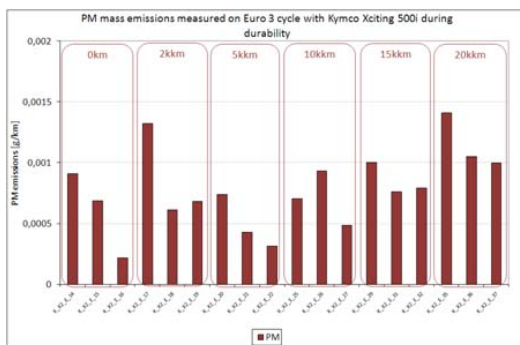
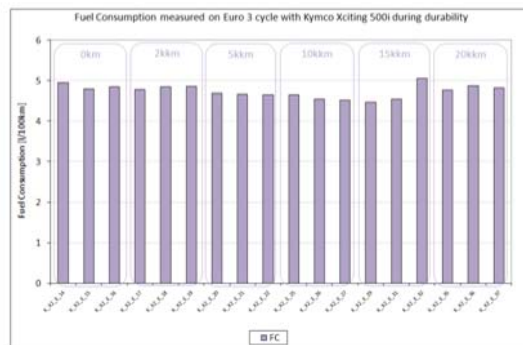
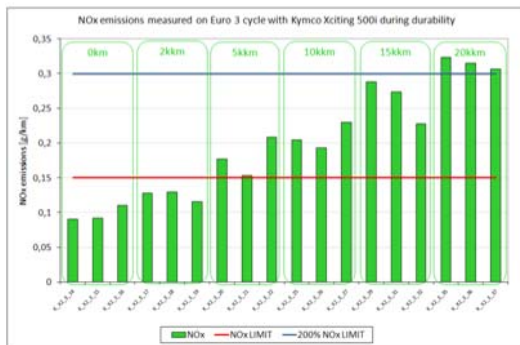
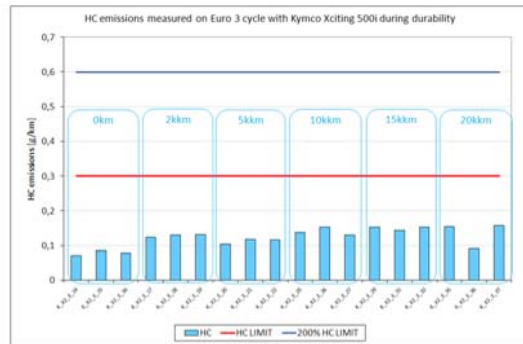
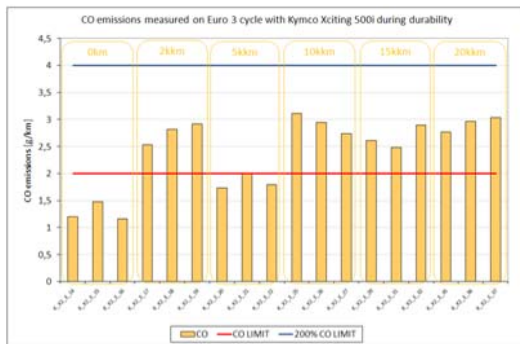
On WMTC



Rich conditions lead to higher particulate numbers. Nevertheless, all bikes met the Euro 5 vehicle limit after recalculation of NEDC equivalent.

Durability Test Results:

The Kymco Xciting 500i scooter was selected for a 30000km durability evaluation with intermediate emissions checks. The mileage accumulation cycle used was the Moto 69 – ACEM durability proposal rev3 from 2005 and based on US AMA cycle. However, the Standard Road Cycle protocol developed in Appendix 3 of Annex VII of the Comitology Regulation for Euro 5/6 (EC)692/2008 would be more appropriate for durability legislation.



CO emissions reached the Euro 3 limit by 2000km and NOx limits were exceeded after 5000km. Mileage accumulation was stopped after 20000km as NOx had already reached the stop criteria which was defined at 200% of Euro 3. Since current legislation on emissions from motorcycles does not contain durability requirements, it is possible that some motorcycles might not be equipped with durable catalytic converters.