

ASIAN & EUROPEAN WLTP RRT

Geneva, 6th of June 2017

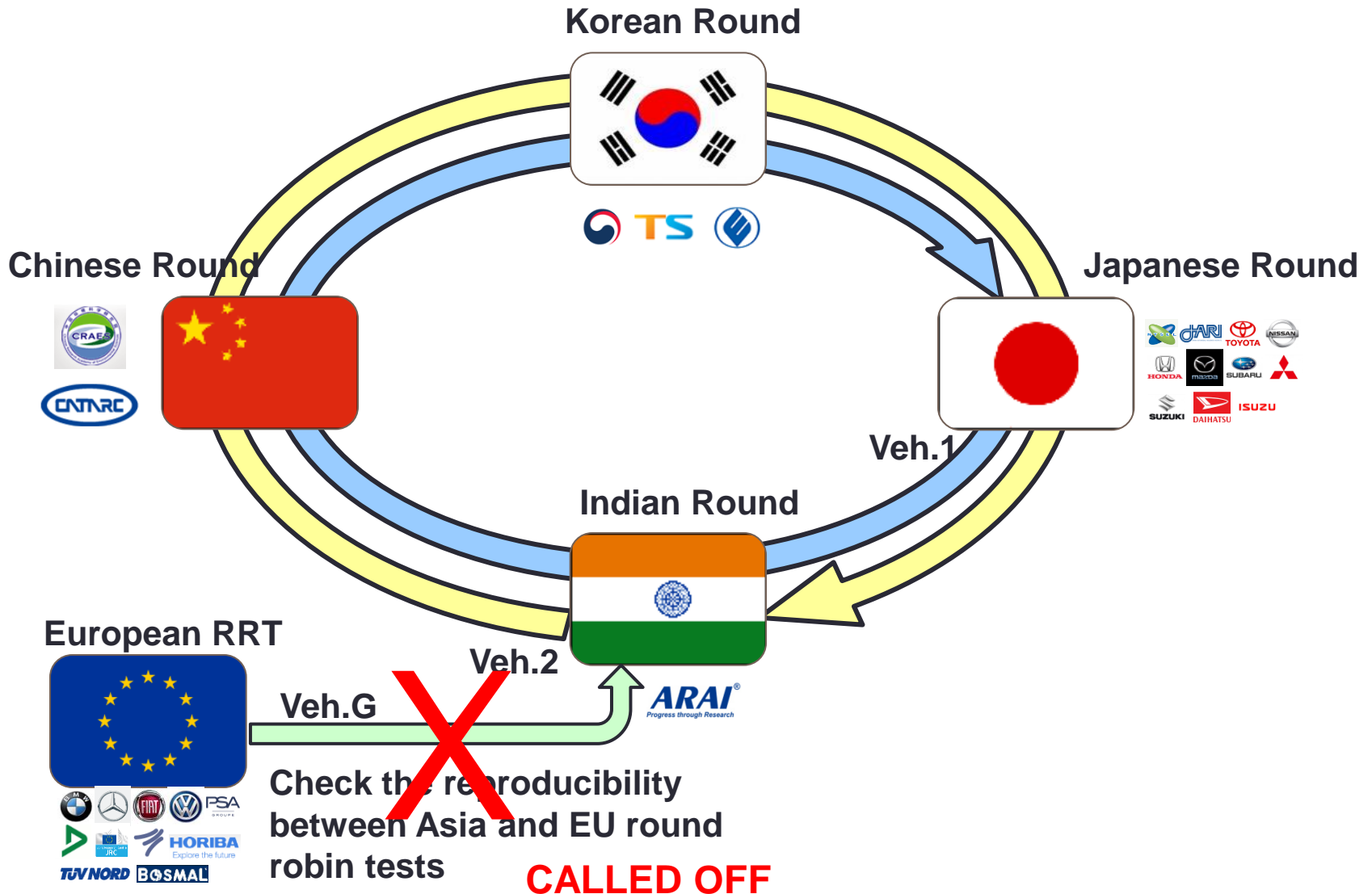
JARI / UTAC

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Objectives

- Check the understanding and the application of the GTR15 (based on phase 1a text) in different labs
- Estimate the repeatability and reproducibility of the GTR15 test procedure in type approval conditions

Regions & labs



RRT Overview

- Asian RRT (Oct 2014 – May 2016)
 - Gasoline vehicle (V1) : 16 labs (20 data sets), 59 tests (54 effective data)
 - Diesel vehicle (V2) : 4 labs (5 data sets), 16 tests (11 effective data)
- European RRT (Sept 2014 – Nov 2015)
 - Gasoline vehicle (V1) : 11 labs, 43 tests
 - Diesel vehicle (V2) : 11 labs, 36 tests

Results

- Results from both RRTs are in Annexes 1 & 2

Actions taken following the RRTs

- Round robin tests were carried out in Asia and Europe. Exhaust gas emissions and fuel consumption were measured in each test facility. **Then the understandings of test procedure, test facilities and the inter-laboratory reproducibility were checked.**
- Technical experts witnessed the tests in each laboratory and they **exchanged views/opinions/information and unified the understanding of test procedure.**
- Some **parts of GTR** which were pointed out by technical experts during RRTs **were revised.**
- The **two RRTs came up with the same conclusions** concerning the uncertainty estimation of the procedure and the actions to be taken
- => **Cross check between the two RRTs was called off**

Comparison of uncertainties Asia/EU

	EU RRT V1 (Petrol) – all labs		Asian RRT V1 (Petrol) - 19 labs	
	Mean	σ Repro	Mean	σ Repro
CO ₂ [g/km]	161	2.6 (1.6%)	162	2.2 (1.3%)
NO _x [mg/km]	95	27 (29%)	11	3 (24%)
CO [mg/km]	456	68 (15%)	332	40 (12%)
HCT [mg/km]	41	9 (23%)	25	5 (20%)

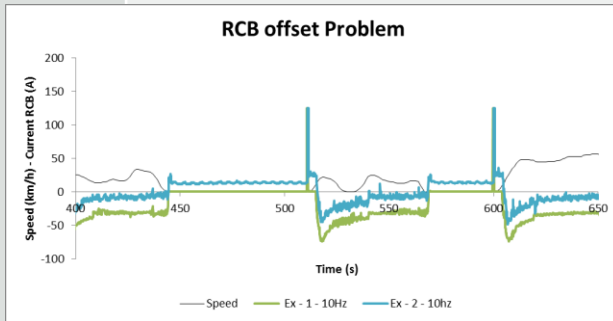
- Similar results from both RRT for the petrol vehicles

Actions taken following the RRTs (1/2)

Item	Points	Actions
Test Equipments Annex 5	<p>Testing facilities requirements/calibration reachable</p> <p>Temperature in the test cell and/or soak room, cooling fan, connecting tube, RCB measurement system, data recording system, etc</p>	<p>Labs: Need to introduce/upgrade/modify the test equipments</p> <p>WLTP IWG: No actions, the feedback from the labs identified no inapplicable requirements</p>
Test Procedure Annex 1	<p>Driving trace</p>	<p>WLTP IWG: Drive trace index and/or normalization method should be taken in GTR (Work is ongoing)</p>
Test Procedure Annex 2	<p>Initial scope of RRT was to check on the Gear shift calculation</p> <p>Too early, labs had not developed their own tools, and different results because of the use of different versions of the HS tool</p>	<p>WLTP IWG: Postpone this issue to a later stage, with a specific validation exercise (work ongoing)</p>
Test Procedure Annex 4	<p>Warm up procedure for RL setting:</p> <p>Warm-up procedure was misinterpreted</p>	<p>Lab : after explanations, GTR procedure appeared to be clear enough (Annex 4 §7)</p> <p>WLTP IWG: no action</p>
	<p>Rotating masses</p> <p>Confusion on the purpose and the conditions of application of m_r</p>	<p>WLTP IWG: GTR was revised to clarify the conditions in which the rotating mass was to be applied (Annex 4 §2.5)</p>
	<p>Dynosetting iterative method</p> <p>Confusion on to what forces the 10N refer to</p>	<p>WLTP IWG: GTR was revised (Annex 4 §8.2.3.4.2), recently reviewed again on the same subject</p>

Actions taken following the RRTs (2/2)

Item	Points	Actions
<p>Test Procedure Annex 8</p>	<p>RCB measurement</p> <p>This measurement was identified as the most critical issue</p>	<p>Labs: Reviewed their procedure/calculation method</p>
		<p>WLTP IWG: GTR was revised regarding calculation method, equipment, frequency and accuracy (Annex 8)</p>
		<p>Labs: Need more training to obtain accurate data</p>
		<p>The zero adjustment procedure should be specified in GTR ?</p> <p>One of the identified issue was the equipment zero adjustment. In IWG Paris the question was raised whether a procedure should better described it or whether training of the labs would be sufficient.</p> <p>It seemed the group was more in favor of considering it as a training issue. Eventually if not, the following modification can be made in the GTR</p> <p>Annex6 App2 between § 2.1.1 & 2.1.2 Annex8 App3 between § 2.1.1 & 2.1.2</p> <p><i>“In order to have accurate measurement, zero adjustment and degaussing shall be performed before the test according to the instrument manufacturer's instructions. »</i></p>



RRTs data are available upon request to the
diamond/golden engineers

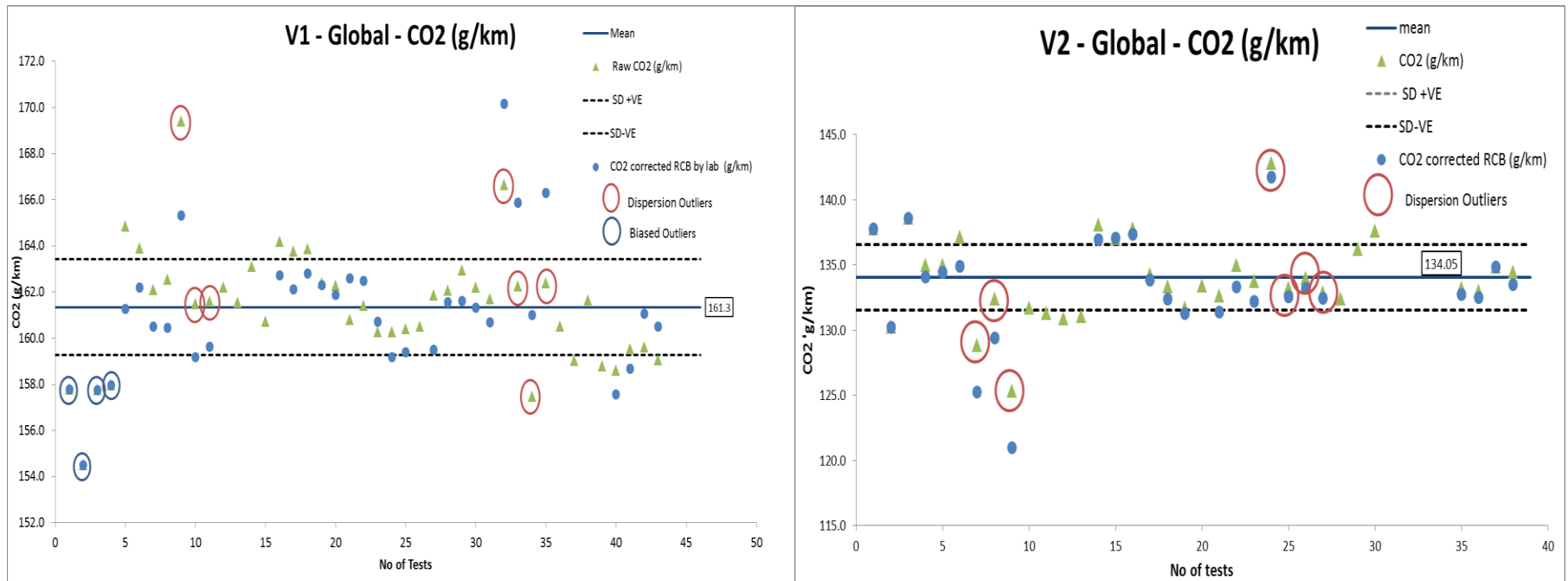
Thank you for your attention

Annex1 EU RRT Results

Test Results

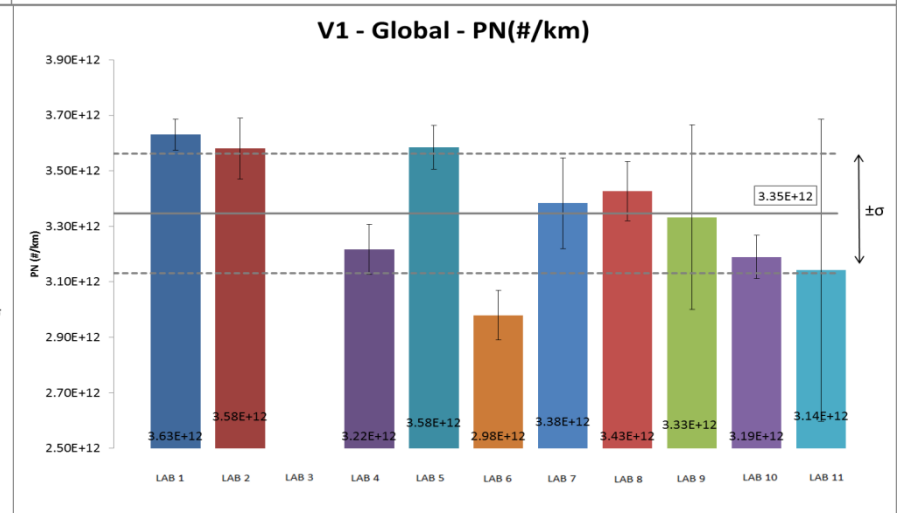
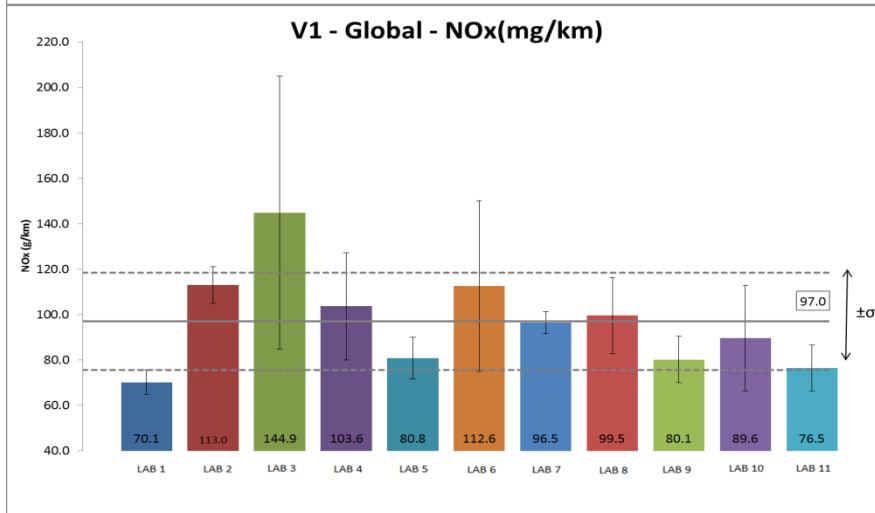
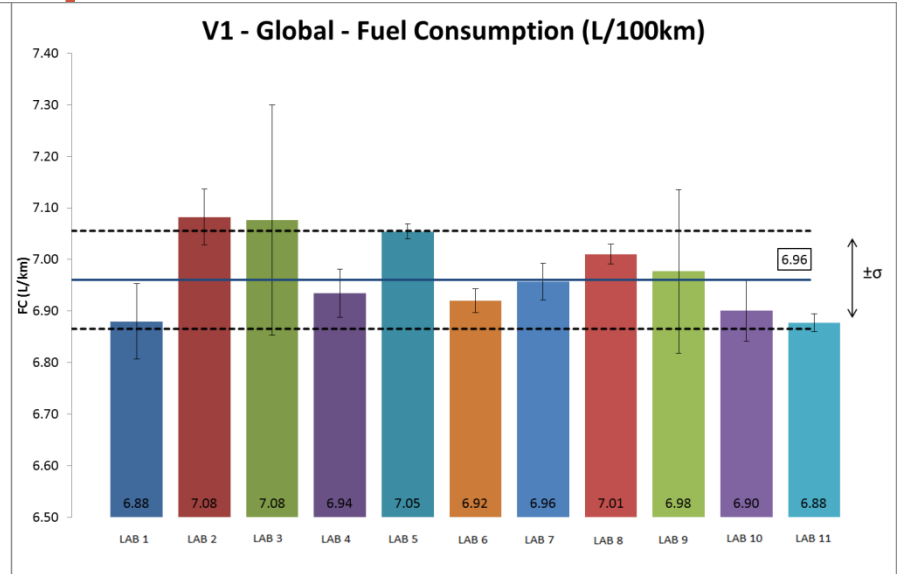
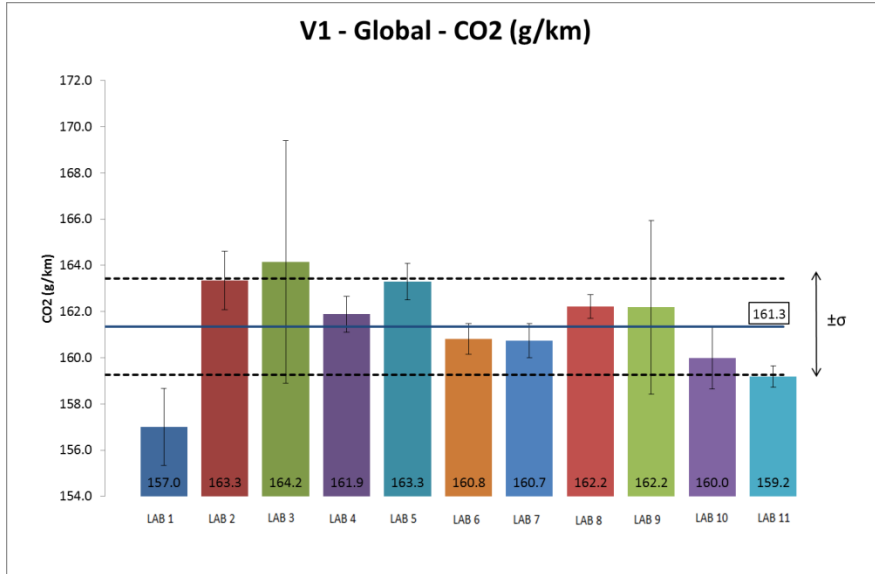
All labs	WLT C	CO2	CO2 corr	FC	NOx	CO	HCT	PN	PM
V1	Mean	161.3	161.5	6.96	95.17	456.25	40.60	3.36E+12	3.94
	σ Repeat	1.9(1.2%)	2.0(1.2%)	0.08(1.1%)	20.32(21.4%)	54.13(11.9%)	6.43(15.8%)	2.2E+11(6.6%)	0.80(20.3%)
	σ Repro	2.6(1.6%)	2.7(1.7%)	0.11(1.7%)	27.17(28.6%)	67.94(14.9%)	9.14(22.5%)	2.9E+11(8.5%)	1.48(37.7%)
V2	Mean	134.5	134.1	5.07	293.991	40.26	7.72	5.25E+11	0.21
	σ Repeat	2.8(2.1%)	2.36(1.8%)	0.05(1.0%)	24.59(3.6%)	7.65(19.0%)	2.28(15.8%)	1.30E+11(24.7%)	0.11(54.7%)
	σ Repro	4.1(3.1%)	2.77(2.1%)	0.07(1.4%)	33.87(7.2%)	16.78(41.7%)	3.52(45.6%)	1.32E+11(25.0%)	0.16(77.4%)
V1	Mean	161.5	160.5	6.97	91.44	463.3	39.98	3.42E+12	3.84
	σ Repeat	0.9(0.6%)	1.3(0.9%)	0.04(0.6%)	16.01(21.4%)	52.9(11.4%)	3.62(9.1%)	1.5E+11(4.4%)	0.35(9.3%)
	σ Repro	1.7(1.1%)	2.0(1.3%)	0.08(1.2%)	20.4(28.5%)	62.9(13.6%)	6.33(15.8%)	2.1E+11(6.2%)	0.72(18.9%)
V2	Mean	133.7	133.4	5.06	282.15	34.89	7.51	5.24E+11	0.22
	σ Repeat	1.3(1.0%)	1.61(1.2%)	0.04(0.8%)	10.11(3.6%)	4.92(14.1%)	0.708(9.4%)	5.24E+10(10%)	0.09(39.9%)
	σ Repro	2.0(1.5%)	1.80(1.3%)	0.06(1.1%)	20.33(7.3%)	8.73(25.0%)	1.53(20.4%)	9.55E+10(18.0%)	0.09(39.9%)

Test results – Focus on CO₂

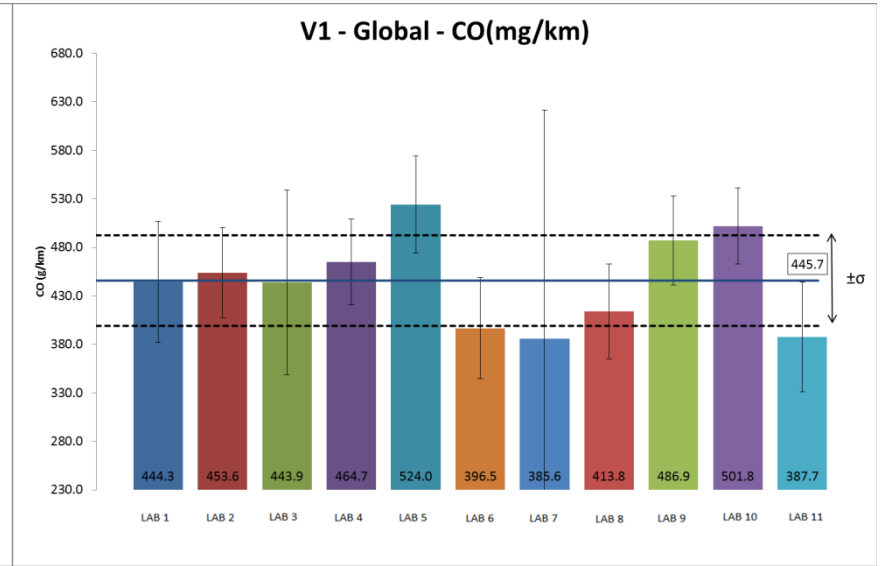
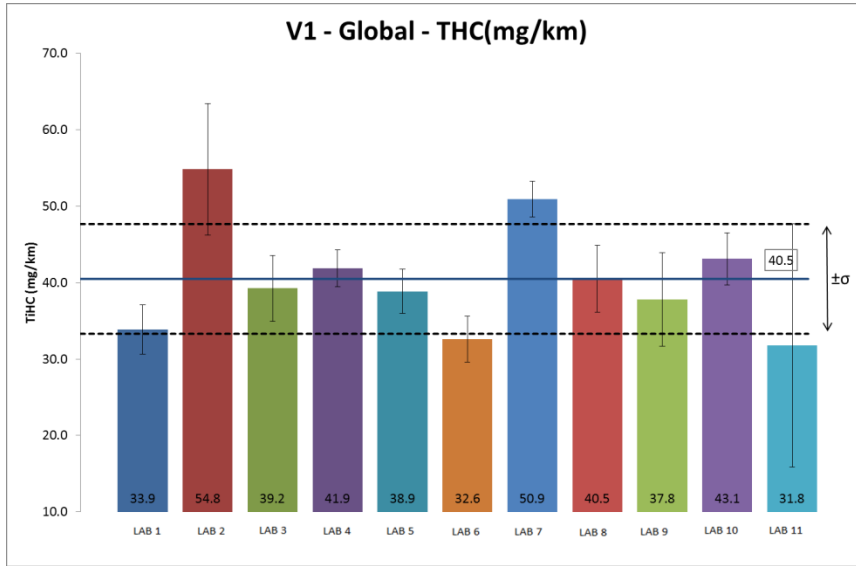


- Dispersion can occur intra-lab (for V1 and V2)
- Biased results inter-lab (for V1 only)

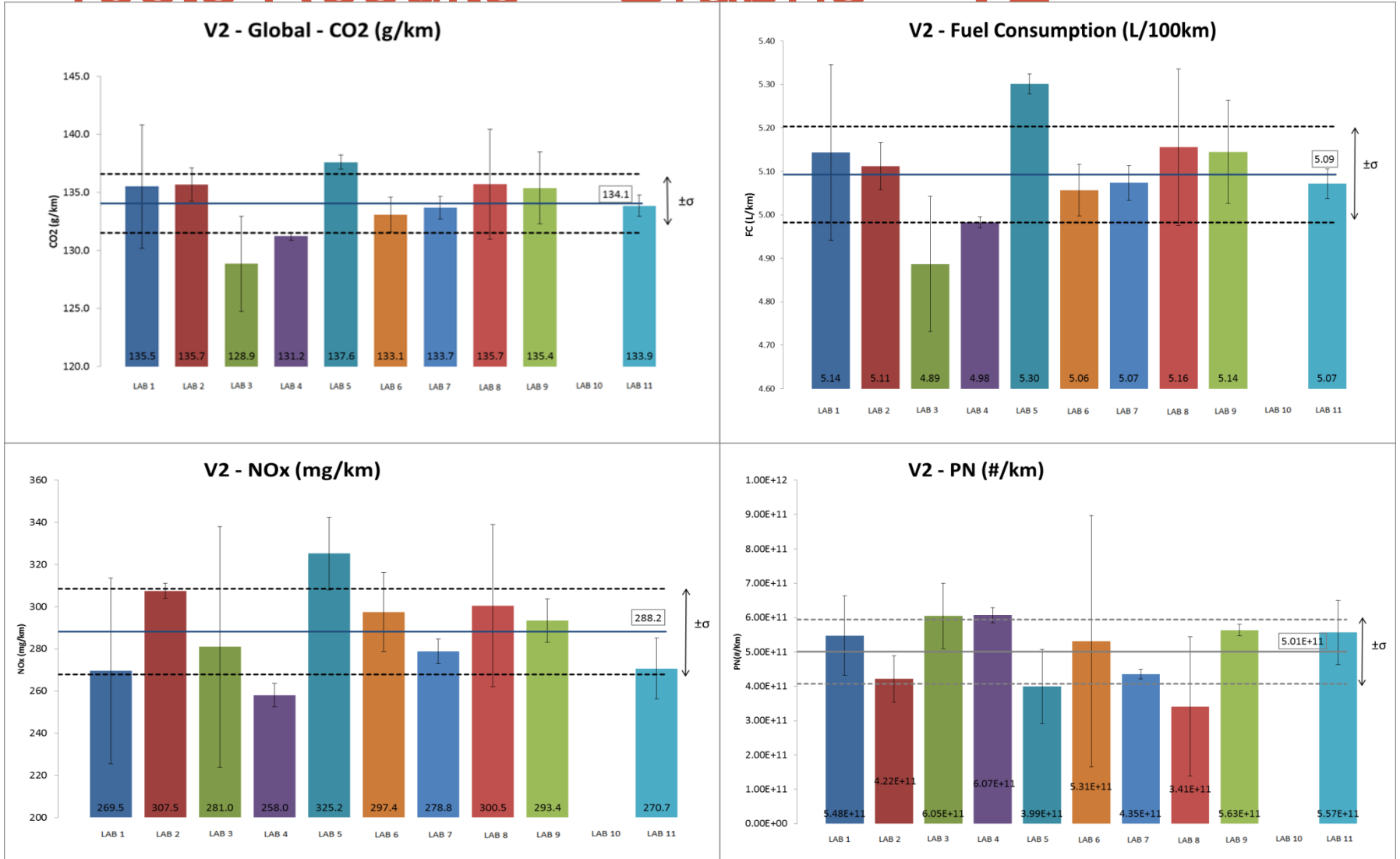
Tests Results – Graphs – V1



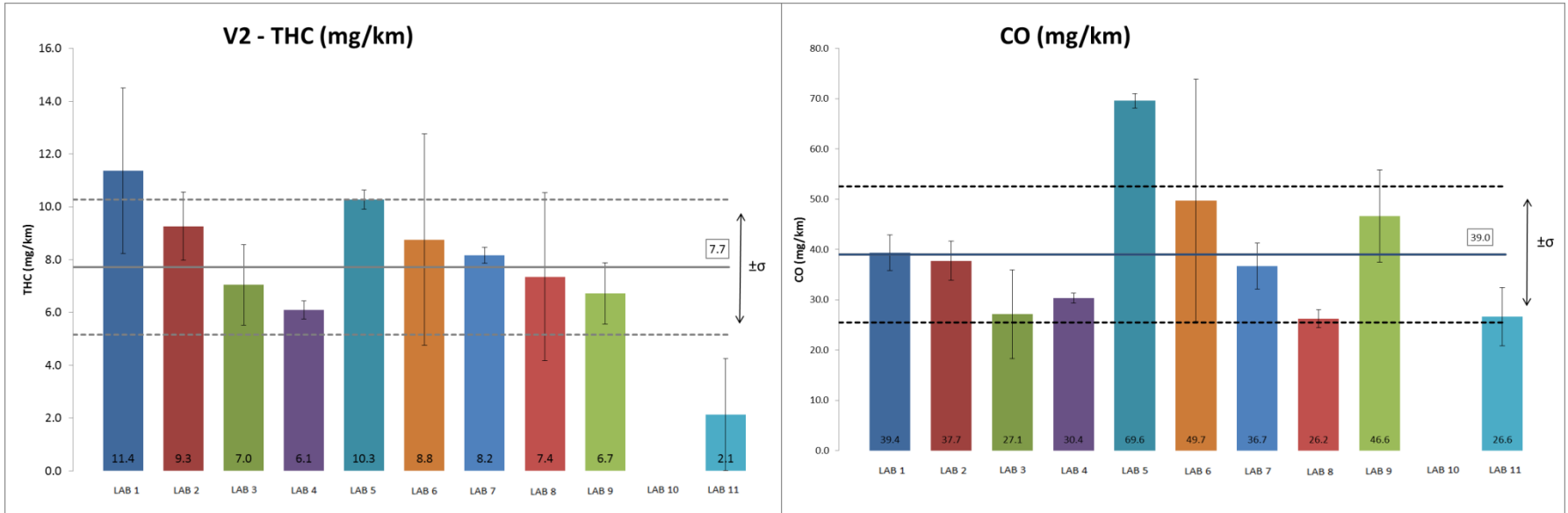
Tests Results – Graphs – V1



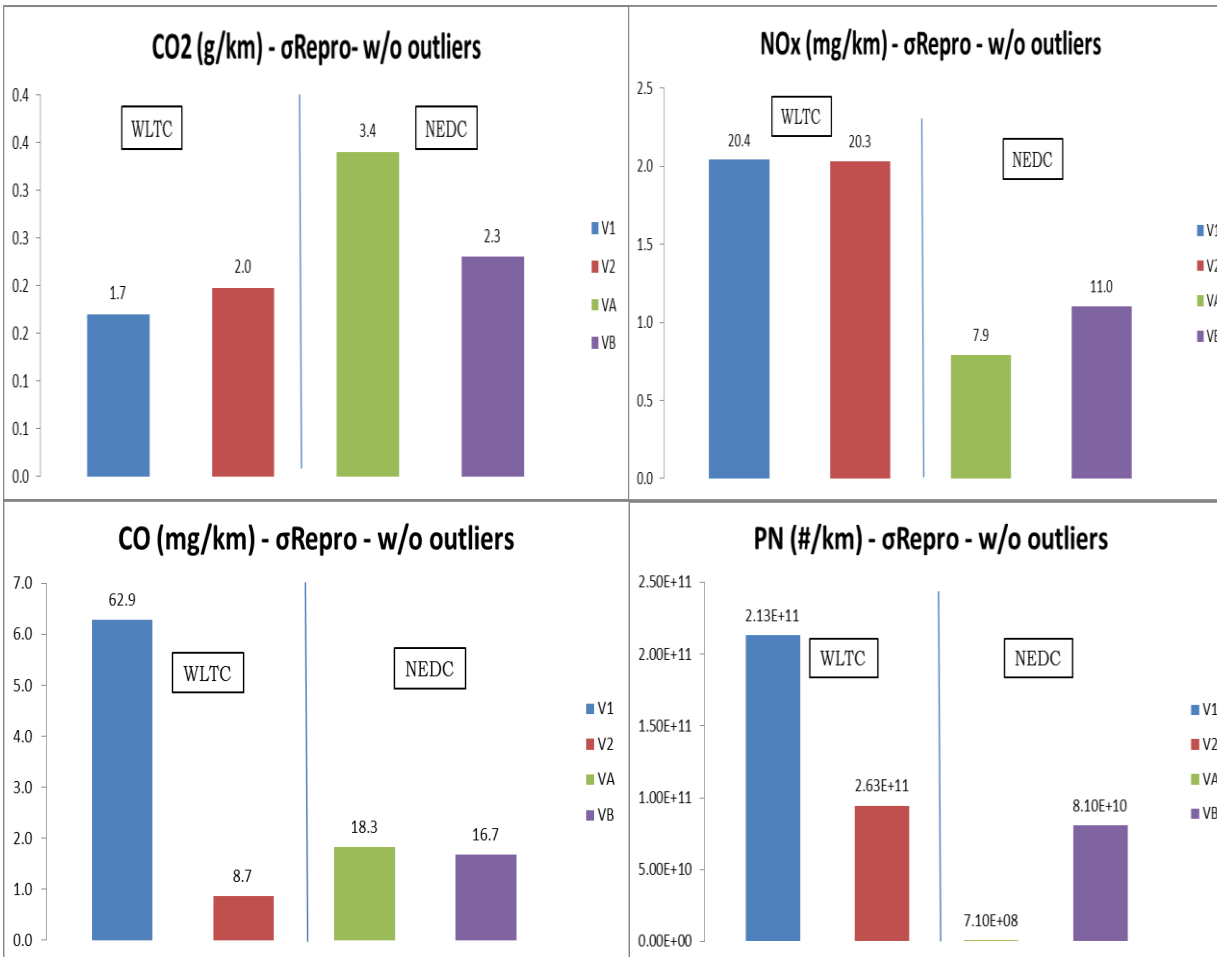
Tests Results – Graphs – V2



Tests Results – Graphs – V2



Test results – Comparison w/ R83



Comparison with ACEA PN RRT program (2009)

The uncertainties of both procedures are equivalent apart from the NO_x for which there is an increase in absolute value, less in

Annex2

Asian RRT Results

Test results

◆ Vehicle 1

Labs	# of Test	CO (g/km)			THC (g/km)			NOx (g/km)			CO2 (g/km)			Fuel consumption (L/100km)		
		AVE	SD	RSD	AVE	SD	RSD	AVE	SD	RSD	AVE	SD	RSD	AVE	SD	RSD
A-1	3	0.334	0.028	8.4	0.026	0.001	4.5	0.008	0.001	6.4	160.4	0.4	0.2	6.91	0.02	0.2
B	3	0.328	0.024	7.3	0.036	0.001	2.3	0.019	0.001	3.2	164.4	0.2	0.1	7.08	0.01	0.1
C	3	0.313	0.021	6.8	0.019	0.002	8.7	0.010	0.001	10.3	156.8	0.1	0.1	6.79	0.00	0.0
A-2	1	0.303	0.000	0.0	0.024	0.000	0.0	0.008	0.000	0.0	159.6	0.0	0.0	6.87	0.00	0.0
D	3	0.361	0.063	17.4	0.032	0.003	8.9	0.012	0.001	11.4	162.4	0.2	0.1	6.84	0.01	0.2
E	4	0.263	0.052	19.9	0.025	0.004	15.2	0.010	0.001	10.7	163.9	0.5	0.3	7.06	0.02	0.3
F	3	0.382	0.012	3.1	0.028	0.002	7.7	0.011	0.003	26.8	158.3	0.6	0.4	6.83	0.02	0.3
G	3	0.373	0.035	9.4	0.030	0.009	28.3	0.012	0.003	27.2	163.5	0.3	0.2	7.05	0.01	0.1
H	3	0.387	0.024	6.1	0.018	0.001	4.4	0.008	0.000	6.1	165.9	0.8	0.5	7.11	0.03	0.5
A-3	2	0.270	0.069	25.6	0.022	0.000	0.2	0.011	0.001	5.4	163.7	0.4	0.2	7.03	0.02	0.3
I	4	0.367	0.029	7.8	0.025	0.002	6.6	0.009	0.000	3.5	163.3	0.5	0.3	7.03	0.03	0.4
J	4	0.368	0.034	9.2	0.023	0.001	3.6	0.010	0.001	9.4	162.1	0.7	0.4	6.99	0.03	0.4
K	5	0.342	0.058	17.0	0.021	0.001	5.3	0.011	0.000	2.8	160.0	0.3	0.2	6.89	0.01	0.2
L	3	0.343	0.034	9.9	0.021	0.001	5.4	0.008	0.001	8.8	161.1	0.5	0.3	6.94	0.02	0.3
M	4	0.275	0.020	7.3	0.021	0.001	3.3	0.011	0.001	5.3	159.7	0.5	0.3	6.88	0.02	0.3
N	3	0.306	0.003	1.1	0.019	0.001	4.8	0.010	0.001	9.5	159.1	0.2	0.1	6.83	0.01	0.1
O	3	0.358	0.032	9.0	0.025	0.001	4.4	0.011	0.001	10.2	159.2	0.2	0.1	6.85	0.01	0.2
P	3	0.286	0.013	4.7	0.019	0.001	6.4	0.009	0.002	17.3	160.2	0.9	0.5	6.89	0.04	0.6
ALL*	54	0.334	0.055	16.4	0.024	0.005	22.0	0.011	0.003	26.5	161.6	2.2	1.3	6.95	0.10	1.4
Inter lab*	18 labs	0.332	0.040	12.0	0.025	0.005	19.5	0.011	0.003	24.4	161.6	2.2	1.3	6.95	0.09	1.4

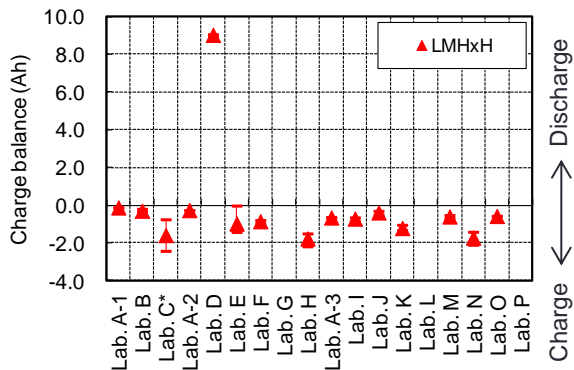
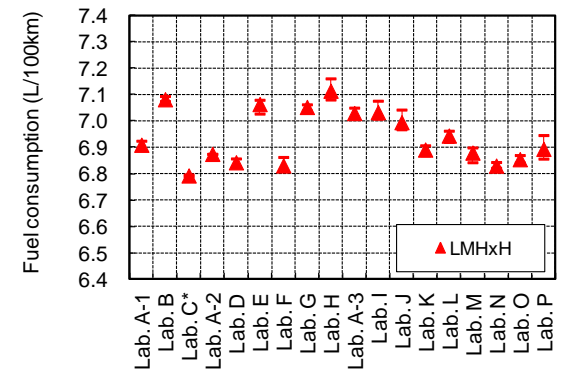
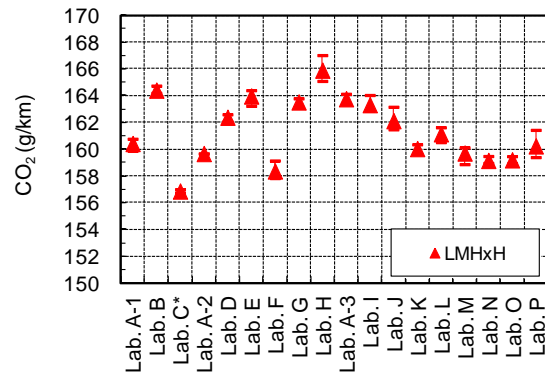
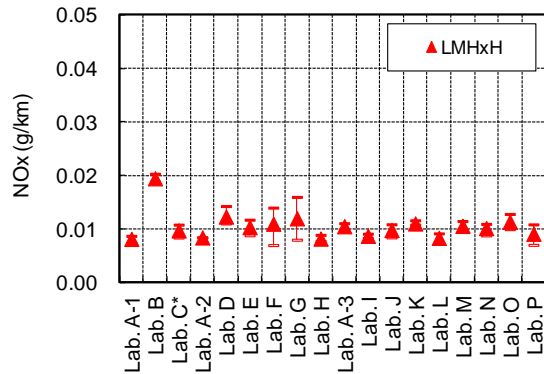
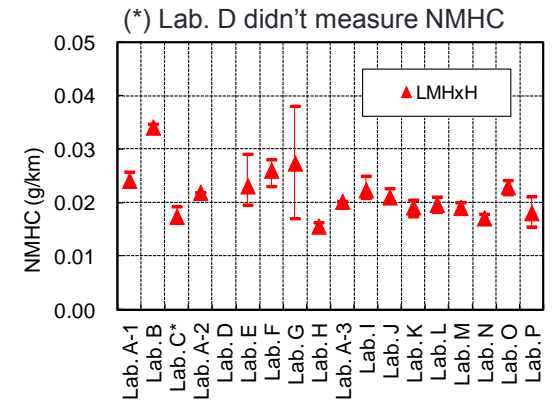
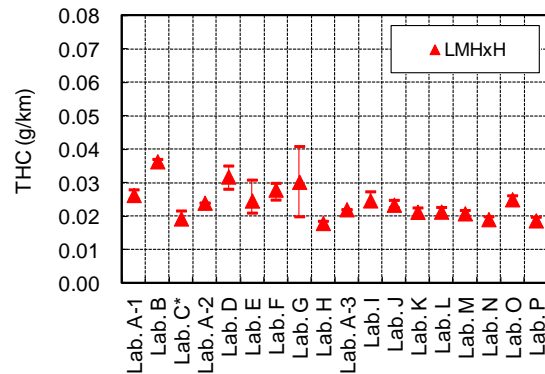
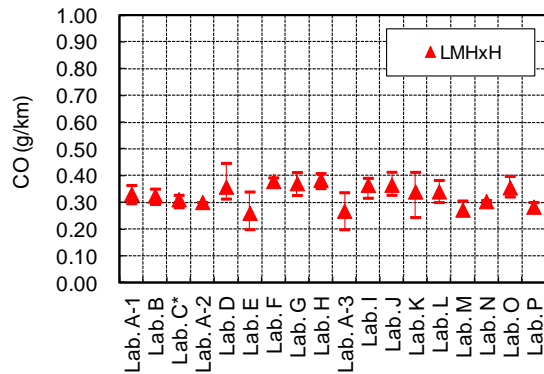
*) except Lab. C data

◆ Vehicle 2

Labs	# of Test	CO			THC			NOx			CO2			Fuel consumption		
		AVE	SD	RSD	AVE	SD	RSD	AVE	SD	RSD	AVE	SD	RSD	AVE	SD	RSD
D-1	5	0.240	0.057	23.9	0.017	0.002	13.2	0.787	0.131	16.6	157.0	5.2	3.3	5.95	0.20	3.3
E	3	0.240	0.024	10.2	0.039	0.002	4.9	0.936	0.016	1.7	177.3	0.8	0.5	6.74	0.03	0.5
H	3	0.159	0.008	4.8	0.045	0.005	11.0	0.914	0.038	4.1	177.4	1.0	0.6	6.75	0.04	0.5
A	2	0.329	0.036	11.1	0.050	0.004	8.1	1.093	0.009	0.8	174.8	0.3	0.2	6.66	0.01	0.2
D-2	3	0.189	0.013	7.0	0.029	0.002	8.5	0.435	0.125	28.7	166.2	1.2	0.7	6.32	0.04	0.7
ALL*	11	0.220	0.064	28.9	0.040	0.008	21.0	0.822	0.255	31.0	173.8	4.9	2.8	6.61	0.19	2.8
Inter lab*	4 labs	0.229	0.065	28.2	0.041	0.008	19.2	0.845	0.246	29.2	173.9	4.6	2.6	6.62	0.18	2.6

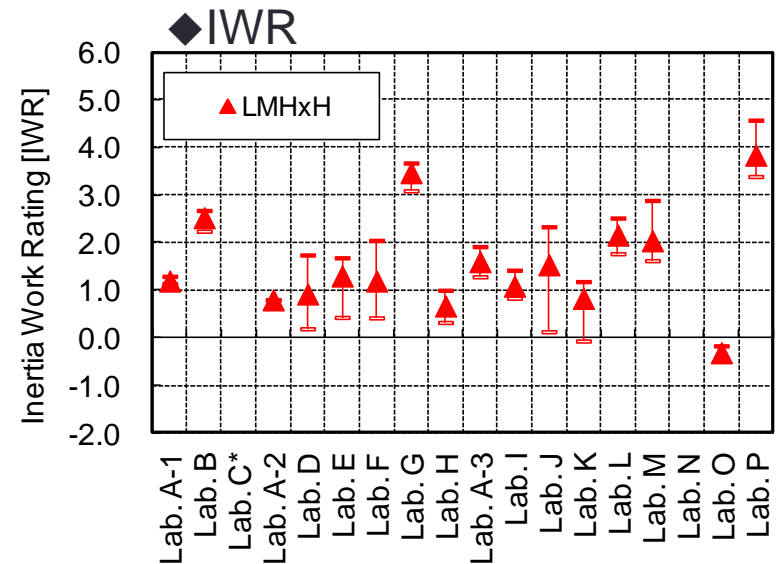
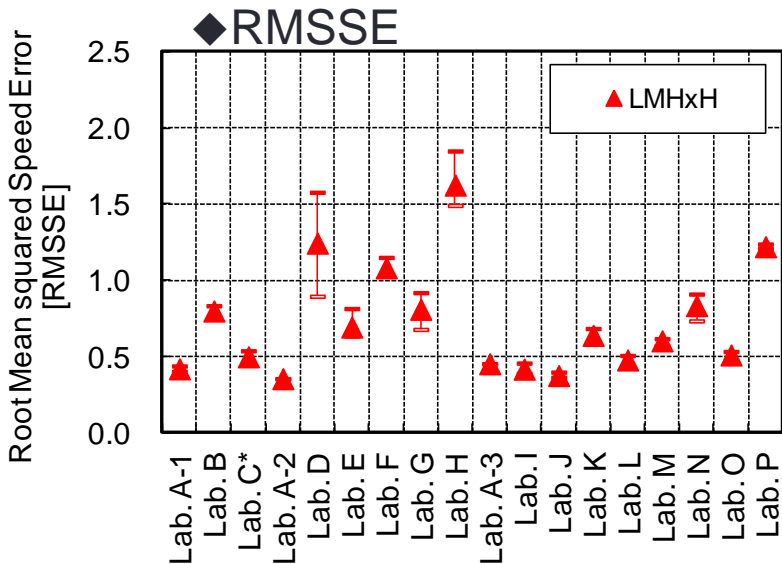
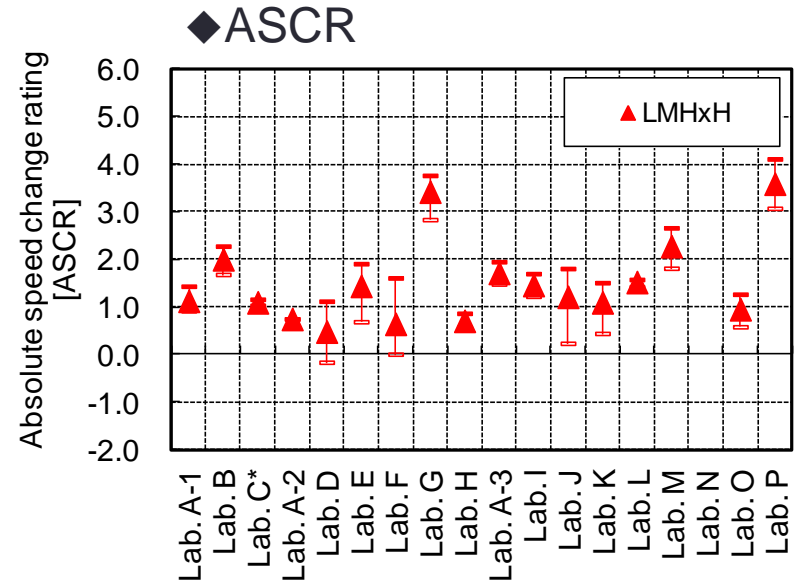
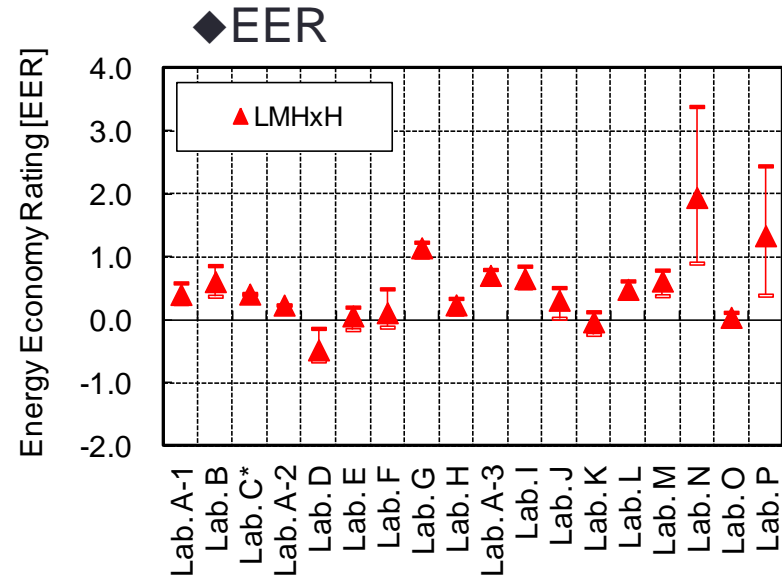
*) except Lab. D-1 data

Test results - Graphs - Vehicle 1



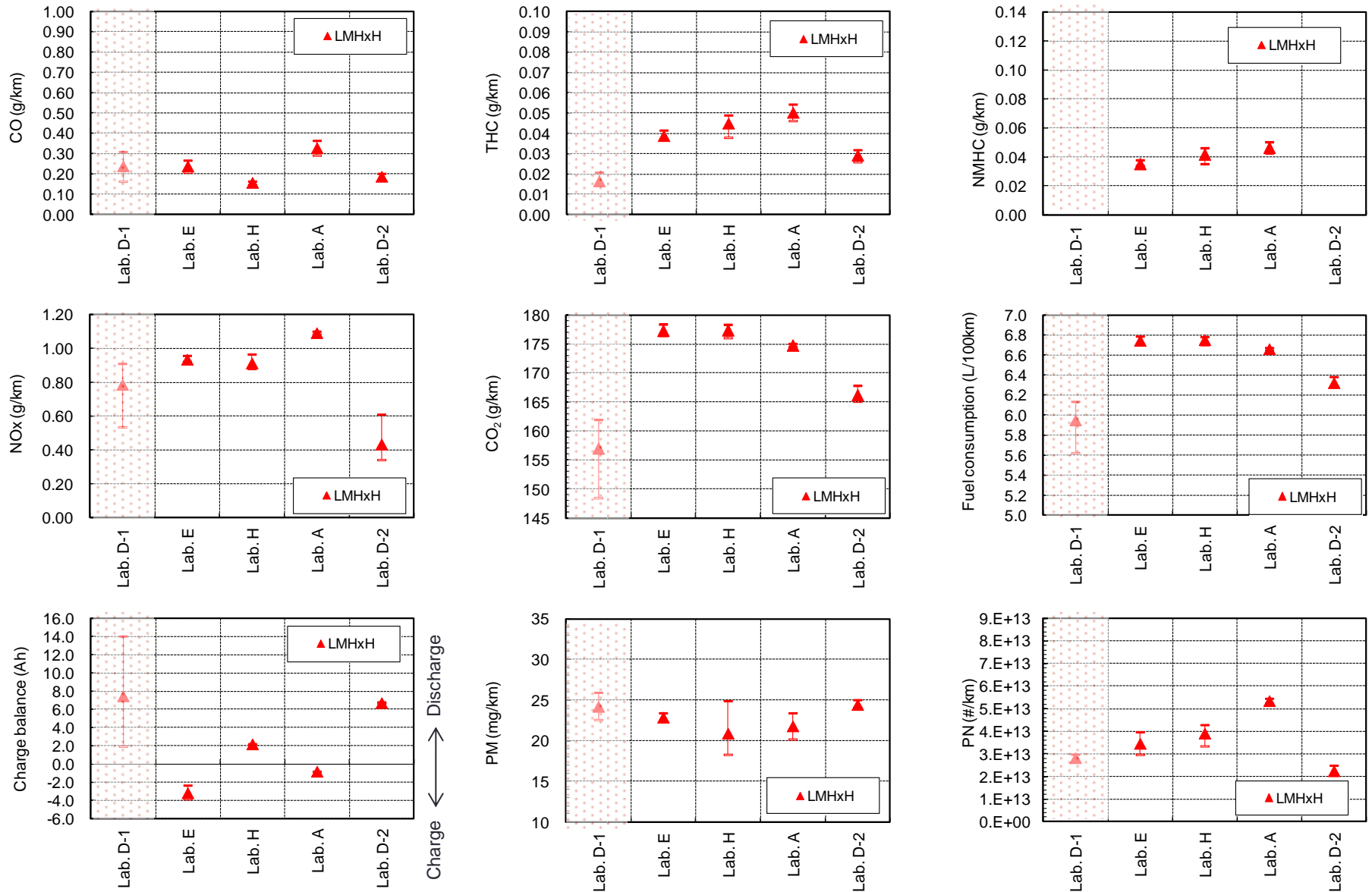
* Lab. G, L and P didn't measure charge balance

Drive trace indexes - Vehicle 1



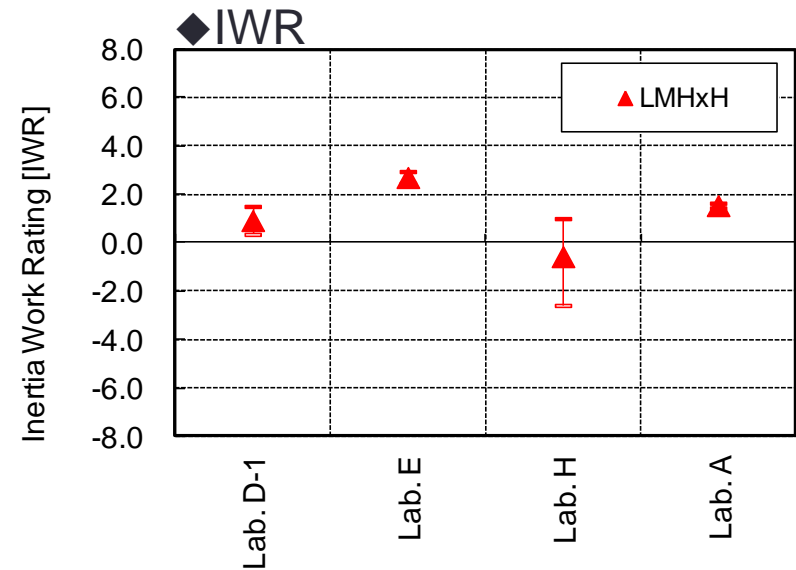
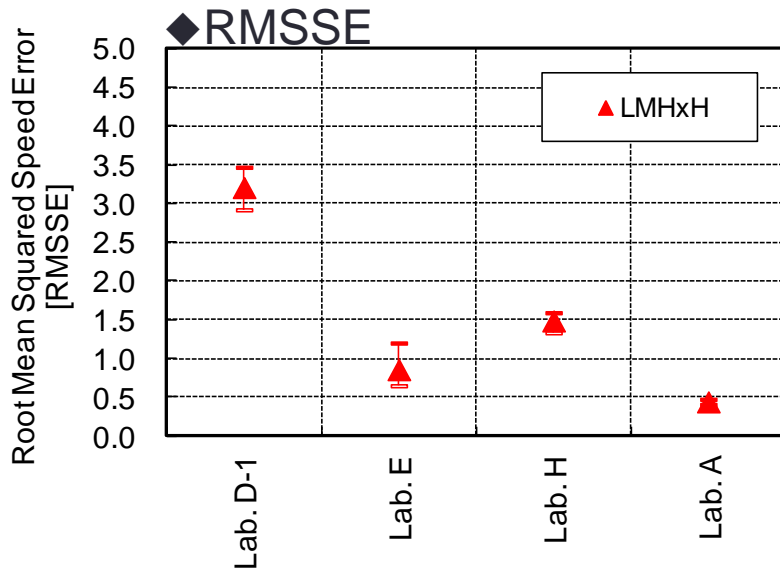
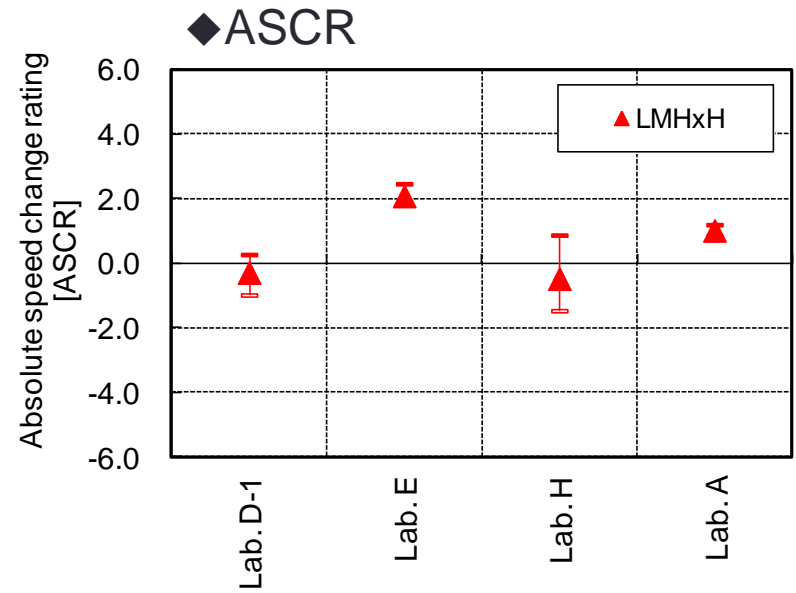
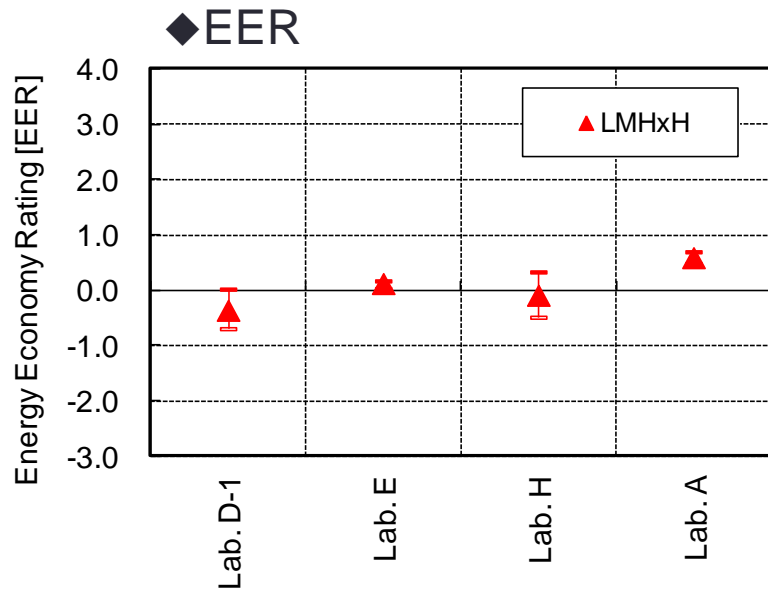
*) Lab. D: calculated by 1Hz data

Test results - Graphs - Vehicle 2



* Warm-up procedure for RL setting on chassis dyno was different from GTR at 1st test of Lab. D. It was corrected to GTR procedure at 2nd test.

Drive trace indexes - Vehicle 2



*) Lab. D: calculated by 1Hz data