European Commission

WLTP: number of tests to be performed at initial vehicle certification

15 April 2015

JRC

Disclaimer: The views expressed are purely those of the writer and may not in any circumstance be regarded as stating an official position of the European Commission

Introduction (I)

Due to the potential variability of the test results and to the fact that the true value of a parameter can be estimated only with a very high number of tests, it is necessary to establish and agree on a practical procedure for vehicle certification while balancing burden for manufacturer and safety for authorities.

Status of discussions

As discussed in WLTP IWG meeting in Pune in November 2014 the number of tests for WLTP certification should be determined on the basis of the CO2 test results, while keeping a “pass-fail” approach for regulated pollutants.

*For regulated pollutants the pass-fail criterion should be based on a 10% margin from the emission limits (i.e. pass if emission result is < emission limit*0.9) on each test as proposed by Europe in the document WLTP-08-43e in Pune.*

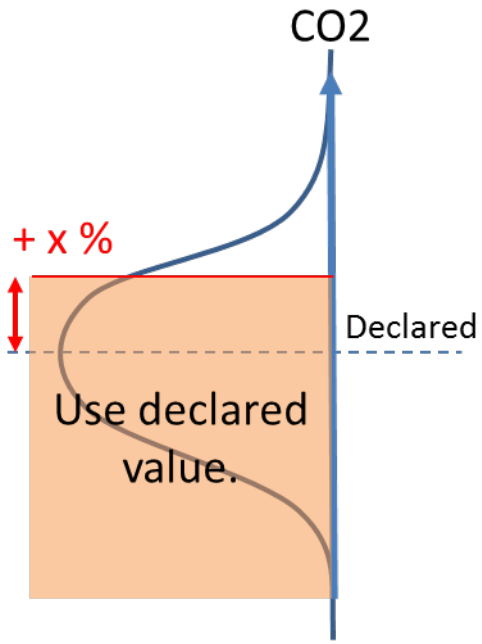
It has to be acknowledged that the manufacturer of the vehicle has a good estimation of the true value of a parameter (ex. CO2 emissions) based on own testing.

The essential step is to verify the estimation of the OEM.

There are two possible approaches to achieve this:(ref. WLTP-09-22e)

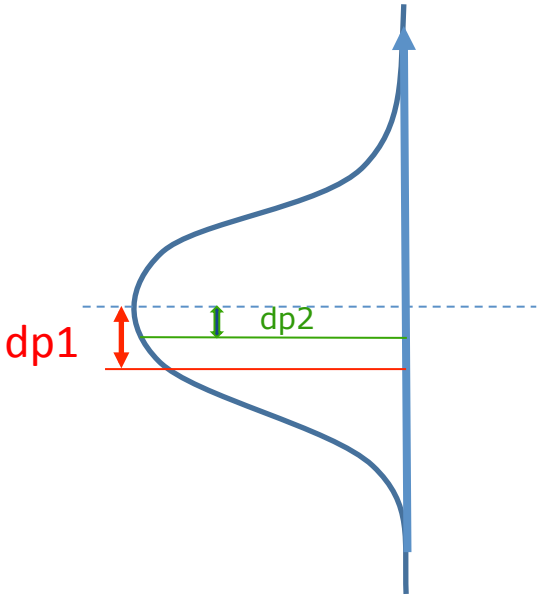
1. Fully independent testing (e.g. based on manufacturer self declaration with tests from authority side, as in US or KOR)
2. Partially independent testing (e.g. tests carried out in the context of type approval while being largely under the control of OEM)

Fully independent test



In this case the Japanese proposal could hold and the only open point would be the value of x. Such testing is nevertheless not the case during type approval in Europe.

Partially independent test

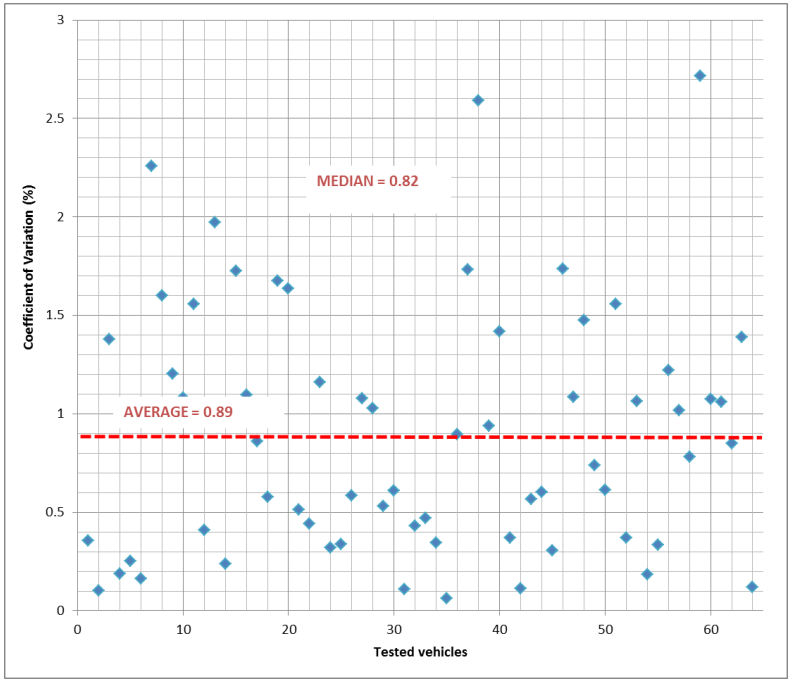


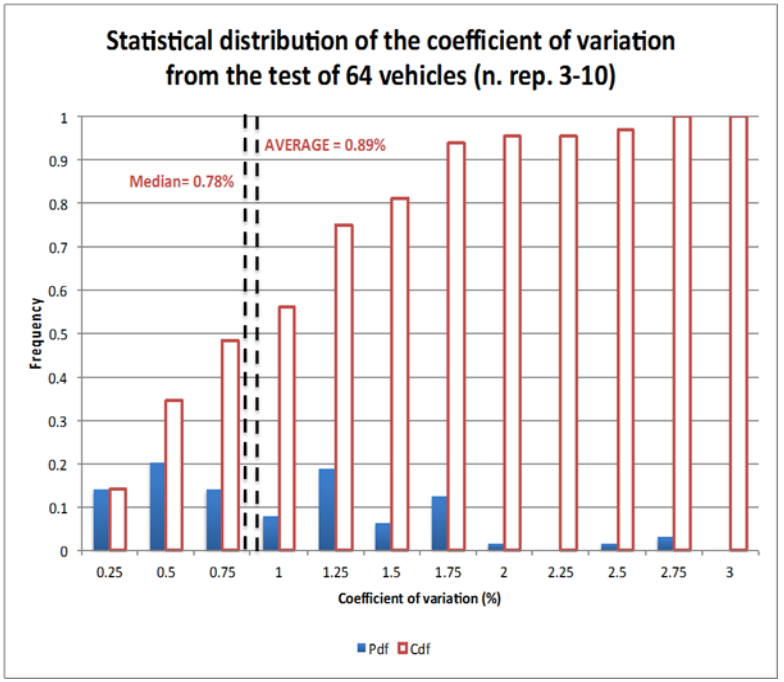
In this case it can be assumed that there is the possibility for the OEM to declare a CO2 value below the average/true value. In order to avoid or minimize its effect, it is necessary to follow a different procedure from the previous one. Open points here are dp1 and dp2.

(dp1 and x can be related and derived in the same way)

Derivation of dp1 and x

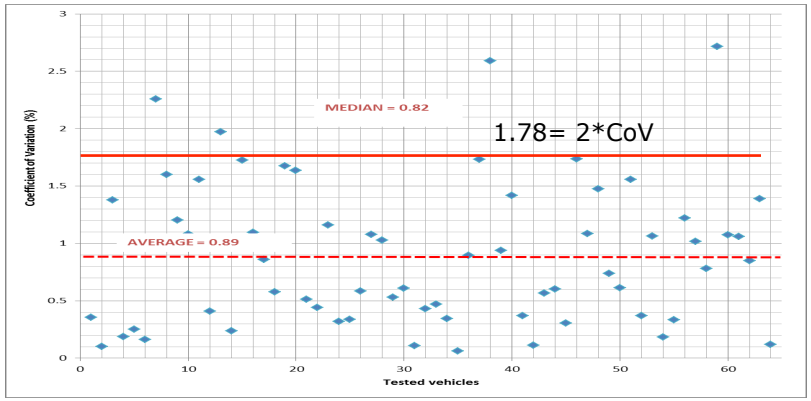
For 64 vehicles, tested in different laboratories (JRC + Validation Phase 2 of WLTP) with 3 to 10 repetitions, we have calculated the distribution of the ratio between standard deviation (σ) and average value (μ) of CO2 emission tests for each vehicle (Coefficient of Variation, in %).

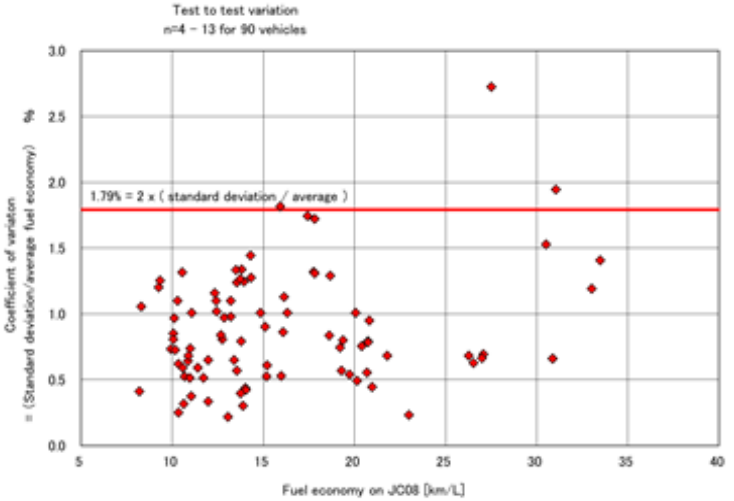




Derivation of dp1 and x

Comparison of European and Japanese data





Derivation of dp2

First method (purely experimental)

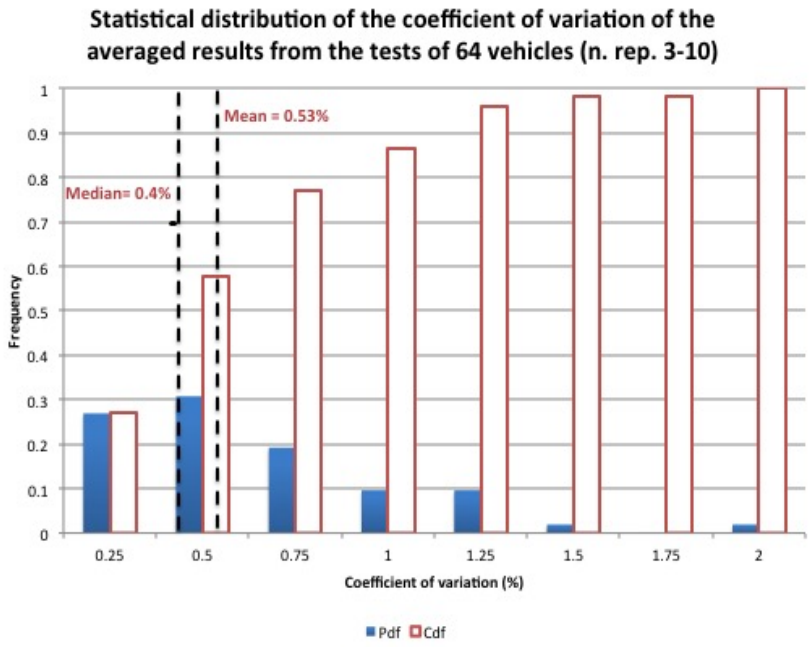
For the 64 vehicles we have first calculated the average CO2 from any combination of 2 repetitions (in case of three repetitions, 1+2, 2+3, 3+1), then we have plotted the ratio between standard deviation (σ) of the three above averages and the total average value (μ) for each vehicle (Coefficient of Variation 2, in %).

Second method (purely statistical)

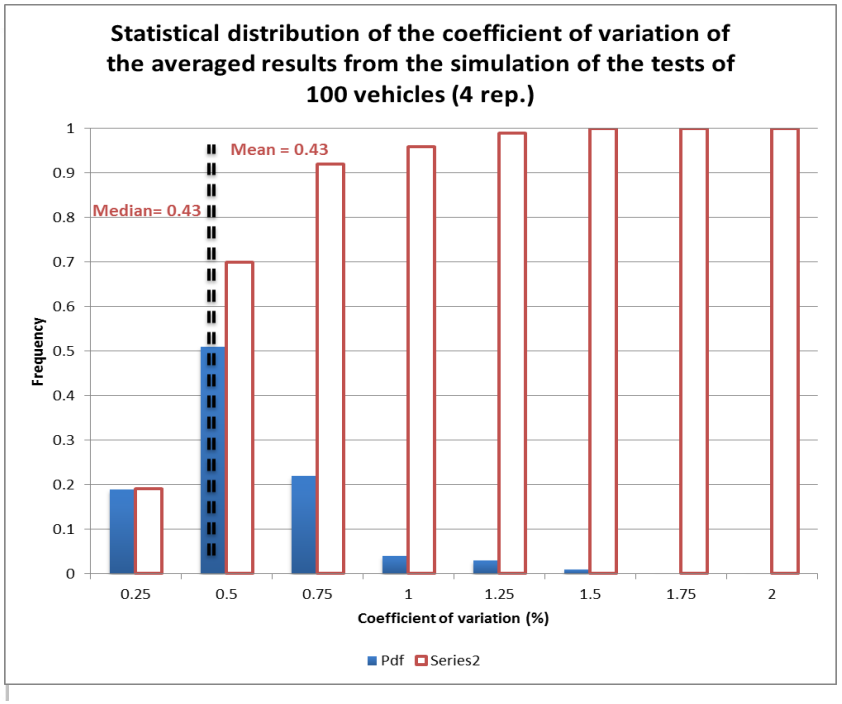
Given an average μ of 1 and the average σ taken from the determination of dp1, 100 random samplings (simulating 100 vehicles) of 4 repetitions each from a normal distribution with μ and σ have been again processed (as above described) to obtain the distribution of the Coefficient of Variation 2 for each sampling/ vehicle.

Derivation of dp2

First method



Second method



Proposal

dp1 = 0.9% (rounded to the nearest half gram, i.e. 0.5 – 1.0 – 1.5 – etc.)

dp2 = 0.45% (rounded to the nearest half gram, i.e. 0.5 – 1.0 – 1.5 – etc.)

x = 1.8%

Conclusions

Agreement

- Number of test for certification purposes should be determined on the basis of CO2 measurement.
- For regulated pollutants there should be a "pass-fail" approach, based on a 10% safety margin from the emission limits.
- It is generally acknowledged that the manufacturer has a good initial estimation of the average/true value of CO2 emissions from the vehicle under certification.

For discussion

- How to deal with partially independent tests during type approval while balancing manufacturer burden and safety for authorities?

  This cannot be solved technically. Either there is a political compromise or regional provisions for Number of Test procedure or parts of it (as dp1 and dp2) would become necessary.

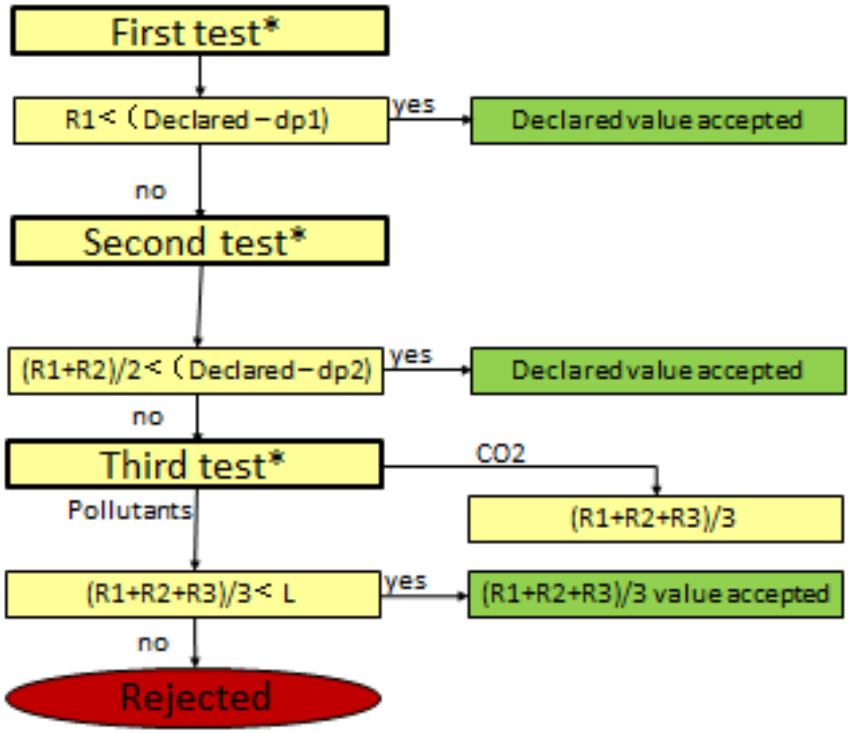
Questions?

European Commission

EU proposal at Geneva

*All results must comply with the criteria pollutant emissions standards.

CO2 test result (or averaged results) has to be better than declared value. **No tolerance at worse side.**



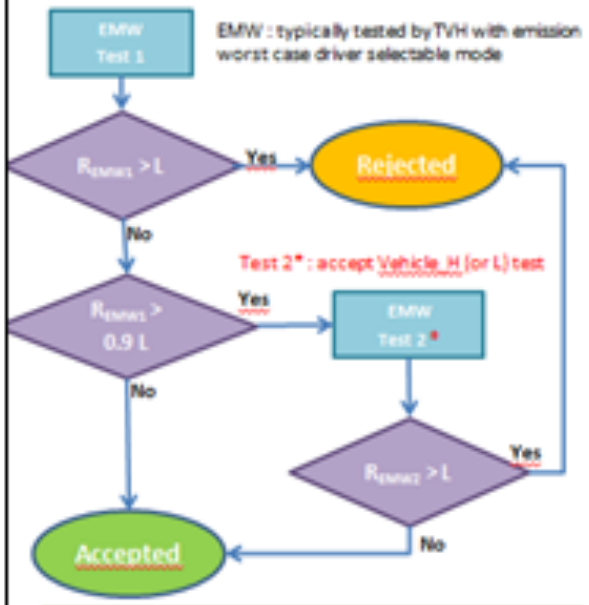
d_p^1 and d_p^2 are parameters to be determined on the basis of technical and political considerations.

European Commission

Japan proposal at Pune

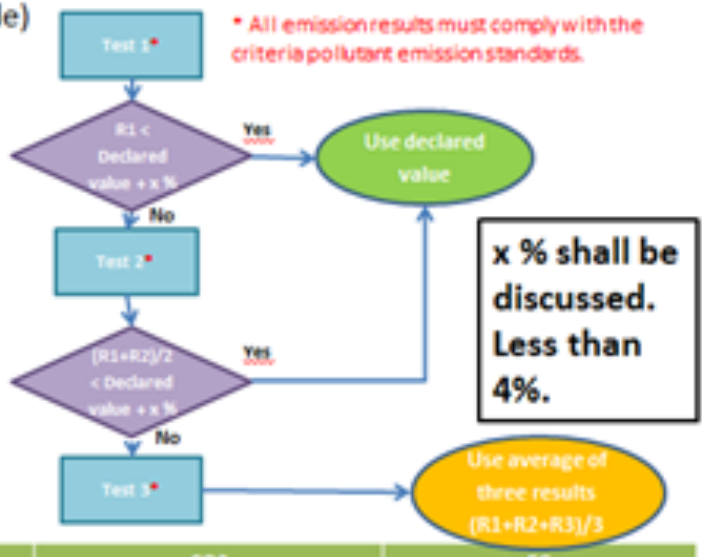
Flow chart A,B

Flow A: Criteria pollutant test with emission worst case

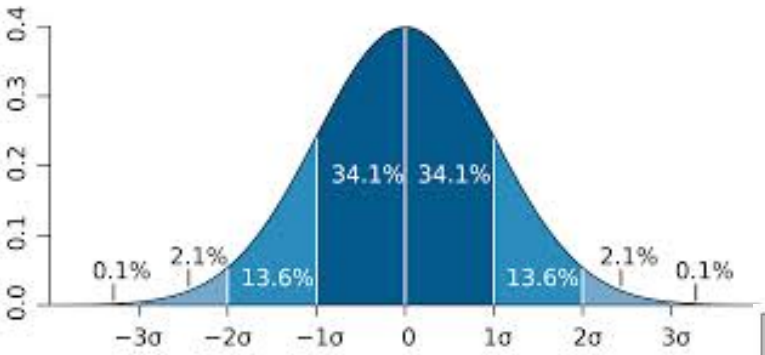


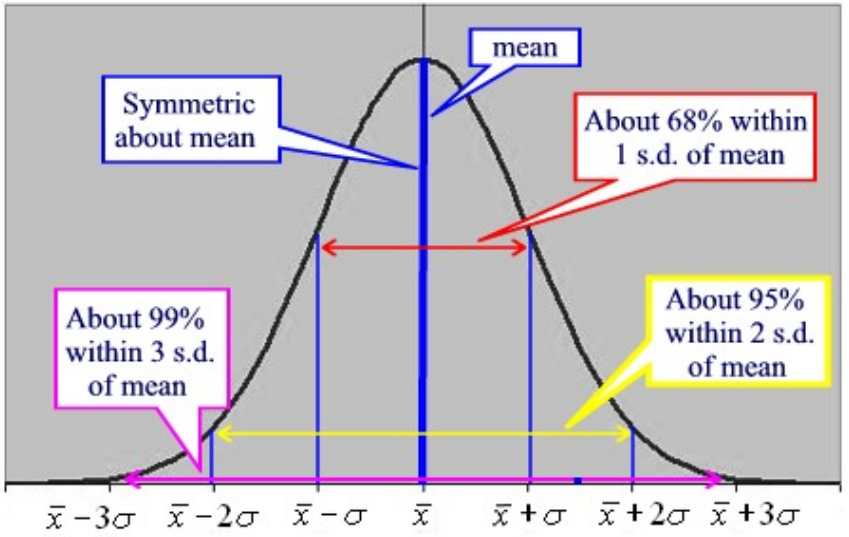
	Pollutant (i)
R_{EMW1}	$P_{EMW1(i)}$
R_{EMW2}	$P_{EMW2(i)}$
Result	Average ($P_{EMW1(i)}$, $P_{EMW2(i)}$)

Flow B: CO2 and Fuel consumption test for TVH and TVL (with Predominant mode or Best and worst case mode)



	CO2	FC
R_1	$CO2_{R1}$	FC_{R1}
R_2	$CO2_{R2}$	FC_{R2}
R_3	$CO2_{R3}$	FC_{R3}
TVH or TVL	TVH_{CO2} or TVL_{CO2} ="Declared value" or "(R1+R2+R3)/3"	TVH_{FC} or TVL_{FC} = "Declared value" or "(R1+R2+R3)/3"
TVInd	Combined app. (TVH_{CO2}, TVL_{CO2})	Combined app. (TVH_{FC}, TVL_{FC})


0.0
0.1
0.2
0.3
0.4
34.1%
34.1%
0.1%
2.1%
13.6%
13.6%
2.1%
0.1%
−3σ
−2σ
−1σ
0
1σ
2σ
3σ


mean
Symmetric about mean
About 68% within 1 s.d. of mean
About 99% within 3 s.d. of mean
About 95% within 2 s.d. of mean
$\bar{x}-3\sigma$
$\bar{x}-2\sigma$
$\bar{x}-\sigma$
$\bar{x}$
$\bar{x}+\sigma$
$\bar{x}+2\sigma$
$\bar{x}+3\sigma$