

INFORMAL GROUP ON GASEOUS FUEL VEHICLES
Within the UN GRPE (WP29)
PROPOSED AMENDMENT GFV-04-04

Name of Organisation submitting Amendment/Work Item:

AEGPL

Person submitting Item: Salvatore Piccolo

Assogasliquidi

Address/phone/email coordinates

Viale Luigi Pasteur 10

ROMA 00144

Italie

Work: +39.065.427.3215 / 3218

Fax: +39.065.913.901

Mobile: +39.347.126.89.41

E-Mail: s.piccolo@federchimica.it

Regulation name and reference number: Regulation 115

Name of Amendment/Work Item:

Document in support to the GFV-04-02, providing the rationale on the Chassis dynamometer setting proposals for the Type 1 test.

RATIONALE

An investigation into two different methods to set the absorbed load for LPG and CNG retrofit systems on a chassis dynamometer has been made.

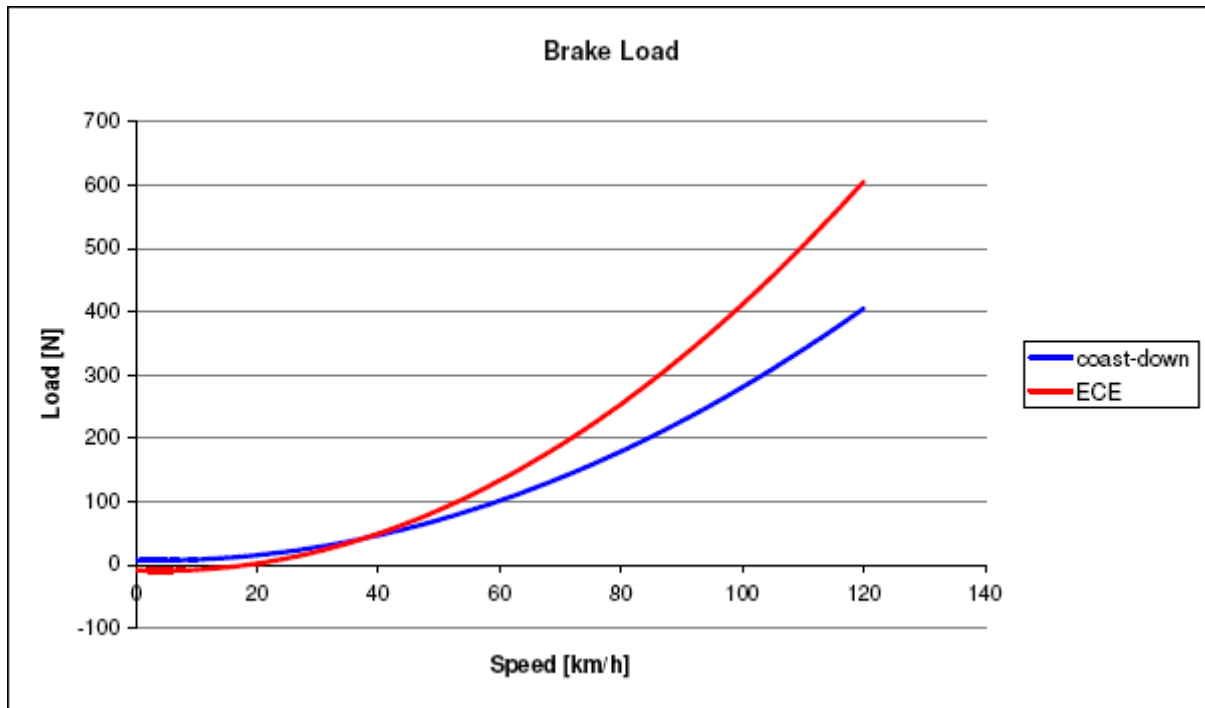
The two different methods are:

- 1) by using coast-down data as provided by the vehicle manufacturer
- 2) by using the so called "table values" from 96/44/EG table 3.2.1

A Peugeot 207 was evaluated, whose reference mass is about 1250 kg.

The weights of the LPG and CNG retrofit systems have been set – most severely - at respectively 60 kg and 160kg.

The speed vs. dyno load (in N) for the vehicle converted with the LPG system is shown in the next graph.



It is clear that at higher speeds, the table values lead to higher chassis dyno load settings.

The next phase of the investigation was aimed at determining the effect of the chassis dyno settings on the energy needed at the wheels to complete the emission cycle.

To do this, the power needed at the wheels to complete the cycle was calculated using a one second interval.

If this power is positive, energy flows from the vehicle (engine) to the chassis dyno. I.e. the engine is driving the chassis dyno. If this power is negative, power flows from the chassis dyno to the vehicle. I.e. the chassis dyno is driving the vehicle, which is thus in coast or braking mode. For conventional (non-hybrid) vehicles, this negative energy is converted into heat and non regenerated.

Thus, only the positive power at the wheels is significant for the fuel consumption and emissions.

¹The next tables show the cumulative positive brake power (CPBP for here on) of the vehicle in the both cases: LPG (Table 1) and CNG (table 2):

Table 1 (LPG)

CASE A	2935	100	coast-down from manufacturer before retrofit with f_0 corrected; corresponding ECE inertia + LPG system weight (60 kg)
CASE B	3336	114	ECE table values before retrofit; corresponding ECE inertia
CASE C	3415	116	ECE table values before retrofit with f_0 corrected; corresponding ECE inertia + LPG system weight (60 kg)
CASE D	3649	124	ECE table values of 1 ref. class above;

¹ Idle operation has been discarded, since this will be the same for the vehicle before and after the retrofit from

			corresponding ECE inertia of 1 ref. class above
--	--	--	---

Table 2 (CNG)

CASE A	3067	100	coast-down from manufacturer before retrofit with f_0 corrected; corresponding ECE inertia + CNG system weight (160kg)
CASE B	3336	109	ECE table values before retrofit; corresponding ECE inertia
CASE C	3548	116	ECE table values before retrofit with f_0 corrected; corresponding ECE inertia + CNG system weight (160 kg)
CASE D	3873	126	ECE table values of 2 ref. classes above; corresponding ECE inertia of 2 ref. classes above

To investigate the influence of the additional weight added to the vehicle, the CPBP is calculated for a number of cases:

- using coast-down from manufacturer corresponding to the vehicle before the retrofit corrected with the additional weight. This is done by increasing the inertia mass by the additional weight (AD) of the system and adjusting the F_0 -coefficient by the factor $(R+AD)/R$ where “ R “ equals the reference mass in kg.
- using table values corresponding to the vehicle before the retrofit;
- using table values corresponding to the vehicle before the retrofit corrected with the additional weight. This is done by increasing the inertia mass by the additional weight (AD) of the system and adjusting the a-coefficient by the factor $(R+AD)/R$ where “ R “ equals the reference mass in kg.
- Using the table values for the next higher reference mass class (one for LPG and two for CNG)

The case A is to be considered the “real case” because it is based on coast-down of the original car whereas only the rolling resistance have been upgraded linearly according to the new mass of the vehicle.

In facts, since the installation of the retrofit system doesn't affect the original shape of the car, the other coefficients have been left unchanged.

Therefore, the values were corrected to a value relative to option A (base case) for each vehicle (thus, option a has A relative CPBP of 100, the other options are indicated as a percentage of option A to be able to better compare these different options).

A further investigation has been carried out to evaluate the influence of the added weight: CPBP has been calculated in the case of coast-down of the vehicle before the retrofit: the gas system weighs, in terms of additional energy expense during the cycle, as 3% for LPG and 7% for CNG.

Instead, the comparison between the case A and case B shows that the energy difference between table values and coastdown – even if adjusted according to the new mass - is much more significant: for LPG the table value CPBP is some 14% higher with respect to the coast-down base case, for CNG 9% more.

A higher error is realized if the table values corresponding to the vehicle before the retrofit corrected with the additional weight (CASE C) are used: 16% of energy difference in comparison with the base case for both fuels.

In the end, if the Regulation 83 had to be applied using the table values for the next higher reference mass class (CASE D) – where achieved with the additional weight of the retrofit system - the positive error with respect to the real case would be of 24% for LPG and 26% for CNG.

Based on this limited investigation, one can wonder if the table values from 96/44/EG table 3.2.1 are still valid for today's vehicles. A re-evaluation of these values seems in place.

From this, we can conclude that:

- 1) the use of table values corresponding to the vehicle before the retrofit corrected with the additional weight or the use of the table values for the next higher reference mass class would significantly overestimate the influence of the added weight;
- 2) when available, the use of coast-down corresponding to the vehicle before the retrofit corrected with the additional weight would represent the “real case”.
- 3) if coast-down coefficients are not available, the use of table values corresponding to the vehicle before the retrofit slightly overestimate the influence of the added weight but represents the only possible choice.

We must know however that option A is not possible on chassis dynamometers that use a set of flywheels to simulate the vehicle inertia since it is often only possible to select the legislated inertia values. If so, the table values corresponding to the vehicle before the retrofit will apply.