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PROPOSAL FOR DRAFT SUPPLEMENT 5 TO REGULATION No. 101

(Emission of CO_2 and fuel consumption measurement)

Transmitted by the Working Party on Pollution and Energy (GRPE)

Note: The text reproduced below was adopted by GRPE at its forty-third session, and is transmitted for consideration to WP.29 and AC.1. It is based on document TRANS/WP.29/GRPE/2000/12/Rev.1, as amended (TRANS/WP.29/GRPE/43, para. 41).

Insert new paragraph 2.11., to read:

"2.11. "Periodically regenerating system" means an anti-pollution device (e.g. catalytic converter, particulate trap) that requires a periodical regeneration process in less than 4,000 km of normal vehicle operation. If a regeneration of an anti-pollution device occurs at least once per Type I test and that has already regenerated at least once during the vehicle preparation cycle, it will be considered as a continuously regenerating system, which does not require a special test procedure. Annex 8 does not apply to continuously regenerating systems.

At the request of the manufacturer, the test procedure specific to periodically regenerating systems will not apply to a regenerative device if the manufacturer provides data to the type approval authority that, during cycles where regeneration occurs, emission of CO_2 does not exceed the declared value by more than 4 per cent after agreement of the technical service."

Paragraph 5.4.1. amend to read :

"5.4.1. The CO_2 value or the value of electric energy consumption adopted as the type approval value shall be the value declared by the manufacturer if the value measured by the technical service does not exceed the declared value by more than 4 per cent. The measured value can be lower without any limitations.
In the case of periodically regenerating systems as defined in paragraph 2.11., the results are multiplied by the factor K_i obtained from annex 8 before being compared to the declared value."

Paragraph 7.1., amend to read:

"7.1. Vehicles powered by an internal combustion engine, except vehicles equipped with a periodically regenerating emission control system

The type approval can be extended to vehicles ..."

Paragraph 7.2., amend to read:

"7.2. Vehicles powered by an internal combustion engine and equipped with a periodically regenerating emission control system

The type approval can be extended to vehicles from the same type or from a different type, differing with regard to the characteristics of annex 3, given in paragraphs 7.1.1. to 7.1.5. above, but not exceeding the family characteristics of annex 8, if the CO_2 emissions measured by the technical service do not exceed by more than 4 per cent the type approved value, and where the same K_i factor is applicable.

The type approval can be extended also to vehicles from the same type, but with a different K_i factor, if the corrected CO_2 value measured by the technical service does not exceed by more than 4 per cent the type approved value."

Paragraph 7.2.(former), renumber as paragraph 7.3.

Insert new paragraph 9.3.1.1.1.4., to read:

"9.3.1.1.1.4. In the case of periodically regenerating systems as defined in paragraph 2.11., the results shall be multiplied by the factor K_i obtained by the procedure specified in annex 8 at the time when type approval was granted.

At the request of the manufacturer, testing may be carried out immediately after a regeneration has been completed."

Annex 1,

Insert new items 1.2.11.2.1.10. to 1.2.11.2.1.10.4., to read:

"1.2.11.2.1.10. Regeneration systems/method of exhaust after-treatment systems, description:

1.2.11.2.1.10.1. The number of Type I operating cycles, or equivalent engine test bench cycles, between two cycles where regenerative phases occur under the conditions equivalent to Type I test (Distance 'D' in figure 1 in annex 8): .....
.....

1.2.11.2.1.10.2. Description of method employed to determine the number of cycles between two cycles where regenerative phases occur:
.....

1.2.11.2.1.10.3. Parameters to determine the level of loading required before regeneration occurs (i.e. temperature, pressure etc.): ...

1.2.11.2.1.10.4. Description of method used to load system in the test procedure described in paragraph 3.1., annex 8: .....
..... "

Items 1.2.11.2.1.10. to 1.2.11.2.10.2. (former), renumber as items 1.2.11.2.1.11. to 1.2.11.2.2.11.2.

Insert new items 1.2.11.2.5.4.1. to 1.2.11.2.5.4.4., to read:

"1.2.11.2.5.4.1. The number of Type I operating cycles, or equivalent engine test bench cycle, between two cycles where regeneration phases occur under the conditions equivalent to Type I test (Distance 'D' in figure 1 in annex 8): .....
.....
.....

1.2.11.2.5.4.2.1. Description of method employed to determine the number of cycles between two cycles where regenerative phases occur:
.....

1.2.11.2.5.4.3. Parameters to determine the level of loading required before regeneration occurs (i.e. temperature, pressure, etc.): ..

1.2.11.2.5.4.4. Description of method used to load system in the test procedure described in paragraph 3.1., annex 8: .....
..... "

Annex 2,

Insert new item 7.1.3., to read:

7.1.3. For vehicles equipped with periodically regenerating systems as defined in paragraph 2.11. of this Regulation, the test results must be multiplied by the factor K_i obtained from annex 8."

Add a new annex 8, to read:

"Annex 8

EMISSIONS TEST PROCEDURE FOR A VEHICLE EQUIPPED WITH A PERIODICALLY REGENERATING SYSTEM

1. INTRODUCTION

1.1. This annex defines the specific provisions regarding type-approval of a vehicle equipped with a periodically regenerating system as defined in paragraph 2.11. of this Regulation.

2. SCOPE AND EXTENSION OF THE TYPE APPROVAL

2.1. Vehicle family groups equipped with periodically regenerating system

The procedure applies to vehicles equipped with a periodically regenerating system as defined in paragraph 2.11. of this Regulation. For the purpose of this annex vehicle family groups may be established. Accordingly, those vehicle types with regenerative systems, whose parameters described below are identical, or within the stated tolerances, shall be considered to belong to the same family with respect to measurements specific to the defined periodically regenerating systems.

2.1.1. Identical parameters are:

Engine:

(a) number of cylinders,
(b) engine capacity (± 15 per cent),
(c) number of valves,
(d) fuel system,
(e) combustion process (2 stroke, 4 stroke, rotary).

Periodically regenerating system (i.e. catalyst, particulate trap):

(a) Construction (i.e. type of enclosure, type of precious metal, type of substrate, cell density),
(b) Type and working principle,
(c) Dosage and additive system,
(d) Volume (± 10 per cent),
(e) Location (temperature ± 50 °C at 120 km/h or 5 per cent difference of max. temperature / pressure).

2.2. Vehicle types of different reference masses

The K_i factor developed by the procedures in this annex for type approval of a vehicle type with a periodically regenerating system as defined in paragraph 2.11. of this Regulation, may be extended to other vehicles in the family group with a reference mass within the next two higher equivalent inertia classes or any lower equivalent inertia.

2.3. Instead of carrying out the test procedures defined in the following section, a fixed K_i value of 1.05 may be used, if the technical service sees no reason that this value could be exceeded.

3. TEST PROCEDURE

The vehicle may be equipped with a switch capable of preventing or permitting the regeneration process provided that this operation has no effect on original engine calibration. This switch shall be permitted only for the purpose of preventing regeneration during loading of the regeneration system and during the pre-conditioning cycles. However, it shall not be used during the measurement of emissions during the regeneration phase; rather the emission test shall be carried out with the unchanged Original Equipment Manufacturer's (OEM) control unit.

3.1. Measurement of carbon dioxide emission and fuel consumption between two cycles where regenerative phases occur

3.1.1. Average of carbon dioxide emission and fuel consumption between regeneration phases and during loading of the regenerative device shall be determined from the arithmetic mean of several approximately equidistant (if more than 2) Type I operating cycles or equivalent engine test bench cycles. As an alternative, the manufacturer may provide data to show that the carbon dioxide emission and fuel consumption remain constant $\pm$ 4 per cent between regeneration phases. In this case, the carbon dioxide emission and fuel consumption measured during the regular Type I test may be used. In any other case emissions measurement for at least two Type I operating cycles or equivalent engine test bench cycles must be completed: one immediately after regeneration (before new loading) and one as close as possible prior to a regeneration phase. All emissions measurements and calculations shall be carried out according to annex 5, paragraphs 1.4.3. and 1.5.

3.1.2. The loading process and K_i determination shall be made during the Type I operating cycle, on a chassis dynamometer or on an engine test bench using an equivalent test cycle dynamometer. These cycles may be run continuously (i.e. without the need to switch the engine off between cycles). After any number of completed cycles, the vehicle may be removed from the chassis dynamometer, and the test continued at a later time.

3.1.3. The number of cycles (D) between two cycles where regeneration phases occur, the number of cycles over which emissions measurements are made (n), and each emissions measurement (M'_{sij}) shall be reported in annex 1, items 1.2.11.2.1.10.1. to 1.2.11.2.1.10.4. or 1.2.11.2.5.4.1. to 1.2.11.2.5.4.4. as applicable.

3.2. Measurement of carbon dioxide emission and fuel consumption during regeneration

3.2.1. Preparation of the vehicle, if required, for the emissions test during a regeneration phase, may be completed using the preparation cycles in paragraph 5.3. of annex 4 of Regulation No. 83 or equivalent engine test bench cycles, depending on the loading procedure chosen in paragraph 3.1.2. above.

3.2.2. The test and vehicle conditions for the test described in annex 5 apply before the first valid emission test is carried out.

3.2.3. Regeneration must not occur during the preparation of the vehicle. This may be ensured by one of the following methods:

3.2.3.1. A "dummy" regenerating system or partial system may be fitted for the pre-conditioning cycles.

3.2.3.2. Any other method agreed between the manufacturer and the type approval authority.

3.2.4. A cold-start exhaust emission test including a regeneration process shall be performed according to the Type I operating cycle, or equivalent engine test bench cycle. If the emissions tests between two cycles where regeneration phases occur are carried out on an engine test bench, the emissions test including a regeneration phase shall also be carried out on an engine test bench.

3.2.5. If the regeneration process requires more than one operating cycle, subsequent test cycle(s) shall be driven immediately, without switching the engine off, until complete regeneration has been achieved (each cycle shall be completed). The time necessary to set up a new test should be as short as possible (e.g. particular matter filter change). The engine must be switched off during this period.

3.2.6. The carbon dioxide emission and fuel consumption values during regeneration (M_{ri}) shall be calculated according to annex 5, paragraph 1.4.3. and 1.5. The number of operating cycles (d) measured for complete regeneration shall be recorded.

3.3. Calculation of the combined carbon dioxide emission and fuel consumption

$$M_{si} = \frac{\sum_{j=1}^{n} M'_{sij}}{n} \quad n \geq 2 \; ; \qquad M_{ri} = \frac{\sum_{j=1}^{d} M'_{rij}}{d}$$

$$M_{pi} = \left\{ \frac{M_{si} * D + M_{ri} * d}{D + d} \right\}$$

where for each carbon dioxide emission and fuel consumption considered:

M'_{sij} = mass emissions of CO_2 in g/km and fuel consumption in l/100 km over one part (i) of the operating cycle (or equivalent engine test bench cycle) without regeneration

M'_{rij} = mass emissions of CO_2 in g/km and fuel consumption in l/100 km over one part (i) of the operating cycle (or equivalent engine test bench cycle) during regeneration. (when n>1, the first Type I test is run cold, and subsequent cycles are hot)

M_{si} = mean mass emissions of CO_2 in g/km and fuel consumption in l/100 km over one part (i) of the operating cycle without regeneration

M_{ri} = mean mass emissions of CO_2 in g/km and fuel consumption in l/100 km over one part (i) of the operating cycle during regeneration

M_{pi} = mean mass emission of CO_2 in g/km and fuel consumption in l/100 km

N = number of test points at which emissions measurements (Type I operating cycles or equivalent engine test bench cycles) are made between two cycles where regenerative phases occur, ≥ 2

d = number of operating cycles required for regeneration

D = number of operating cycles between two cycles where regenerative phases occur

For exemplary illustration of measurement parameters see figure 8/1.

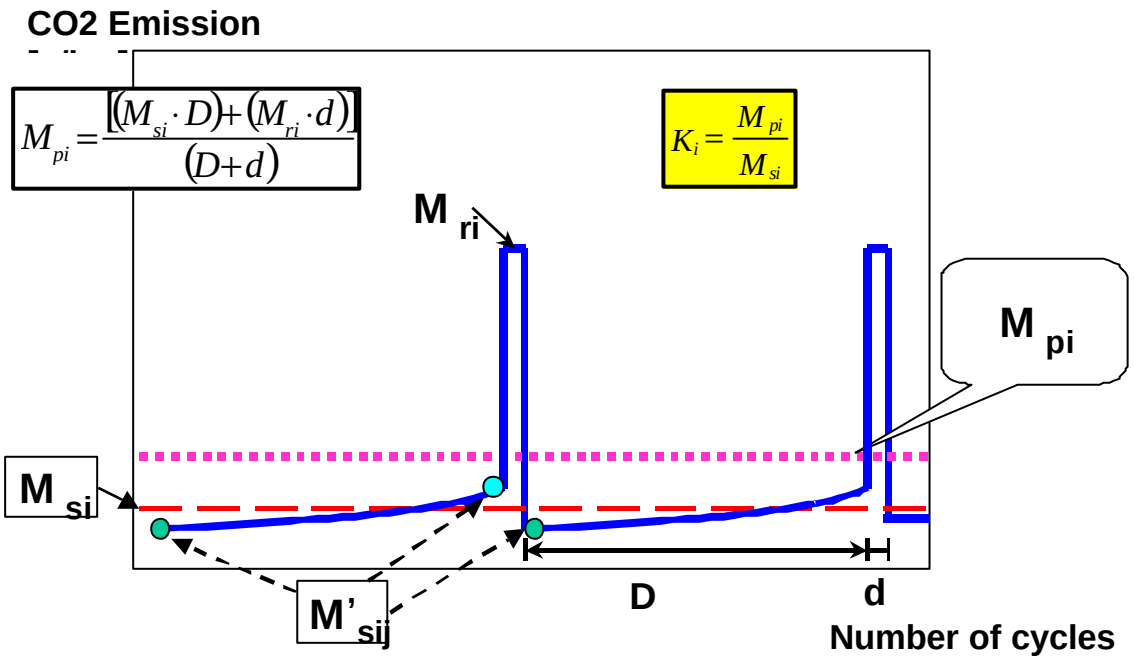

Figure 8/1: Parameters measured during carbon dioxide emission and fuel consumption test during and between cycles where regeneration occurs (schematic example, the emissions during 'D' may increase or decrease)

3.4. Calculation of the regeneration factor K for each carbon dioxide emission and fuel consumption (i) considered

$$K_i = M_{pi} / M_{si}$$

M_{si}, M_{pi} and K_i results shall be recorded in the test report delivered by the technical service.

K_i may be determined following the completion of a single sequence."

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