Chapter 15

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

1. INTRODUCTION

This chapter defines the specific provisions regarding type-approval of a vehicle equipped with a periodically regenerating system as defined in paragraph 1.1.1

1.1 DEFINITIONS

1.1.1 "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. During cycles where regeneration occurs, emission standards can be exceeded. 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 vehicle preparation cycle, it will be considered as a continuously regenerating system which does not require a special test procedure. This chapter 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, emissions remain below the standards given in applicable Gazette Notification applied for the concerned vehicle category after agreement of the test agency.

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 1.1.1. 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) Combustion process.

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 90 km/h or 5 per cent difference of max. temperature / pressure).

2.2. Vehicle types of different reference masses

The K_i factors developed by the procedures in this chapter for type approval of a vehicle type with a periodically regenerating system as defined in paragraph 1.1.1, 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.

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. Exhaust emission measurement between two cycles where regenerative phases occur

Average emissions 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 emissions remain constant (+/-15 per cent) between regeneration phases. In this case, the emissions 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 Chapter 3 paragraph 5, 6, 7 and 8.

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. 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 Chapter 2 , items 7.1 to 7.4 or 8.4.1 to 8.4.4 as applicable.

3.2. Measurement of emissions 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 chapter 3 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 Type I test described in chapter 3 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 test agency.

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 emission values during regeneration (M_{ri}) shall be calculated according to chapter 8. The number of operating cycles (d) measured for complete regeneration shall be recorded.

3.3. Calculation of the combined exhaust emissions

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

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

where for each pollutant (i) considered:

M'_{sij} = mass emissions of pollutant (i) in g/km over one Type I operating cycle (or equivalent engine test bench cycle) without regeneration

M'_{rij} = mass emissions of pollutant (i) in g/km over one Type I 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 emission of pollutant (i) in g/km without regeneration

M_{ri} = mean mass emission of pollutant (i) in g/km during regeneration

M_{pi} = mean mass emission of pollutant (i) in g/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.

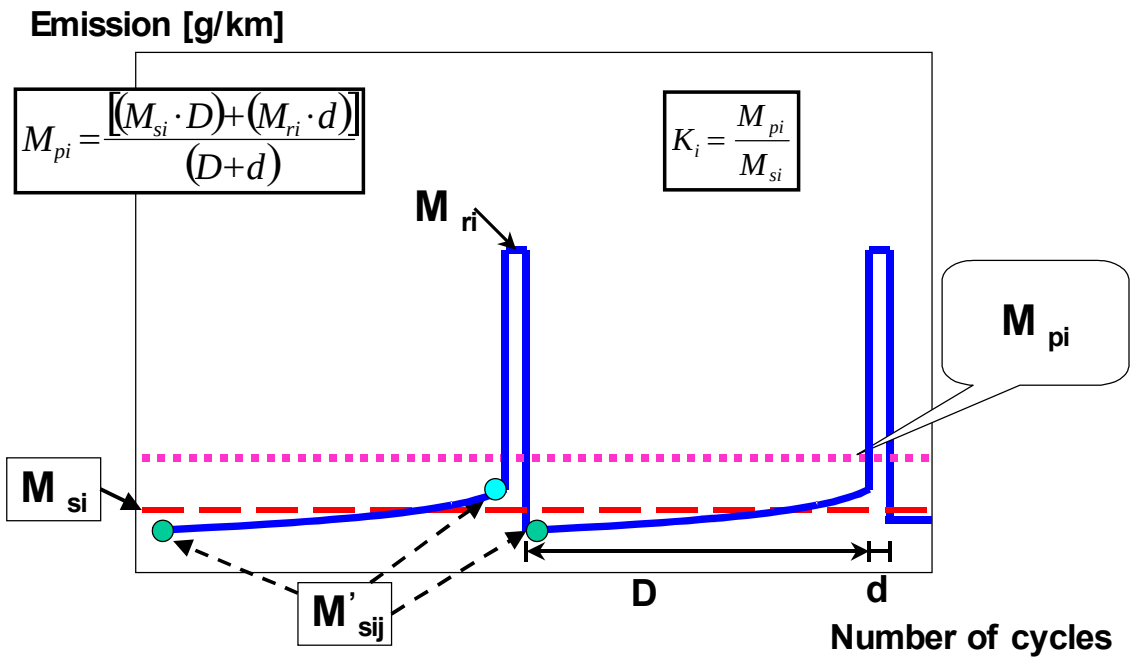

Figure 8/1: Parameters measured during emissions test during and between cycles where regeneration occurs (schematic example, the emissions during 'D' may increase or decrease)

3.4. Calculation of the regeneration factor K for each pollutant (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 Testing Agency.

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