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ANNEX 1

ANNEX

to the

Commission Regulation xxx/2016 amending Commission Regulation (EC) No 692/2008 as regards the methodology for the determination of evaporative emissions (Type 4 test)

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Annex VI to Regulation (EC) N° 692/2008 is replaced by the following.

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ANNEX VI

1. INTRODUCTION

1.1. This Annex describes the procedure for the Type 4 test, which determines the emission of hydrocarbons by evaporation from the fuel systems of vehicles with positive ignition engines.

2. TECHNICAL REQUIREMENTS

2.1. Introduction

The procedure includes the evaporative emissions test and two additional tests, one for the aging of the carbon canister, as described in point 5.1, and one for the permeability of the fuel storage system, as described in point 5.2.

The evaporative emissions test (Figure 1) is designed to determine hydrocarbon evaporative emissions as a consequence of diurnal temperatures fluctuation, hot soaks during parking, and urban driving.

2.2 The evaporative emissions test consists of:

a) Test drive including an urban (Part One) and an extra-urban (Part Two) driving cycle, followed by two urban (Part One) driving cycles,

b) Hot soak loss determination,

c) Diurnal loss determination.

The mass emissions of hydrocarbons from the hot soak and the diurnal loss phases are added up together with the permeability factor to provide an overall result for the test.

3. VEHICLE AND FUEL

3.1. Vehicle

3.1.1. The vehicle shall be in good mechanical condition and have been run in and driven at least 3,000 km before the test. For the purpose of the determination of evaporative emissions, the mileage and the age of the vehicle used for certification shall be recorded. The evaporative emission control system shall be connected and have been functioning correctly over the run in period and the carbon canister(s) shall have been subject to normal use, neither undergoing abnormal purging nor abnormal loading. The carbon canister(s) aged according to the Procedure set out in paragraph 5.1 shall be connected as described in Figure 1.

3.2. Fuel

3.2.1. The Type I E10 reference fuel specified in Annex IX to Regulation (EC) N° 692/2008 shall be used. For the purposes of this Regulation, E10 reference shall mean the Type I reference fuel, except for the canister aging, as set out in point 5.1.

4. TEST EQUIPMENT FOR EVAPORATIVE TEST

4.1. Chassis dynamometer

The chassis dynamometer shall meet the requirements of Appendix 1 of Annex 4a to UN/ECE Regulation No 83.

4.2. Evaporative emission measurement enclosure

The evaporative emission measurement enclosure shall meet the requirements of paragraph 4.2. of Annex 7 to UN/ECE Regulation No 83.

Figure 1

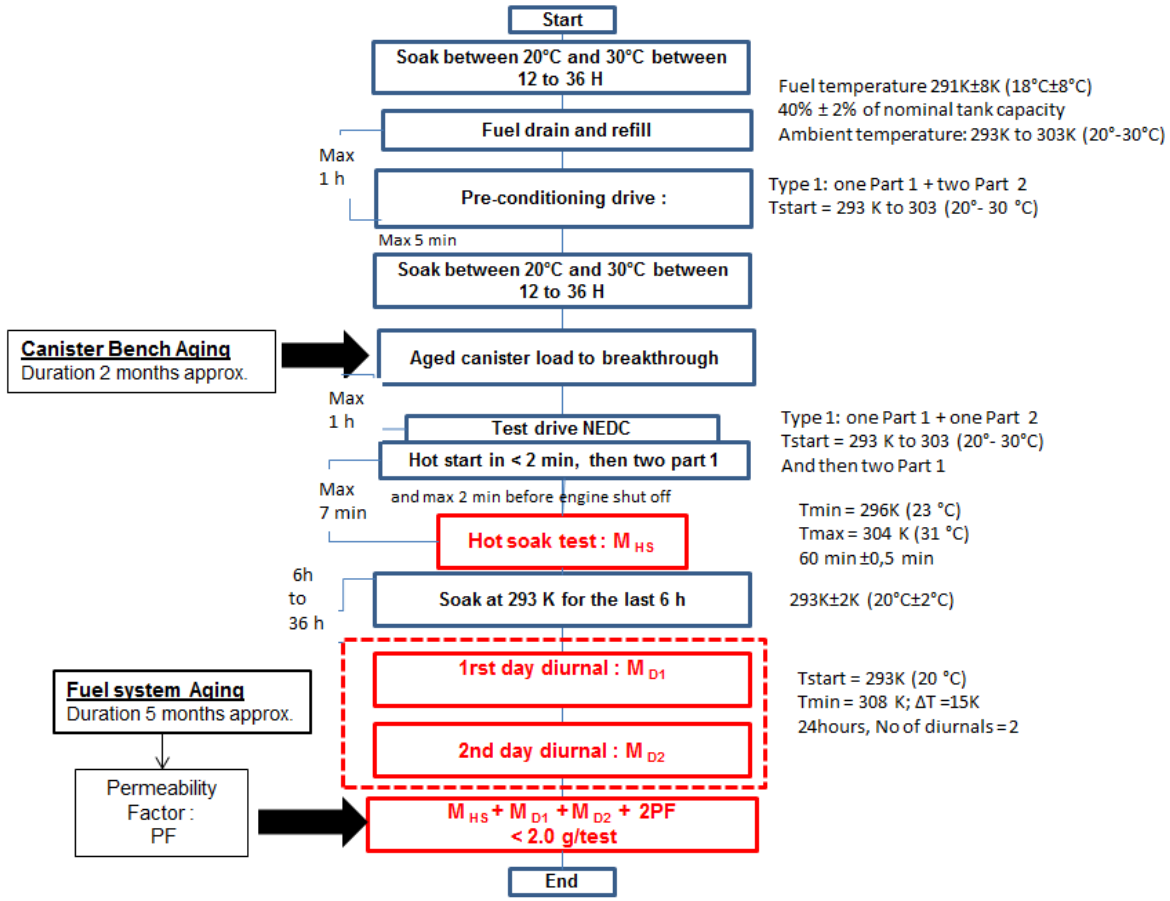
Determination of evaporative emissions

3000 km run-in period (no excessive purge/load)

Use of aged of canister(s)

Steam-clean of vehicle (if necessary)

Reducing or removing non-fuel background emission sources (if agreed)



Notes:

1. Evaporative emission control families – as in paragraph 3.2 of Annex I

2. Exhaust emissions may be measured during Type I test drive but these are not used for legislative purposes. Exhaust emission legislative test remains separate.

4.3. Analytical systems

The analytical systems shall meet the requirements of paragraph 4.3. of Annex 7 to UN/ECE Regulation No 83.

4.4. Temperature recording

The temperature recording shall meet the requirements of paragraph 4.5. of Annex 7 to UN/ECE Regulation No 83.

4.5. Pressure recording

The pressure recording shall meet the requirements of paragraph 4.6. of Annex 7 to UN/ECE Regulation No 83.

4.6. Fans

The fans shall meet the requirements of paragraph 4.7. of Annex 7 to UN/ECE Regulation No 83.

4.7. Gases

The gases shall meet the requirements of paragraph 4.8. of Annex 7 to UN/ECE Regulation No 83.

4.8. Additional Equipment

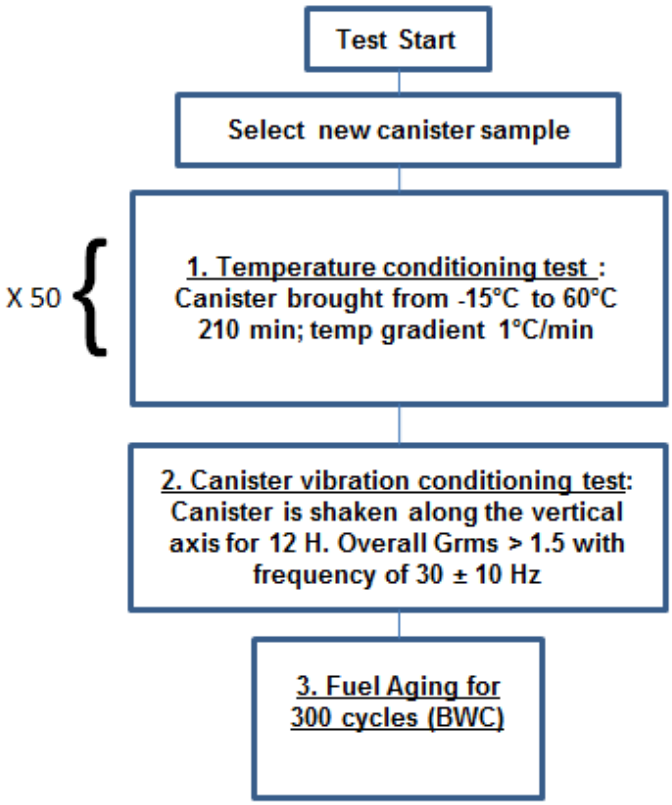
The additional equipment shall meet the requirements of paragraph 4.9. of Annex 7 to UN/ECE Regulation No 83.

5. TEST PROCEDURE

5.1. Canister(s) bench aging

Before performing the hot soak and diurnal losses sequences, the canister(s) must be aged according the following procedure described in Figure 2.

Figure 2: Canister bench aging procedure

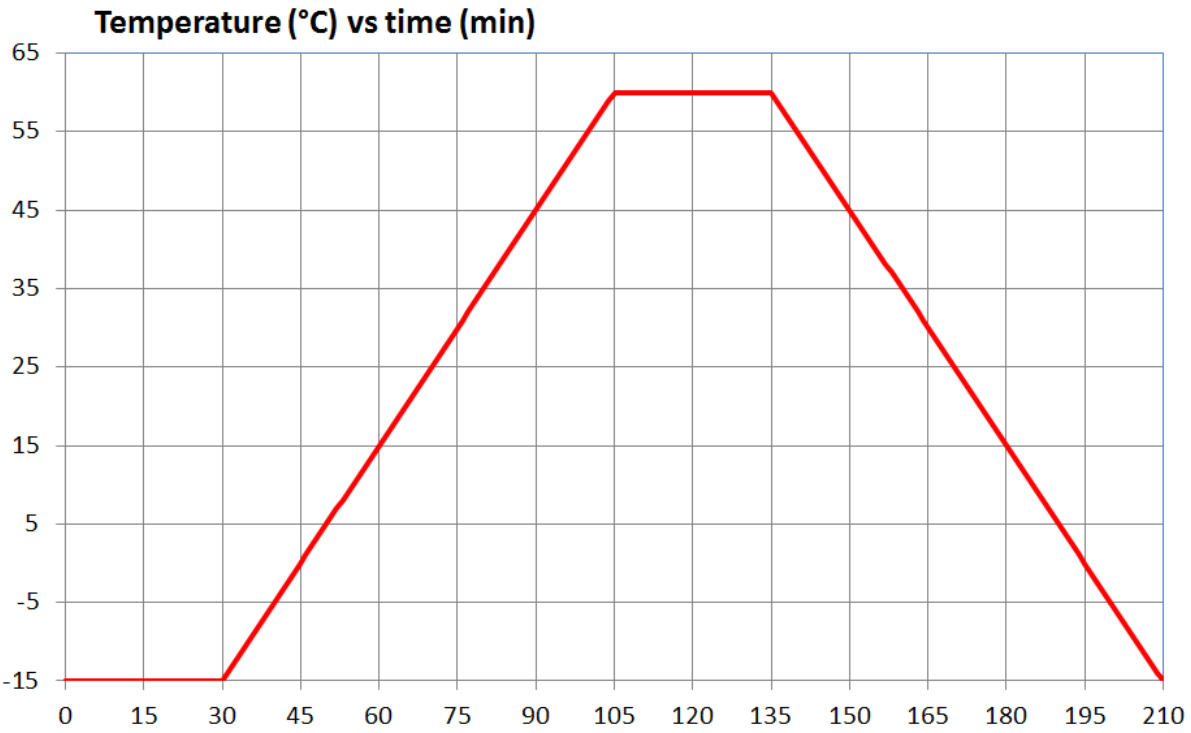


5.1.1. Temperature conditioning test

In a dedicated temperature chamber, the canister(s) is (are) cycled between temperatures from -15°C to 60°C, with 30 min of stabilisation at -15°C and 60°C. Each cycle shall last 210 min as in Figure 3. The temperature gradient shall be as close as possible to 1°C/min. No forced air flow should to pass through the canister(s).

The cycle is repeated 50 times consecutively. In total, this operation will last 175 hours.

Figure 3: Temperature conditioning cycle



5.1.2. Canister vibration conditioning test

After the temperature aging procedure, the canister(s) is (are) shaken along the vertical axis with the canister(s) mounted as per its orientation in the vehicle with overall Grms[1] > 1.5m/sec[2] with frequency of 30 ± 10 Hz. The test shall last 12 hours.

5.1.3. Canister Fuel aging test

5.1.3.1. Fuel Aging for 300 cycles

5.1.3.1.1. After the temperature conditioning test and vibration test, the canister(s) is aged with a mixture of Type I E10 market fuel as specified in point 5.1.3.1.1.1 below and nitrogen or air with a 50 ± 15 percent fuel vapour volume. The fuel vapour fill rate must be kept between 60 ± 20 g/h.

The canister(s) is (are) loaded to the corresponding breakthrough. Breakthrough shall be considered as the point at which the cumulative quantity of hydrocarbons emitted is equal to 2 grams. As an alternative, the loading is deemed completed when the equivalent concentration level at the vent hole reaches 3000 ppm.

5.1.3.1.1.1 The E10 market fuel used for this test shall fulfil the same requirements as an E10 reference fuel for the following points:

- Density at 15 °C

[1] Grms: The root mean square (rms) value of the vibration signal is calculated by squaring the magnitude of the signal at every point, finding the average (mean) value of the squared magnitude, then taking the square root of the average value. The resulting number is the Grms metric.

- Vapour Pressure (DVPE)
- Distillation (evaporates only)
- Hydrocarbon analysis (olefins, aromatics, benzene only)
- Oxygen content
- Ethanol content

5.1.3.1.2. The canister(s) shall be purged according the procedure of paragraph 5.1.3.8. of Annex 7 to UN/ECE Regulation No 83. The standard conditions are 273.2 K and 101.33 kPa.

The canister must be purged between 5 minutes to 1 hour maximum after loading.

5.1.3.1.3. The steps of the procedure set out in points 5.1.3.1.1. and .5.1.3.1.2. shall be repeated 50 times, followed by a measurement of the Butane Working Capacity (BWC), meant as the ability of an activated carbon canister to absorb and desorb butane from dry air under specified conditions, in 5 butane cycles, as described in point 5.1.3.1.4 below. The fuel vapour ageing will continue until 300 cycles are reached. A measurement of the BWC in 5 butane cycles, as set out in point 5.1.3.1.4, will be made after the 300 cycles.

5.1.3.1.4. After 50 and 300 Fuel aging cycles, a measurement of BWC is performed. This measurement consists of loading the canister according to paragraph 5.1.6.3., of Annex 7 to UN/ECE Regulation No 83 until breakthrough. The BWC is recorded.

Then, the canister(s) shall be purged according the procedure of paragraph 5.1.3.8. of Annex 7 to UN/ECE Regulation No 83.

The canister must be purged between 5 minutes to 1 hour maximum after loading.

The operation of butane loading is repeated 5 times. The BWC is recorded after each butane loading step. The BWC_{50} is calculated as the average of the 5 BWC and recorded.

In total, the canister(s) will be aged with 300 fuel aging cycles + 10 butane cycles and considered to be stabilized.

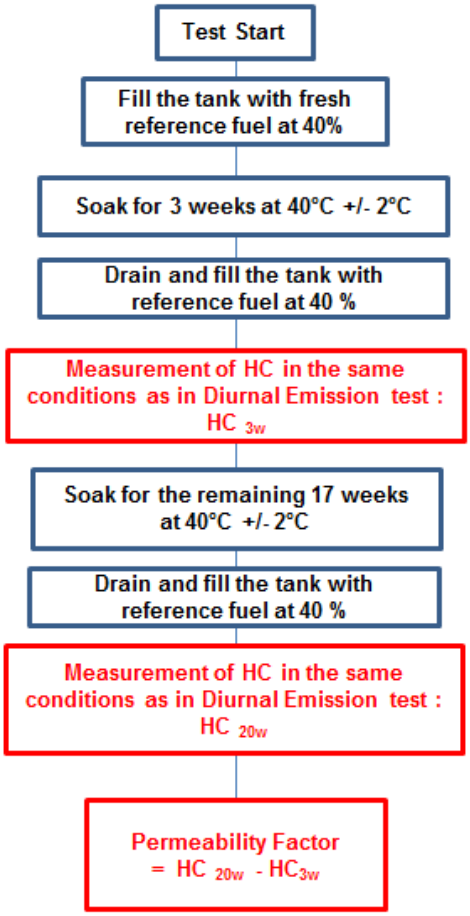
5.1.3.2. If the canister(s) is (are) provided by the Suppliers, the Manufacturers shall inform in advance the Type Approval Authorities to allow them to witness any part of the aging in the Supplier's facilities.

5.1.3.3 The manufacturer shall provide to the Type Approval Authorities a test report including at least the following elements:

- Type of activated carbon,
- Loading rate,
- Fuel specifications,
- BWC measurements

5.2. Determination of the Permeability Factor of the Fuel System (Figure 4)

Figure 4 : Determination of the Permeability Factor



The fuel storage system representative of a family is selected and fixed to a rig, then soaked with E10 reference fuel for 20 weeks at 40°C +/- 2°C. The orientation of the fuel storage system on the rig has to be similar to the original orientation on the vehicle.

5.2.1. The tank is filled with fresh E10 reference fuel at a temperature of 18°C±8 °C. The tank is filled at 40 +/-2 % of the nominal tank capacity. Then, the rig with the fuel system is placed in a specific and secure room with a controlled temperature of 40°C +/-2 °C for 3 weeks.

5.2.2. At the end of the 3rd week, the tank is drained and refilled with fresh E10 reference fuel at a temperature of 18°C±8 °C at 40 +/-2 % of the nominal tank capacity.

Within 6 to 36 hours, the last 6h at 20°C±2°C the rig with the fuel system is placed in a VT-SHED a diurnal procedure is performed over a period of 24 hours, according to the procedure described according to paragraph 5.7. of Annex 7 of UN/ECE Regulation No 83. The fuel system is vented to the outside of the VT-SHED to eliminate the possibility of the tank venting emissions being counted as permeation. The HC emissions are measured and the value is recorded as HC_{3W}.

5.2.3. The rig with the fuel system is placed again in a specific and secure room with a controlled temperature of 40°C +/-2 °C for the remaining 17 weeks.

5.2.4. At the end of the remaining 17th week, the tank is drained and refilled with fresh reference fuel at a temperature of 18°C±8 °C at 40 +/-2 % of the nominal tank capacity.

Within 6 to 36 hours, the last 6h at 20°C±2 °C, the rig with the fuel system is placed in a VT-SHED a diurnal procedure is performed over a period of 24 hours, according to the procedure described according to paragraph 5.7. Annex 7 of UN/ECE Regulation No 83. The fuel system is vented to the outside of the VT-SHED to eliminate the possibility of the tank venting emissions being counted as permeation. The HC emissions are measured and the value is recorded as HC_{20W}.

5.2.5. The Permeability Factor is the difference between HC_{20W} and HC_{3W} in g/24h with 3 digits.

5.2.6. If the Permeability Factor is determined by the Suppliers, the Manufacturers shall inform in advance the Type Approval Authorities to allow witness check in Supplier's facilities.

5.2.7 The manufacturer shall provide to the Type Approval Authorities a test report containing at least the following elements:

a) A full description of the fuel storage system tested, including information on the type of tank tested, whether the tank is monolayer or multilayer and which types of materials are used for the tank and other parts of the fuel storage system,

b) the weekly mean temperatures at which the ageing was performed,

c) the HC measured at week 3 (HC_{3W}),

d) the HC measured at week 20 (HC_{20W})

e) the resulting Permeability Factor (PF)

5.2.8 As an exception to points 5.2.1 to 5.2.7 above, the Manufacturers using multilayer tanks may choose to use the following assigned permeability factor (APF) instead of the complete measurement procedure mentioned above:

APF multilayer tank= 120 mg/24h

5.2.8.1 Where the manufacturer chooses to use Assigned Permeability Factors, the manufacturer shall provide to the Type Approval Authority, a declaration in which the type of tank is clearly specified, as well as a declaration of the type of materials used.

5.3. Sequence of measurement of hot soak and diurnal losses

The vehicle is prepared in accordance to paragraph 5.1.1. and 5.1.2. of Annex 7 of UN/ECE Regulation No 83. At the request of the manufacturer and with the approval of the responsible

authority, non-fuel background emission sources may be removed or reduced before testing (e.g. baking tire or vehicle, removing washer fluid).

5.3.1. Soak

The vehicle is parked for a minimum of 12 hours and a maximum of 36 hours in the soak area. The engine oil and coolant temperatures shall have reached the temperature of the area or within ±3 C of it at the end of the period.

5.3.2. Fuel drain and refill

The fuel drain and refill is performed in accordance to the procedure of paragraph 5.1.7. of Annex 7 of UN/ECE Regulation No 83.

5.3.3. Preconditioning drive

Within one hour from the completing of fuel drain and refill, the vehicle is placed on the chassis dynamometer and driven through one Part One and two Part Two driving cycles of Type I according to Annex 4a to UN/ECE Regulation No 83.

Exhaust emissions are not sampled during this operation.

5.3.4. Soak

Within five minutes of completing the preconditioning operation the vehicle is parked for a minimum of 12 hours and a maximum of 36 hours in the soak area. The engine oil and coolant temperatures shall have reached the temperature of the area or within ±3 C of it at the end of the period.

5.3.5. Canister breakthrough

The canister(s) aged according to the sequence described in paragraph 5.1 is loaded to breakthrough according to the procedure paragraph 5.1.4 of Annex 7 to UN/ECE Regulation No 83.

5.3.6. Dynamometer test

5.3.6.1. Within one hour from completing of canister loading, the vehicle is placed on the chassis dynamometer and driven through one Part One and one Part Two driving cycles of Type I according to Annex 4a to UN/ECE Regulation No 83. Then the engine is shut off. Exhaust emissions may be sampled during this operation but the results shall not be used for the purpose of exhaust emission type approval.

5.3.6.2. Within two minutes of completing the Type I Test drive specified in point 5.3.6.1 the vehicle is driven a further conditioning drive consisting of two Part One test cycles (hot start) of Type I. Then the engine is shut off again. Exhaust emissions need not be sampled during this operation.

5.3.7. Hot Soak

After the Dynamometer test, hot soak evaporative emissions test is performed in accordance to paragraph 5.5 of Annex 7 to UN/ECE Regulation No 83. The hot soak losses result is calculated according to paragraph 6 of Annex 7 to UN/ECE Regulation No 83 and recorded as M_{HS}.

5.3.8. Soak

After hot soak evaporative emissions test, a soak is performed according to paragraph 5.6 of Annex 7 to UN/ECE Regulation No 83.

5.3.9. Diurnal test

5.3.9.1. After the soak, a first measurement of Diurnal Losses over 24 hours is performed according to paragraph 5.7 of Annex 7 to UN/ECE Regulation No 83. Emissions are calculated according to paragraph 6 of Annex 7 to UN/ECE Regulation No 83. The obtained value is recorded as M_{D1}.

5.3.9.2. After the first 24 hours diurnal test, a second measurement of Diurnal Losses over 24 hours is performed according to paragraph 5.7 of Annex 7 to UN/ECE Regulation No 83. Emissions are calculated according to paragraph 6 of Annex 7 to UN/ECE Regulation No 83. The obtained value is recorded as M_{D2}.

5.3.10. Calculation

The result of $M_{HS}+M_{D1}+M_{D2}+2PF$ shall be below the limit defined in Table 3 of Annex 1 to Regulation (EC) No 715/2007.

5.3.11 The manufacturer shall provide to the Type Approval Authorities a test report containing at least the following elements:

a) description of the soak periods, including time and mean temperatures

b) description to aged canister used and reference to exact ageing report

c) mean temperature during the hot soak test

d) measurement during hot soak test, HSL

e) measurement of first diurnal, $DL_{1st\ day}$

f) measurement of second diurnal, $DL_{2nd\ day}$

g) final evaporative test result, calculated as "$M_{HS}+M_{D1}+M_{D2}+2PF$ "