

[<sup>F1</sup>ANNEX VITYPE IV TEST  
THE DETERMINATION OF EVAPORATIVE EMISSIONS  
FROM VEHICLES WITH SPARK-IGNITION ENGINES**Textual Amendments**

- F1** Substituted by [Council Directive of 26 June 1991 amending Directive 70/220/EEC on the approximation of the laws of the Member States relating to measures to be taken against air pollution by emissions from motor vehicles \(91/441/EEC\)](#).

[<sup>F25</sup> TEST PROCEDURE

## 5.1. Test preparation

## 5.1.1. The vehicle is mechanically prepared before the test as follows:

- the exhaust system of the vehicle must not exhibit any leaks,
- the vehicle may be steam cleaned before the test,
- in the case of use of the gasoline canister load option (5.1.5) the fuel tank of the vehicle must be equipped with a temperature sensor to enable the temperature to be measured at the mid-point of the fuel in the fuel tank when filled to 40 % of its capacity,
- additional fittings, adapters or devices may be fitted to the fuel system in order to allow a complete draining of the fuel tank. For this purpose it is not necessary to modify the shell of the tank,
- the manufacturer may propose a test method in order to take into account the loss of hydrocarbons by evaporation coming only from the fuel system of the vehicle.

## 5.1.2. The vehicle is taken into the test area where the ambient temperature is between 293 °K and 303 °K (20 and 30 °C).

## 5.1.3. The ageing of the canister(s) has to be verified. This may be done by demonstrating that it has accumulated a minimum of 3 000 km. If this demonstration is not given, the following procedure is used. In the case of a multiple canister system each canister must undergo the procedure separately.

## 5.1.3.1. The canister is removed from the vehicle. Special care must be taken during this step to avoid damage to components and the integrity of the fuel system.

## 5.1.3.2. The weight of the canister must be checked.

## 5.1.3.3. The canister is connected to a fuel tank, possibly an external one, filled with reference fuel, to 40 % volume of the fuel tank(s).

## 5.1.3.4. The fuel temperature in the fuel tank must be between 283 °K (10 °C) and 287 °K (14 °C).

## 5.1.3.5. The (external) fuel tank is heated from 288 °K to 318 °K (15 ° to 45 °C) (1 °C increase every 9 minutes).

## 5.1.3.6. If the canister reaches breakthrough before the temperature reaches 318 °K (45 °C), the heat source must be turned off. Then the canister is weighed. If the canister did not reach breakthrough during the heating to 318 °K (45 °C), the procedure from 5.1.3.3 must be repeated until breakthrough occurs.

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- 5.1.3.7. Breakthrough may be checked as is described in 5.1.5 and 5.1.6 of this Annex, or with the use of another sampling and analytical arrangement capable of detecting the emission of hydrocarbons from the canister at breakthrough.
- 5.1.3.8. The canister must be purged with  $25 \pm 5$  litres per minute with the emission laboratory air until 300 bed volume exchanges are reached.
- 5.1.3.9. The weight of the canister must be checked.
- 5.1.3.10. The steps of the procedure in 5.1.3.4 to 5.1.3.9 must be repeated nine times. The test may be terminated prior to that, after not less than three ageing cycles, if the weight of the canister after the last cycles has stabilized.
- 5.1.3.11. The evaporative emission canister is reconnected and the vehicle restored to its normal operating condition.
- 5.1.4. One of the methods specified in 5.1.5 and 5.1.6 must be used to precondition the evaporative canister. For vehicles with multiple canisters, each canister must be preconditioned separately.
  - 5.1.4.1. Canister emissions are measured to determine breakthrough.

Breakthrough is here defined as the point at which the cumulative quantity of hydrocarbons emitted is equal to 2 grams.

- 5.1.4.2. Breakthrough may be verified using the evaporative emission enclosure as described in 5.1.5 and 5.1.6 respectively. Alternatively, breakthrough may be determined using an auxiliary evaporative canister connected downstream of the vehicle's canister. The auxiliary canister must be well purged with dry air prior to loading.
- 5.1.4.3. The measuring chamber must be purged for several minutes immediately before the test until a stable background is obtained. The chamber air mixing fan(s) must be switched on at this time.

The hydrocarbon analyser must be zeroed and spanned immediately before the test.

- 5.1.5. Canister loading with repeated heat builds to breakthrough
  - 5.1.5.1. The fuel tank(s) of the vehicle(s) is (are) emptied using the fuel tank drain(s). This must be done so as not to abnormally purge or abnormally load the evaporative control devices fitted to the vehicle. Removal of the fuel cap is normally sufficient to achieve this.
  - 5.1.5.2. The fuel tank(s) is (are) refilled with test fuel at a temperature of between 283 °K to 287 °K (10 to 14 °C) to  $40\% \pm 2\%$  of the tank's normal volumetric capacity. The fuel cap(s) of the vehicle must be fitted at this point.
  - 5.1.5.3. Within one hour of being refuelled the vehicle must be placed, with the engine shut off, in the evaporative emission enclosure. The fuel tank temperature sensor is connected to the temperature recording system. A heat source must be properly positioned with respect to the fuel tank(s) and connected to the temperature controller. The heat source is specified in 4.4. In the case of vehicles fitted with more than one fuel tank, all the tanks must be heated in the same way as described below. The temperatures of the tanks must be identical to within  $\pm 1,5$  °K.
  - 5.1.5.4. The fuel may be artificially heated to the starting diurnal temperature of 293 °K (20 °C)  $\pm 1$  °K.

- 5.1.5.5. When the fuel temperature reaches at last 292 °K (19 °C), the following steps must be taken immediately: the purge blower must be turned off; enclosure doors closed and sealed; and measurement initiated of the hydrocarbon level in the enclosure.
- 5.1.5.6. When the fuel temperature of the fuel tank reaches 293 °K (20 °C) a linear heat build of 15 °K (15 °C) begins. The fuel must be heated in such a way that the temperature of the fuel during the heating conforms to the function below to within  $\pm 1,5$  °K. The elapsed time of the heat build and temperature rise is recorded.

$$T_r = T_0 + 0,2333 \times t$$

where:

- $T_r$  = required temperature (K);  
 $T_0$  = initial temperature (K);  
 $t$  = time from start of the tank heat build in minutes.

- 5.1.5.7. As soon as breakthrough occurs or when the fuel temperature reaches 308 °K (35 °C), whichever occurs first, the heat source is turned off, the enclosure doors unsealed and opened, and the vehicle fuel tank cap(s) removed. If breakthrough has not occurred by the time the fuel temperature 308 °K (35 °C), the heat source is removed from the vehicle, the vehicle removed from the evaporative emission enclosure and the entire procedure outlined in 5.1.7 repeated until breakthrough occurs.

#### 5.1.6. Butane loading to breakthrough

- 5.1.6.1. If the enclosure is used for the determination of the breakthrough (see 5.1.4.2) the vehicle must be placed, with the engine shut off, in the evaporative emission enclosure.
- 5.1.6.2. The evaporative emission canister must be prepared for the canister loading operation. The canister must not be removed from the vehicle, unless access to it in its normal location is so restricted that loading can only reasonably be accomplished by removing the canister from the vehicle. Special care must be taken during this step to avoid damage to the components and the integrity of the fuel system.
- 5.1.6.3. The canister is loaded with a mixture composed of 50 % butane and 50 % nitrogen by volume at a rate of 40 grams butane per hour.
- 5.1.6.4. As soon as the canister reaches breakthrough, the vapour source must be shut off.
- 5.1.6.5. The evaporative emission canister must then be reconnected and the vehicle restored to its normal operating condition.

#### 5.1.7. Fuel drain and refill

- 5.1.7.1. The fuel tank(s) of the vehicle(s) is (are) emptied using the fuel tank drain(s). This must be done so as not to abnormally purge or abnormally load the evaporative control devices fitted to the vehicle. Removal of the fuel cap is normally sufficient to achieve this.
- 5.1.7.2. The fuel tank(s) is (are) refilled with test fuel at a temperature of between 291 °K  $\pm 8$  °K (18  $\pm 8$  °C) to 40  $\pm 2$  % of the tank's normal volumetric capacity. The fuel cap(s) of the vehicle must be fitted at this point.

#### 5.2. Preconditioning drive

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- 5.2.1. Within one hour from the completing of canister loading in accordance with 5.1.5 or 5.1.6 the vehicle is placed on the chassis dynamometer and driven through one Part One and two Part Two driving cycles of Type I test as specified in Annex III. Exhaust emissions are not sampled during this operation.
- 5.3. Soak
- 5.3.1. Within five minutes of completing the preconditioning operation specified in 5.2.1 the engine bonnet must be completely closed and the vehicle driven off the chassis dynamometer and parked in the soak area. The vehicle is parked for a minimum of 12 hours and a maximum of 36 hours. The engine oil and coolant temperatures must have reached the temperature of the area or within  $\pm 3$  °K of it at the end of the period.
- 5.4. Dynamometer test
- 5.4.1. After conclusion of the soak period the vehicle is driven through a complete Type I test drive as described in Annex III (cold start urban and extra urban test). Then the engine is shut off. Exhaust emissions may be sampled during this operation but the results must not be used for the purpose of exhaust emission type-approval.
- 5.4.2. Within two minutes of completing the Type I test drive specified in 5.4.1 the vehicle is driven a further conditioning drive consisting of one urban test cycle (hot start) of a Type I test. Then the engine is shut off again. Exhaust emissions need not be sampled during this operation.
- 5.5. Hot soak evaporative emissions test
- 5.5.1. Before the completion of the conditioning drive the measuring chamber must be purged for several minutes until a stable hydrocarbon background is obtained. The enclosure mixing fan(s) must also be turned on at this time.
- 5.5.2. The hydrocarbon analyser must be zeroed and spanned immediately prior to the test.
- 5.5.3. At the end of the conditioning drive the engine bonnet must be completely closed and all connections between the vehicle and the test stand disconnected. The vehicle is then driven to the measuring chamber with a minimum use of the accelerator pedal. The engine must be turned off before any part of the vehicle enters the measuring chamber. The time at which the engine is switched off is recorded on the evaporative emission measurement data recording system and temperature recording begins. The vehicle's windows and luggage compartments must be opened at this stage, if not already opened.
- 5.5.4. The vehicle must be pushed or otherwise moved into the measuring chamber with the engine switched off.
- 5.5.5. The enclosure doors are closed and sealed gas-tight within two minutes of the engine being switched off and within seven minutes of the end of the conditioning drive.
- 5.5.6. The start of a  $60 \pm 0,5$  minute hot soak period begins when the chamber is sealed. The hydrocarbon concentration, temperature and barometric pressure are measured to give the initial readings  $C_{HC,i}$ ,  $P_i$  and  $T_i$  for the hot soak test. These figures are used in the evaporative emission calculation, section 6. The ambient SHED temperature  $T$  must not be less than 296 °K and no more than 304 °K during the 60-minute hot soak period.
- 5.5.7. The hydrocarbon analyser must be zeroed and spanned immediately before the end of the  $60 \pm 0,5$  minute test period.

- 5.5.8. At the end of the  $60 \pm 0,5$  minute test period the hydrocarbon concentration in the chamber must be measured. The temperature and the barometric pressure are also measured. These are the final readings  $C_{HC,f}$ ,  $P_f$  and  $T_f$  for the hot soak test used for the calculation in section 6.
- 5.6. Soak
- 5.6.1. The test vehicle must be pushed or otherwise moved to the soak area without use of the engine and soaked for not less than 6 hours and not more than 36 hours between the end of the hot soak test and the start of the diurnal emission test. For at least 6 hours of this period the vehicle must be soaked at  $293 \text{ °K} \pm 2 \text{ °K}$  ( $20 \text{ °C} \pm 2 \text{ °C}$ ).
- 5.7. Diurnal test
- 5.7.1. The test vehicle must be exposed to one cycle of ambient temperature according to the profile specified in Appendix 2 with a maximum deviation of  $\pm 2 \text{ °K}$  at any time. The average temperature deviation from the profile, calculated using the absolute value of each measured deviation, must not exceed  $1 \text{ °K}$ . Ambient temperature must be measured at least every minute. Temperature cycling begins when time  $t_{\text{start}} = 0$ , as specified in 5.7.6.
- 5.7.2. The measuring chamber must be purged for several minutes immediately before the test until a stable background is obtainable. The chamber mixing fan(s) must also be switched on at this time.
- 5.7.3. The test vehicle, with the engine shut off and the test vehicle windows and luggage compartment(s) opened must be moved into the measuring chamber. The mixing fan(s) must be adjusted in such a way as to maintain a minimum air circulation of 8 km/h under the fuel tank of the test vehicle.
- 5.7.4. The hydrocarbon analyser must be zeroed and spanned immediately before the test.
- 5.7.5. The enclosure doors must be closed and gas-tight sealed.
- 5.7.6. Within 10 minutes of closing and sealing the doors, the hydrocarbon concentration, temperature and barometric pressure are measured to give the initial readings  $C_{HC,i}$ ,  $P_f$  and  $T_f$  for the diurnal test. This is the point where time  $t_{\text{start}} = 0$ .
- 5.7.7. The hydrocarbon analyser must be zeroed and spanned immediately before the end of the test.
- 5.7.8. The end of the emission sampling period occurs 24 hours  $\pm$  6 minutes after the beginning of the initial sampling, as specified in 5.7.6. The time elapsed is recorded. The hydrocarbon concentration, temperature and barometric pressure are measured to give the final readings  $C_{HC,i}$ ,  $P_f$  and  $T_f$  for the diurnal test used for the calculation in section 6. This completes the evaporative emission test procedure.]]

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#### Textual Amendments

- F2** Substituted by [Directive 98/69/EC of the European Parliament and of the Council of 13 October 1998 relating to measures to be taken against air pollution by emissions from motor vehicles and amending Council Directive 70/220/EEC](#).