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BSI Standards Publication

Petrol vapour recovery during refuelling of motor vehicles at service stations

Part 1: Test methods for the type approval efficiency assessment of petrol vapour recovery systems

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National foreword

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A list of organizations represented on this committee can be obtained on request to its secretary.

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Benzindampf-Rückführung während der Betankung von Kraftfahrzeugen an Tankstellen - Teil 1: Prüfverfahren für die Typzulassung der Effinzienzbewertung von Gasrückführungssystemen

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Foreword

This document (EN 16321-1:2013) has been prepared by Technical Committee CEN/TC 393 “Equipment for storage tanks and for filling stations”, the secretariat of which is held by DIN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by March 2014, and conflicting national standards shall be withdrawn at the latest by March 2014.

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EN 16321, *Petrol vapour recovery during refuelling of motor vehicles at service stations*, is divided into the following parts:

— *Part 1:Test methods for the type approval efficiency assessment of petrol vapour recovery systems*;

— *Part 2: Test methods for verification of vapour recovery systems at service stations*.

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1 Scope

This European Standard specifies the measurement and test methods for the efficiency assessment of petrol vapour recovery systems for service stations (Stage II).

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 228:2012, *Automotive fuels — Unleaded petrol — Requirements and test methods*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
back pressure
differential pressure relative to atmosphere caused by the flow resistance of the petrol vapour recovery return line from the system to the petrol vapour receiving area

3.2
maximum back pressure
differential pressure relative to atmosphere at the outlet of the vapour pump up to which the system operates properly

3.3
basic emission
hydrocarbons (petrol vapour) that are emitted into the environment during refuelling of test tanks without an operating petrol vapour recovery system

3.4
gas volume meter
device for continuous measurement of air or vapour volume

Note 1 to entry: Bellows type gas volume meters are recommended.

3.5
boot measurement method
measurement method whereby the hydrocarbon emissions from the filler neck area of the test tanks that are not retrieved by the petrol vapour recovery system are collected in a collecting device (boot)

3.6
calibration factor of the gas volume meter
specific factor of the gas volume meter used for the data processing when using an external display

3.7
certificate
qualification document confirming that the petrol vapour recovery system meets the requirements of this standard

3.8
correction factor
system dependent factor used to allow calibration and periodic checking of the vapour recovery system under simulated flow conditions using air

3.9
simulated petrol flow method
dry test method
method for determining the petrol vapour/petrol ratio without any fuel flow

3.10
efficiency
ratio between the average values of the hydrocarbon mass recovered to the petrol vapour receiving area and the basic emission

3.11
petrol dispenser
metering pump or dispenser according to EN 13617-1

3.12
petrol meter
measuring instrument to measure the petrol volume flow

3.13
hose assembly
fuel hose complete with an internal vapour tubing or vapour hose and fitted with couplings

[SOURCE: EN 13483:2013, Clause 3]

3.14
nozzle
automatic delivery nozzle which is a manually operated device that controls the flow of fuel during a dispensing operation and includes a spout and an automatic shut-off mechanism

[SOURCE: EN 13012:2012, 3.1]

3.15
pulsing rate
number of pulses generated from 1 l of petrol flow

3.16
proportionality
linearity of the petrol vapour/petrol ratio at different petrol volume flow rates

3.17
residual emission
hydrocarbons (petrol vapour) that are emitted to the environment during refuelling of test tanks with the petrol vapour recovery system operating

3.18
SHED chamber
measuring facility for verification of the test equipment used in determining the basic and residual emission

Note 1 to entry: SHED stands for Sealed Housing for Evaporative Determination.

3.19
test tank
petrol tank and filler neck of a motor vehicle of the representative fleet of motor vehicles, fitted with a plate allowing the interface of the test equipment to be positioned in a similar way as would be achieved with the motor vehicle body

3.20
petrol vapour/petrol ratio
ratio of the recovered volume of petrol vapour/air mixture to the volume of petrol dispensed at the same time

Note 1 to entry: Petrol vapour/petrol ratio expressed in percentage.

3.21
post processing unit
PPU
device for setting and control of the vapour recovery system to simulate petrol flow, to read data, to change settings, to calculate and to indicate results

Note 1 to entry: A hand-held control unit is a post-processing unit.

3.22
collecting device
boot
device to capture the hydrocarbon emissions from the filler neck of the motor vehicle or test tank

3.23
vapour processing unit
unit to process petrol vapour captured during refuelling

Note 1 to entry: The vapour processing unit may exhaust petrol vapour to atmosphere.

3.24
delivery point
dispensing nozzle with associated vapour collection components

3.25
de-activation time
time between the detection of a petrol vapour/petrol ratio error, self-diagnostic error or self-test error, and the delivery point being de-activated

3.26
wet test method
method for determining the petrol vapour/petrol ratio with fuel flow

3.27
air/petrol ratio
ratio of the recovered volume of air to the volume of petrol dispensed at the same time

Note 1 to entry: Air/petrol ratio expressed in percentage.

3.28
gas flow meter
device for measurement of air or vapour flow rate

3.29
maximum petrol volume flow rate
maximum petrol volume flow rate stated by the applicant of the petrol vapour recovery system

Note 1 to entry: Maximum petrol volume flow rate expressed in litre per minute.

4 Requirements

4.1 General

The maximum back pressure stated by the applicant of the petrol vapour recovery system shall be ≥ 1 kPa.

The test equipment placed in the return-line shall not add more back pressure than 1 kPa.

An overview of the performance characteristics and the appropriate tests is given in Table 1.

Table 1 — Performance characteristics

Performance characteristic	Requirement	Subclause	Criterion	Test according to:
efficiency	$\eta \geq 85$ %	4.2	—	5.2
petrol vapour/petrol ratio	individual measurement: 95 % ≤ x ≤ 105 % average value: 98 % ≤ y ≤ 102 %	4.3	—	5.3
proportionality	95 % ≤ z ≤ 105 %	4.4.2 4.4.3	maximum petrol flow rate stated by the applicant petrol volume flow rate (38,0 ± 1,0) l·min^{-1}	5.4
	z ± 5 %	4.4.4	(28,5 ± 1,0) l·min^{-1}	5.4
	z ± 10 %	4.4.5	(19,0 ± 1,0) l·min^{-1}	5.4
	95 % ≤ z ≤ 105 %	4.4.6	(38,0 ± 1,0) l·min^{-1}	5.4
	z ± 10 %	4.4.7	(19,0 ± 1,0) l·min^{-1}	5.4
	$\lvert k_b - k_a \rvert \leq 0{,}03$	4.5.7	petrol volume flow rate (38,0 ± 1,0) l min^{-1}, maximum back pressure and back pressure < 1 kPa	5.5.2, 5.5.3

4.2 Efficiency

When tested in accordance with 5.2 the efficiency of each petrol vapour recovery system shall reach at least 85 %.

4.3 Petrol vapour /petrol ratio

Systems intended to return petrol vapour directly to a storage tank, shall be tested in accordance with 5.3 at a petrol volume flow rate of (38,0 ± 1,0) l·min^{-1}.

Where a petrol vapour recovery pump serves more than one delivery point, the test shall initially be performed on one delivery point with no other delivery points dispensing. The test shall be repeated on the same delivery point with the maximum number of simultaneous delivery points, as stated by the applicant of the vapour recovery system, also delivering fuel. During this test all delivery points shall deliver fuel at a petrol volume flow rate of (38,0 ± 1,0) $l \cdot min^{-1}$.

The individual petrol vapour/petrol ratios shall be ≥ 95 % and ≤ 105 %. The average petrol vapour/petrol ratios of all tests according to 5.3 shall be ≥ 98 % and ≤ 102 %.

For systems which process the petrol vapour, the requirements of 4.6 apply.

4.4 Proportionality

4.4.1 The sequence 4.4.2 to 4.4.12 shall be carried out at a defined back pressure. The defined back pressure shall be the maximum back pressure stated by the applicant of the petrol vapour recovery system measured at a petrol volume flow rate of (38,0 ± 1,0) $l \cdot min^{-1}$.

4.4.2 Where the maximum petrol volume flow rate stated by the applicant of the petrol vapour recovery system is greater than 38,0 $l \cdot min^{-1}$, the petrol vapour recovery system shall be tested at the maximum petrol flow rate according to 5.4 and the result shall be recorded. The petrol vapour/petrol ratio shall be ≥ 95 % and ≤ 105 %.

4.4.3 The petrol vapour recovery system shall be tested according to 5.4 at a petrol volume flow rate of (38,0 ± 1,0) $l \cdot min^{-1}$ and the result shall be recorded. The petrol vapour/petrol ratio shall be ≥ 95 % and ≤ 105 %.

4.4.4 The petrol vapour recovery system shall be tested according to 5.4 at a petrol volume flow rate of (28,5 ± 1,0) $l \cdot min^{-1}$ and the result shall be recorded.

4.4.5 The petrol vapour recovery system shall be tested according to 5.4 at a petrol volume flow rate of (19,0 ± 1,0) $l \cdot min^{-1}$ and the result shall be recorded.

4.4.6 The petrol vapour recovery system shall be tested according to 5.4 at a petrol volume flow rate of (38,0 ± 1,0) $l \cdot min^{-1}$ and the result shall be recorded.

4.4.7 The petrol vapour recovery system shall be tested according to 5.4 at a petrol volume flow rate of (19,0 ± 1,0) $l \cdot min^{-1}$ and the result shall be recorded.

4.4.8 Where the maximum petrol volume flow rate stated by the applicant of the petrol vapour recovery system is greater than 38,0 $l \cdot min^{-1}$, the petrol vapour recovery system shall be tested at the maximum petrol flow rate according to 5.4 and the result shall be recorded. The petrol vapour/petrol ratio shall be ≥ 95 % and ≤ 105 %.

4.4.9 The result of 4.4.4 shall be within ± 5 % of 4.4.3.

4.4.10 The result of 4.4.5 shall be within ± 10 % of 4.4.3.

4.4.11 The result of 4.4.6 shall be within the tolerance of 4.4.3.

4.4.12 The result of 4.4.7 shall be within ± 10 % of 4.4.6.

4.4.13 The sequence 4.4.2 through 4.4.12 shall be repeated at a back pressure < 1 kPa.

4.4.14 The maximum petrol volume flow rate stated by the applicant shall be tested and given in the test certificate.

4.4.15 Where a petrol vapour recovery pump serves more than one delivery point the sequence 4.4.2 through 4.4.13 shall initially be performed with only one delivery point operational. The sequence shall be repeated at the maximum vacuum pressure stated by the applicant of the vapour recovery system. The sequence shall then be repeated at the minimum vacuum pressure stated by the applicant of the vapour recovery system. The maximum number of delivery points stated on the certificate shall not require a vacuum pressure greater than the maximum vacuum pressure used for the tests.

4.5 Correction factor

4.5.1 The petrol vapour recovery system shall be tested according to 5.5.2 at a petrol volume flow rate of (38,0 ± 1,0) l·min^{-1} and maximum back pressure stated by the applicant of the vapour recovery system, the ratio calculated in 5.5.2 is (r_1) and shall be recorded.

4.5.2 The petrol vapour recovery system shall be tested according to 5.5.3 at a petrol volume flow rate of (38,0 ± 1,0) l·min^{-1} and maximum back pressure stated by the applicant of the vapour recovery system, the ratio calculated in 5.5.3 is (r_2) and shall be recorded.

4.5.3 The petrol vapour recovery system shall be tested according to 5.5.2 at a petrol volume flow rate of (38,0 ± 1,0) l min^{-1} and at a back pressure < 1 kPa, the ratio calculated in 5.5.2 is (r_3) and shall be recorded.

4.5.4 The petrol vapour recovery system shall be tested according to 5.5.3 at a petrol volume flow rate of (38,0 ± 1,0) l·min^{-1} and at a back pressure < 1 kPa, the ratio calculated in 5.5.3 is (r_4) and shall be recorded.

4.5.5 The correction factor k_a shall be calculated according to Formula (1) with maximum back pressure and record the result:

$$k_a = \frac{r_2}{r_1} \tag{1}$$

4.5.6 The correction factor k_b shall be calculated according to Formula (2) with a back pressure < 1 kPa and record the result:

$$k_b = \frac{r_4}{r_3} \tag{2}$$

4.5.7 $|k_b - k_a|$ shall be ≤ 0,03.

The correction factor k shall be calculated according to Formula (3) and shall be rounded to two decimal places.

$$k = \frac{k_a + k_b}{2} \tag{3}$$

4.6 Vapour processing unit

Vapour processing units are not mandatory. Vapour processing units may be used in systems which do not return petrol vapour to a storage tank. When vapour processing units are incorporated the exhaust emission hydrocarbon content shall be ≤ 3 % of the input hydrocarbon mass when tested with a state of the art measurement method, e.g. with FID (Flame Ionisation Detector).

5 Measurement and test methods for the assessment of petrol vapour recovery systems at service stations

5.1 General test conditions

It shall be verified that the test equipment and the vapour recovery system under test are free from leaks.

During the measurements, the following parameters and boundary conditions shall be maintained:

a) petrol according to Table 1 of EN 228:2012;

b) petrol temperature (15 ± 5) °C measured at the nozzle outlet;

c) petrol vapour pressure shall be measured before the first test and after the last test. The vapour pressure shall not change by more than ± 10 % from the first measurement;

d) maximum back pressure ± 10 %;

e) ambient air temperature (20 ± 5) °C;

f) test tanks according to Annex A;

g) gas volume meter capable of operating at flow rates of between 10 l min^{-1} and 50 l min^{-1}, having an accuracy of ± 2 %.

5.2 Efficiency test

5.2.1 General

The basis for the calculation of the efficiency shall be the determination of the basic emission and the residual emission. The basic emission shall be measured with the petrol vapour recovery system switched off and the residual emission with the petrol vapour recovery system switched on. The residual emission shall be determined for each test tank in two orientations of the nozzle on the filler neck.

a) Normal position (nozzle trigger guard in the vertical position); and

b) position of the nozzle rotated 45° with respect to the normal position with bottom of the handle pointing to the rear of the car.

The test shall be performed with the maximum back pressure of the vapour recovery system stated by the applicant.

The measurement shall be carried out with a petrol volume flow rate of (38,0 ± 1,0) l·min^{-1}. It shall be carried out twice on each test tank.

If, on an individual test tank, the two test results for the efficiency in % differ by no more than 1,5 %, the average of these results shall be recorded.

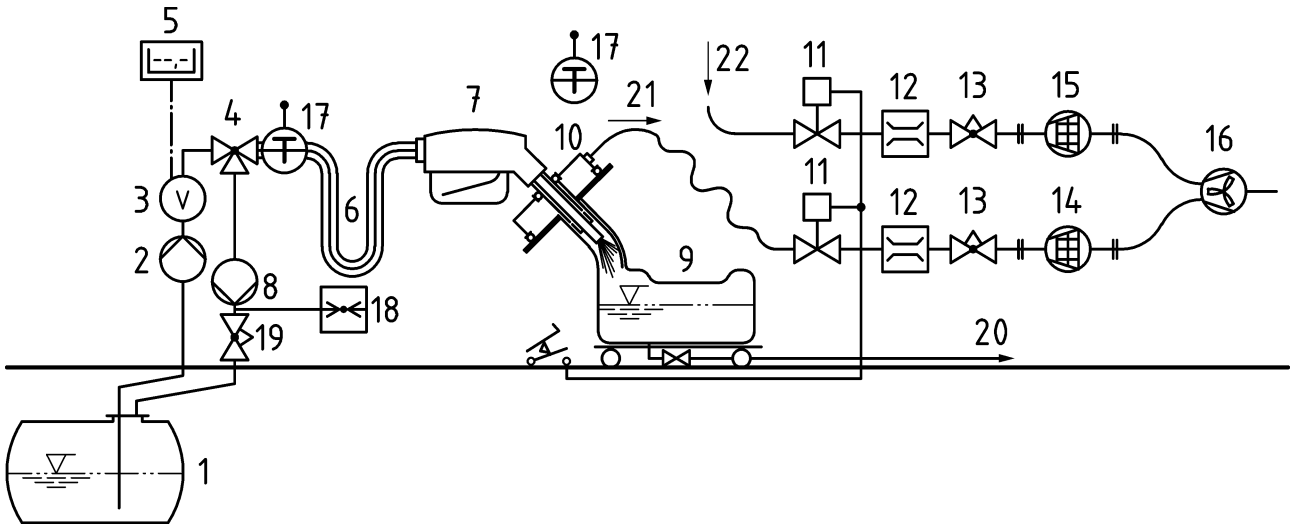
If, on an individual test tank, the two test results for the efficiency in % differ by more than 1,5 % a third measurement shall be carried out. If the third result differs by no more than 1,5 % from the second measurement, then the average of the second and third measurement shall be recorded.

If, on an individual test tank, the third result differs by more than 1,5 % from the second measurement, but differs by less than 1,5 % from the first measurement, then the average of the first and third measurement shall be recorded.

If the third result differs by more than 1,5 % from both the second measurement and the first measurement, then the test has failed.

The efficiency of the vapour recovery system shall be calculated using the average result for each test tank according to 5.2.6.

The basic emission and the residual emission shall be determined by absorption of the emitted hydrocarbons on activated carbon and gravimetric analysis. The hydrocarbons shall be captured at the filler neck, where the emissions occur, using a collecting device (boot), see Figure 1. Before new test equipment is used for testing petrol vapour recovery systems, the performance of the test equipment including a test tank shall be verified by comparative measurements in a SHED chamber.



Key

part of the dispenser

1	underground storage tank	5	petrol volume display
2	petrol pump	6	hose assembly
3	petrol volume meter	7	nozzle
4	splitter valve	8	vapour recovery pump

part of the measuring equipment

9	test tank	16	blower
10	petrol vapour collecting device (boot)	17	temperature measuring device
11	two simultaneous working valves	18	back pressure measurement device
12	gas flow meter	19	mechanical valve for back pressure control
13	valve for gas flow adjustment	20	to the underground storage tank
14	adsorber	21	petrol vapour
15	comparing adsorber	22	air inlet

Figure 1 — Example of the equipment for the determination of the efficiency of petrol vapour recovery systems

5.2.2 Test tanks

The three tanks of motor vehicles according to Annex A shall be used as test tanks or the original motor vehicles may be used.

An example for an installation of a test tank is given in Figure 2.

Figure 2 — Example of a test tank from VW Golf according to Annex A mounted in a frame and fitted with a plate simulating the motor vehicle body in close proximity to the tank filler neck

5.2.3 Test procedure

1) Remove petrol from the tank to below 10 % of the tank capacity.

2) Refuel the tank to a minimum of 90 % tank capacity with the petrol for the test.

3) Remove petrol from the tank to (20 ± 5) % of the tank capacity.

4) Close the filler cap and wait for a dwell time of (20 ± 5) min.

5) Commence tests with the nozzle in the normal position (vertical with handle downwards).

6) With the vapour recovery system turned off, refuel the tank to determine the basic emission. Refuel up to (80 ± 5) % of the tank capacity. The refuelling shall be a single delivery at a petrol flow rate of (38,0 ± 1,0) $l \cdot min^{-1}$.

7) Repeat step 3 and step 4.

8) With the vapour recovery system turned on, refuel the tank to determine the residual emission by refuelling up to (80 ± 5) % of the tank capacity.

9) Repeat step 3 and step 4.

10) Repeat steps 6 to 9 with the same nozzle orientation and same test tank.

11) Repeat steps 6 to 10 with the nozzle position rotated by 45° with bottom of the handle pointing to the rear of the car.

12) Repeat steps 1 to 11 for the other test tanks.

Step 1 to step 4 are intended to prepare the tanks of the test vehicles or the test tanks, in order to establish initial reference conditions for the test.

If the measurements have been interrupted at any point in the above sequence for more than 12 h the next measurement shall be restarted at step 1.

5.2.4 Test refuelling

During test refuelling the nozzle shall be fitted to the boot and shall be fully inserted into the filler neck. The boot shall fit to the plate of the test tank or to the vehicle body. The boot shall not influence the function of the vapour recovery system.

5.2.5 Adsorber

The petrol vapours drawn from the boot are passed through equipment to adsorb the hydrocarbon, e.g. activated carbon adsorber, which completely adsorbs the hydrocarbons. Where activated carbon adsorbers are used, the capacity of the adsorber shall be approximately 10 times the capacity that is required for the anticipated hydrocarbon mass. To compensate for possible adverse effects caused by air humidity variations, a second (comparatively smaller) adsorber shall be connected in parallel to the adsorber used for the petrol vapours. Ambient air is passed through this second adsorber. Both adsorber lines shall be adjusted to the same volume flow rate. Changes in weight of the reference adsorber shall be taken into account in the analysis.

Sequence of operations:

a) Both adsorbers are purged with ambient air.

b) Each carbon adsorber shall be weighed with a resolution of 0,1 g (accuracy class II).

c) The adsorbers are installed into the test equipment and the test refuelling is performed.

d) Immediately after the test refuelling, the adsorbers are re-weighed.

5.2.6 Calculation of the efficiency

The individual measurements for determining the basic and residual emission shall be arithmetically averaged for each series of measurements. The efficiency shall be calculated based on the average values of all tests with the group of test tanks according to Formula (4).

$$\eta = \frac{EB - ER}{EB} \cdot 100 \qquad (4)$$

where

η is efficiency, in %;

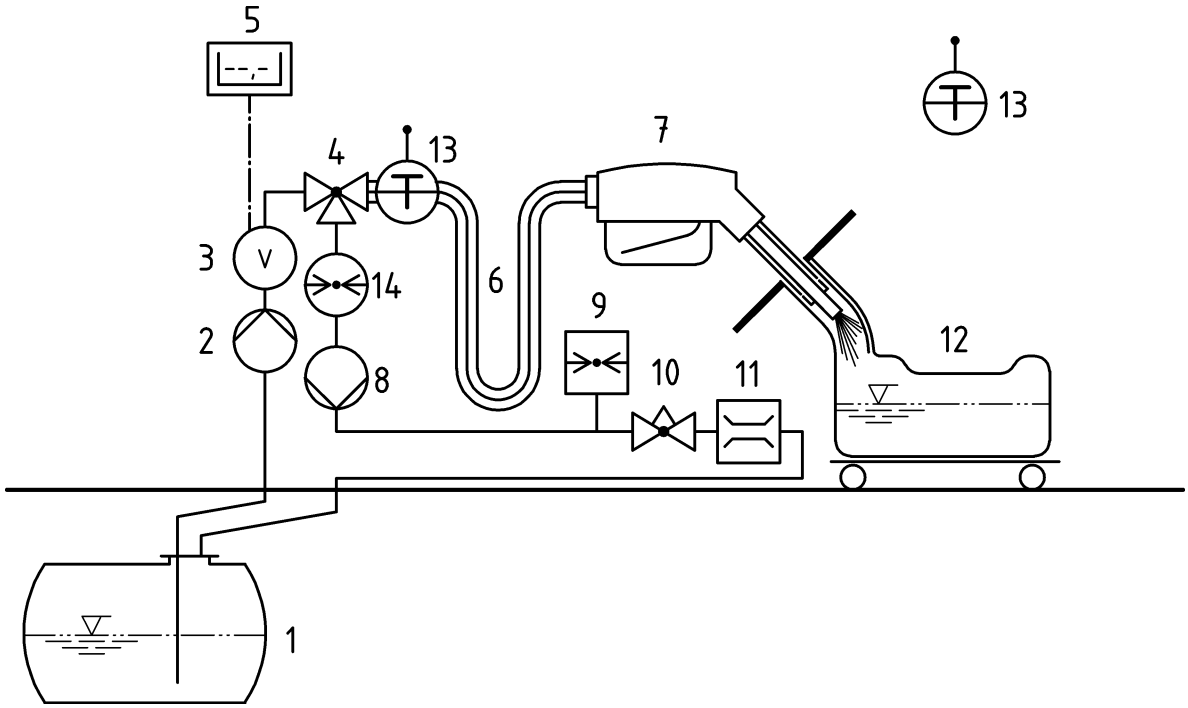
EB is basic emission, in $g \cdot l^{-1}$;

ER is residual emission, in $g \cdot l^{-1}$.

5.3 Petrol vapour/petrol ratio

5.3.1 General

For the test of the petrol vapour/petrol ratio test equipment according to Figure 3 or equivalent shall be used.



Key

part of the test installation

1	underground storage tank	4	splitter valve
2	petrol pump	5	petrol volume display
3	petrol volume meter		

part of the vapour recovery system

6	hose assembly	8	vapour recovery pump
7	nozzle		

part of the test measuring equipment

9	pressure measurement device	12	test tank
10	mechanical valve for back pressure control	13	temperature measuring device
11	gas volume meter	14	vacuum measurement device

Figure 3 — Schematic representation of a measuring set-up (example) for determination of petrol vapour/petrol ratio

5.3.2 Test procedure

1) The test shall be carried out using one test tank selected from Annex A.

2) Remove petrol from the tank to below 10 % of the tank capacity.

3) Refuel the tank to a minimum of 90 % tank capacity with the petrol for the test.

4) Remove petrol from the tank to (20 ± 5) % of the tank capacity.

5) Close the filler cap and wait for a dwell time of (20 ± 5) min.

6) Refuel the petrol tank with a constant petrol volume flow rate of (38,0 ± 1,0) $l \cdot min^{-1}$ for a minimum of 1 min.

7) Measure at the same time the volume of recovered petrol vapour V_v and the volume of petrol V_l which is dispensed and record the data.

8) The test shall be carried out three times with a back pressure of < 0,1 kPa and three times with maximum back pressure stated by the applicant of the petrol vapour recovery system.

9) Calculate the individual ratios and record the results.

10) Calculate the average ratio for tests with a back pressure of < 0,1 kPa and calculate the average ratio for tests with maximum back pressure stated by the applicant of the petrol vapour recovery system and record the results.

5.4 Proportionality test

5.4.1 General

Test equipment according to Figure 3 or equivalent shall be used.

The vacuum pressure shall be measured in the vapour recovery line at a distance of approximately 10x the internal diameter of the vapour recovery line from the vapour inlet of the vapour recovery pump.

The back pressure shall be measured in the vapour recovery line at a distance of approximately 10x the internal diameter of the vapour recovery line from the vapour outlet of the vapour recovery pump.

The tests shall be carried out at the petrol volume flow rate and back pressure according to 4.4.

5.4.2 Test procedure

1) The test shall be carried out using one test tank selected from Annex A.

2) Remove petrol from the tank to below 10 % of the tank capacity.

3) Refuel the tank to a minimum of 90 % tank capacity with the petrol for the test.

4) Remove petrol from the tank to (20 ± 5) % of the tank capacity.

5) Close the filler cap and wait for a dwell time of (20 ± 5) min.

6) Refuel the petrol tank with a constant petrol volume flow rate according to 4.4 for at least 1 min.

7) Measure at the same time the volume of recovered petrol vapour V_v and the volume of petrol V_l which was dispensed and record the data.

8) Calculate the individual ratio $\frac{V_v}{V_l} \cdot 100$ and record the result.

9) Repeat steps 4 to 6 a further 4 times.

10) Calculate from the individual ratios the average ratio.

5.5 Correction factor determination

5.5.1 General

For the setting, self-test and monitoring of the petrol vapour recovery system with a measurement method that determines the petrol vapour recovery rate with ambient air, a correction factor shall be used.

The tests shall be carried out at the petrol volume flow rate and back pressure according to 4.5.

5.5.2 Test with petrol vapour

1) For the test of the petrol vapour/petrol ratio, test equipment according to Figure 3 or equivalent shall be used.

2) The test shall be carried out using one test tank selected from Annex A.

3) Refuel the petrol tank with a constant petrol volume flow rate of (38,0 ± 1,0) $l \cdot min^{-1}$ for at least 1 min.

4) Measure at the same time the volume of recovered petrol vapour V_v and the volume of petrol V_l which was dispensed and record the data.

5) Calculate the individual ratio $\frac{V_v}{V_l} \cdot 100$ and record the results.

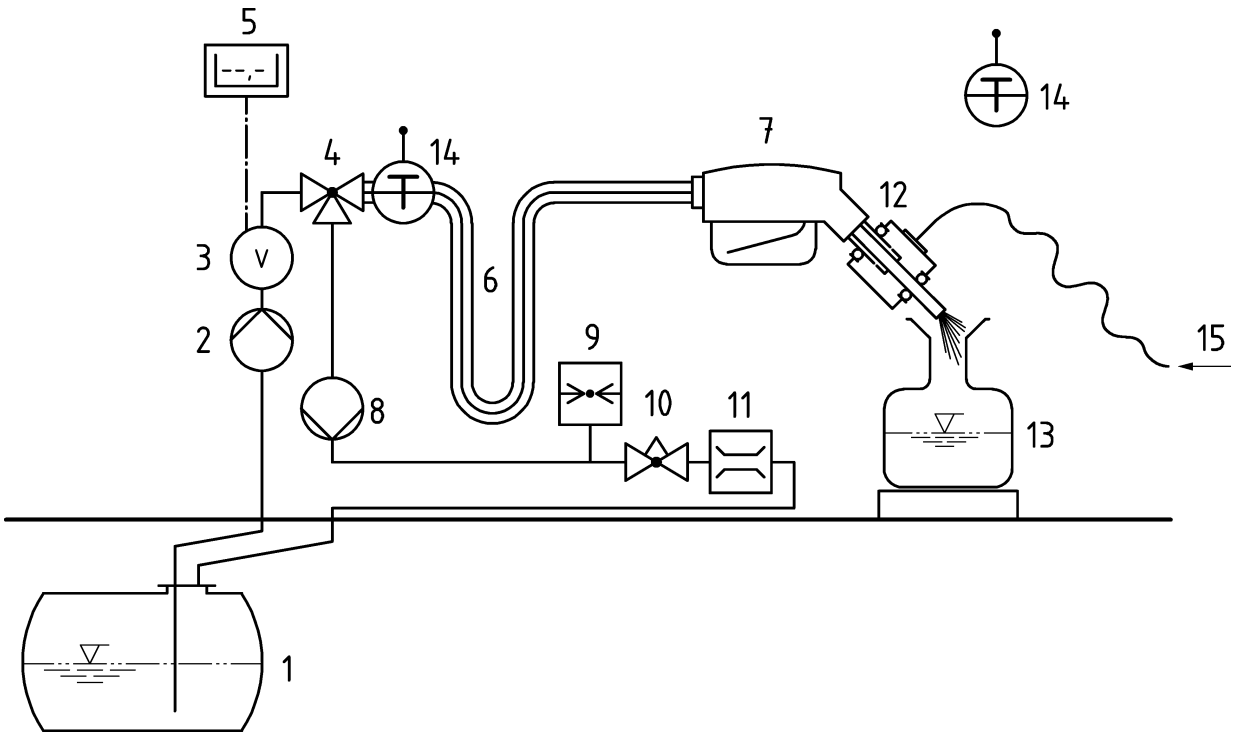
6) Repeat steps 3 to 5 a further 2 times.

7) Calculate the average ratio **(r_1 or r_3)**.

5.5.3 Test with air

To collect the petrol dispensed during this test, any appropriate container is allowed.

For the test of the air/petrol ratio, test equipment according to Figure 4 or equivalent shall be used.



Key

part of the test installation

1	underground storage tank	4	splitter valve
2	petrol pump	5	petrol volume display
3	petrol volume meter		

part of the vapour recovery system

6	hose assembly	8	vapour recovery pump
7	nozzle		

part of the test measuring equipment

9	pressure measurement device	13	collecting facility
10	mechanical valve for back pressure control	14	temperature measuring device
11	gas volume meter	15	air inlet
12	measuring adapter		

Figure 4 — Schematic representation of a measuring set-up (example) for determination of the correction factor

1) Dispense with a constant petrol volume flow rate of (38,0 ± 1,0) l·min^{-1} for a minimum of 1 min.

2) Measure at the same time with the bellows type gas meter the volume of recovered air V_a and the volume of petrol V_l which was dispensed and record the data.

3) Calculate the individual ratio $\frac{V_a}{V_l} \cdot 100$ and record the results.

4) Repeat steps 1 to 3 a further 2 times.

5) Calculate the average ratio **(r_2 or r_4).**

5.6 Retesting criteria for modifications

Retesting criteria for modifications to the petrol vapour recovery system are according to Annex B.

6 Automatic monitoring systems

Where automatic monitoring systems are used they shall meet the requirements according to Annex D.

7 Environmental aspects

Environmental aspects should be considered in accordance with Annex F.

8 Certificate for vapour recovery systems

The certificate shall contain the certification of conformity and at least the following data:

a) Identification of:

   1) the nozzle,

   2) the hose assembly,

   3) the vapour recovery pump, if applicable,

   4) the vapour recovery control valve, if applicable,

   5) the vapour recovery control board, if applicable.

b) Boundary conditions for use, including:

   1) the maximum petrol volume flow rate,

   2) the maximum back pressure in the vapour recovery line,

   3) the correction factor for the system setting with ambient air,

   4) the maximum no. of delivery points.

The format of the certificate shall be according to Annex C.

The format of the verification label should be according to Annex E.

9 Marking

All installed petrol vapour recovery systems shall be marked with information for the subsequent verifications.

NOTE Recommendations for sufficient information are provided in Annex D of EN 16321–2:2013.

Annex A
(normative)

List of representative tanks

Type identification
VW platform “Golf VI” petrol
VW platform “Polo V” petrol
Renault platform “Megane 3” petrol

NOTE Only applicable for tanks that are mounted on cars sold in Europe.

Annex B
(normative)

Retesting criteria for modifications

If the modification has a major impact on the properties of the petrol vapour recovery system according to Table B.1, a new petrol vapour recovery system test shall be carried out. If the modification only affects specific test criteria of the system test, measurements need only be carried out for the relevant system components.

Table B.1 — Decision matrix for the system test with modification or replacement of components

Test criterion **Component**	**Efficiency**	**Correction factor**	**Proportionality**
Nozzle	major	minor	none
Nozzle with proportional valve	major	minor	major
Vapour recovery pump	minor	major	Normally minor. Major for speed controlled pumps
Control valve	minor	major	major
Control board	minor	major	major
Pipe in the dispenser	minor	minor	minor
Hose assembly	minor	major	major
Boundary conditions			
Back pressure	minor	major	major
Petrol volume flow rate	major	major	major
Number of delivery points	major	major	major
Maximum and minimum vacuum pressure in the vapour recovery line in case of more than one delivery point for one vapour pump	major	major	major
Major: re-test is required. Minor: need for re-test shall be assessed in a technical file by the certificate issuer.			

Annex C
(normative)

Certificate format

Certificate No. xx.xxx

The test body for petrol vapour recovery systems certifies having conducted tests according to EN 16321-1 on the following petrol vapour recovery system:

NOTE This certificate does not cover any other construction or performance requirements.

Type of system:	*(Short description of the general function of the system)*
Electronics:	*(Electronics which impact the vapour recovery system performance)*
Nozzle:	*(Type of Nozzle with vapour recovery line)*
Hose assembly:	*(Type of Hose assembly with vapour recovery line)*
Control board:	*(Only in case of electronically controlled PV/P ratio by proportional valve or drive controlled vapour pumps)*
Proportional valve:	*(Type of proportional valve) optional*
Vapour recovery pump:	*(Type of petrol vapour pump)*

Conditions for installation and operation: *(Requirements to ensure system performance in use)*

(mandatory for central systems)

Maximum volume of the vapour recovery line operating in underpressure:	**xxx l**
Minimum diameter of the vapour recovery line:	**x ”/ NB xx**
Maximum no. of simultaneous operating fuelling points under compliance of a vapour recovery rate of 95 % – 105 %:	**xx**
Maximum petrol volume flow rate:	38 **l/min** *or greater*
Maximum back pressure in petrol vapour pump outlet line	
with maximum vapour flow:	1 kPa *(10* mbar) *or greater*
Correction factor for system settings with simulated petrol-flow of 38 $l \cdot min^{-1}$:	**x,xx**
Measured efficiency in %	**XX %**

The vapour recovery system corresponds to the state of the art as defined in the “Directive 2009/126/EC”.

Country, City, date of certification Signatory

Annex D
(normative)

Monitoring system

D.1 General

The applicant shall specify the operating vapour temperature range of the monitoring system. This shall be at least −10 °C to +40 °C.

Where the monitoring system is intended for use with petrol vapour recovery systems with a petrol volume flow rate of greater than 38 $l \cdot min^{-1}$ the applicant shall provide a mode for monitoring petrol vapour recovery systems operating at a petrol volume flow rate of 38 $l \cdot m^{-1}$. This mode shall be used for the tests associated with this annex.

A vapour recovery efficiency error occurs when the petrol vapour/petrol ratio, averaged over the duration of the refuelling operation, is < 85 %, or > 115 %, on 10 consecutive valid refuelling operations.

The applicant shall provide facilities to simulate or induce errors. These shall include simulating or inducing a vapour recovery efficiency error, and simulating or inducing self-test errors.

Self-test errors may include flow meter disconnection or low battery.

A valid refuelling operation is achieved when the vapour flow rate reaches ≥ 25 $l \cdot min^{-1}$ during refuelling, and the refuelling duration is ≥ 20 s before petrol flow completion.

Petrol flow completion has occurred at a time > 60 s after petrol flow is interrupted.

D.2 Requirements

Where the monitoring system is intended for use with petrol vapour recovery systems with a petrol volume flow rate of greater than 38 $l \cdot min^{-1}$,the maximum vapour volume flow rate of the monitoring system shall be greater than (maximum petrol volume flow rate +7 $l \cdot min^{-1}$).

Where the applicant of the monitoring system does not define a maximum vapour volume flow rate for the monitoring system, this flow rate shall be 45 $l \cdot min^{-1}$.

The accuracy of the flow sensor within the monitoring system shall be tested by a gas meter calibration body using a reference meter with an accuracy of better than 0,5 %. The flow sensor shall be tested at an ambient temperature of (20 ± 5) °C with air and with butane. Tests shall be performed at flow rates of 25 $l \cdot min^{-1}$, 30 $l \cdot min^{-1}$, 35 $l \cdot min^{-1}$, 40 $l \cdot min^{-1}$ and the maximum vapour volume flow rate for the monitoring system. All individual test results shall be recorded. No result shall deviate by > 10 % from the reference meter.

The pressure loss created by installing the monitoring system shall be tested in accordance with D.3.1. The difference between the inlet and outlet pressure shall be < 3 kPa.

With a vapour flow rate of (38,0 ± 1,0) $l \cdot min^{-1}$ and a petrol flow rate of (38,0 ± 1,0) $l \cdot min^{-1}$, the monitoring system shall be tested in accordance with D.3.2. The monitoring system shall record the petrol vapour/petrol ratio for each refuelling operation. Each shall have a petrol vapour/petrol ratio between 85 % and 115 %. The monitoring system shall not signal an alarm.

With a vapour flow rate of (30,0 ± 1,0) $l \cdot min^{-1}$ and a petrol flow rate of (38,0 ± 1,0) $l \cdot min^{-1}$, the monitoring system shall be tested in accordance with D.3.2. The monitoring system shall record each refuelling operation to have a petrol vapour/petrol ratio outside the limits of 85 % and 115 %. The monitoring system shall signal an alarm during, or at the end of, the final refuelling associated with each test.

With a vapour flow rate of (46,0 ± 1,0) $l \cdot min^{-1}$ and a petrol flow rate of (38,0 ± 1,0) $l \cdot min^{-1}$, the monitoring system shall be tested in accordance with D.3.2. The monitoring system shall record each refuelling operation to have a petrol vapour/petrol ratio outside the limits of 85 % and 115 %. The monitoring system shall signal an alarm during, or at the end of, the final refuelling associated with each test.

A hardware fault shall be induced and the monitoring system shall be tested in accordance with D.3.3. The monitoring system shall signal an alarm each time an error is induced.

When tested in accordance with D.3.4 the monitoring system shall not de-active the delivery point prior to the programmed de-activation time. The delivery point shall be de-activated after the de-activation time. It shall be verified that the de-activation time cannot be set to a value of greater than 168 h.

D.3 Measurement and test methods

D.3.1 Test for pressure loss

The test gas shall be air. Tests shall be performed at an ambient temperature of (20 ± 5) °C.

The monitoring system shall be installed with pipework connected to the inlet and outlet of the system. The internal pipe diameter shall be ≤ 15 mm and ≥ 6 mm. The airflow through the monitoring system may be provided by a pump and shall be measured with a gas flow meter with an accuracy of maximum 0,5 %. The vapour flow rate shall be maintained at the maximum vapour volume flow rate stated by the applicant of the monitoring system. The pressure shall be measured at the inlet and outlet of the monitoring system. The difference between the inlet and outlet pressure shall be recorded.

D.3.2 Test for detection of a vapour recovery efficiency error

The test gas shall be air and it shall be ensured that no condensate of water occurs during the test. The refuelling operation may be simulated or performed with petrol.

Tests shall be performed at an ambient temperature of (20 ± 5) °C.

For monitoring systems which are part of self-calibrating vapour recovery systems, the self-calibrating feature shall be turned off for this test.

The airflow through the monitoring system may be provided by a pump and shall be measured with a gas flow meter with an accuracy of maximum 0,5 %. A single test shall comprise 10 refuelling operations. Each refuelling operation shall be of duration > 20 s, and < 150 s. After each refuelling operation, the status of whether the monitor deems the vapour recovery efficiency to be within the limits of 85 % to 115 % shall be indicated and recorded. The alarm status shall also be indicated and recorded.

The test shall be performed 3 times. The alarm status shall be reset between tests.

D.3.3 Test for an alarm when the monitor detects an error during a self-test

A hardware error shall be induced or simulated in accordance with applicant's instructions. Where an error requires a refuelling operation to take place in order to detect the error, the refuelling operation may be simulated or performed with petrol. The alarm status shall be recorded after each error induced. The alarm status shall be reset between tests.

D.3.4 Test for de-activation of a delivery point

The de-activation time for the monitoring system may be reduced to 12 h for the test.

Refuelling operations during the test may be simulated or performed with petrol.

An error shall be created by inducing or simulating a vapour recovery efficiency error or by inducing or simulating a self-test error. An alarm shall be signalled.

During the test period, power shall be removed from the monitoring system for a minimum of 1 h. This shall be completed at least 1 h prior to the end of the test.

A refuelling operation shall be simulated (600 ± 5) s prior to the de-activation time, and the status of the delivery point shall be recorded.

A refuelling operation shall be simulated (600 ± 5) s after the de-activation time, and the status of the delivery point shall be recorded.

D.4 Example monitoring system certificate

Certificate No. xx.xxx EU

The test body for petrol vapour monitoring systems,
certifies having conducted tests according to EN 16321-1:

On the following petrol vapour monitoring system:

NOTE This certificate does not cover any other construction or performance requirements.

Type of system: *(Short description of the general function of the system)*

Manufacturer

System components

Gas flow sensor

Other components

Approved for use with

Country, City, date of certification Signatory

Annex E
(informative)

Identification of petrol vapour recovery systems

The verification label should have the following information:

Petrol vapour recovery system according to EN XXX
Installer or modifier: **Date of installation or modification:** ☐ **Pulsing rate: ——–** ☐ **Data: ——-** ☐ **Mechanical system** **k-factor:** **Certificate no.:**

If a specific test method is required by the certificate this method should be mentioned on the label.

Annex F
(informative)

Environmental aspects

F.1 The number of tests should be as few as necessary for the certification.

F.2 Wherever possible air should be used for the tests instead of petrol vapour.

F.3 Where a simulated test is allowed this test should be used instead of a test with petrol.

F.4 When used for test purposes petrol should be used as often as possible before disposal.

F.5 Used petrol should be disposed of in accordance with national law.

F.6 The test equipment should be designed in a way to minimise unintended petrol vapour emissions.

F.7 The design and the use of the test equipment should minimise spillage of petrol.

F.8 Maximum use should be made of high efficiency motors, lighting and displays.

F.9 Components intended to move in normal use, for example motors and pumping units, should be selected and mounted to minimise noise and vibration.

Bibliography

[1] EN 13012:2012, *Petrol filling stations — Construction and performance of automatic nozzles for use on fuel dispensers*

[2] EN 13483:2013, *Rubber and plastic hoses and hose assemblies with internal vapour recovery for measured fuel dispensing systems — Specification*

[3] EN 13617-1, *Petrol filling stations — Part 1: Safety requirements for construction and performance of metering pumps, dispensers and remote pumping units*

[4] EN 16321-2:2013, *Petrol vapour recovery during refuelling of motor vehicles at service stations — Part 2: Test methods for verification of vapour recovery systems at service stations*

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