
**Motorcycles — Measurement method
for evaporative emissions —**

**Part 2:
Permeation test procedure**

*Motocycles — Méthode de mesure pour les émissions par
évaporation —*

Partie 2: Méthode d'essai de perméation

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 22, *Road Vehicles*, Subcommittee SC 38, *Motorcycles and mopeds*.

A list of all parts in the ISO 21755 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

This document specifies the measurement method for evaporative emissions from motorcycles by using a permeation test procedure. However, the amount of permeation from a non-metallic fuel tank is generally larger than that from a metallic fuel tank. Therefore, this document also specifies a permeability test procedure in an informative annex solely for non-metallic fuel tanks as optional. This permeability test procedure is expected to be used also by fuel tank manufacturers.

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Motorcycles — Measurement method for evaporative emissions —

Part 2: Permeation test procedure

1 Scope

This document specifies a basic measurement method by using a permeation test procedure for evaporative emissions from motorcycles. It is applicable to motorcycles equipped with a fuel tank to store liquid high volatile fuel and with a spark ignition engine (four-stroke engine, two-stroke engine or rotary piston engine).

2 Normative references

There are no normative references in this document.

3 Terms and definitions

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <http://www.electropedia.org/>

3.1

permeability

losses through the walls of the non-metallic fuel tank

3.2

permeation

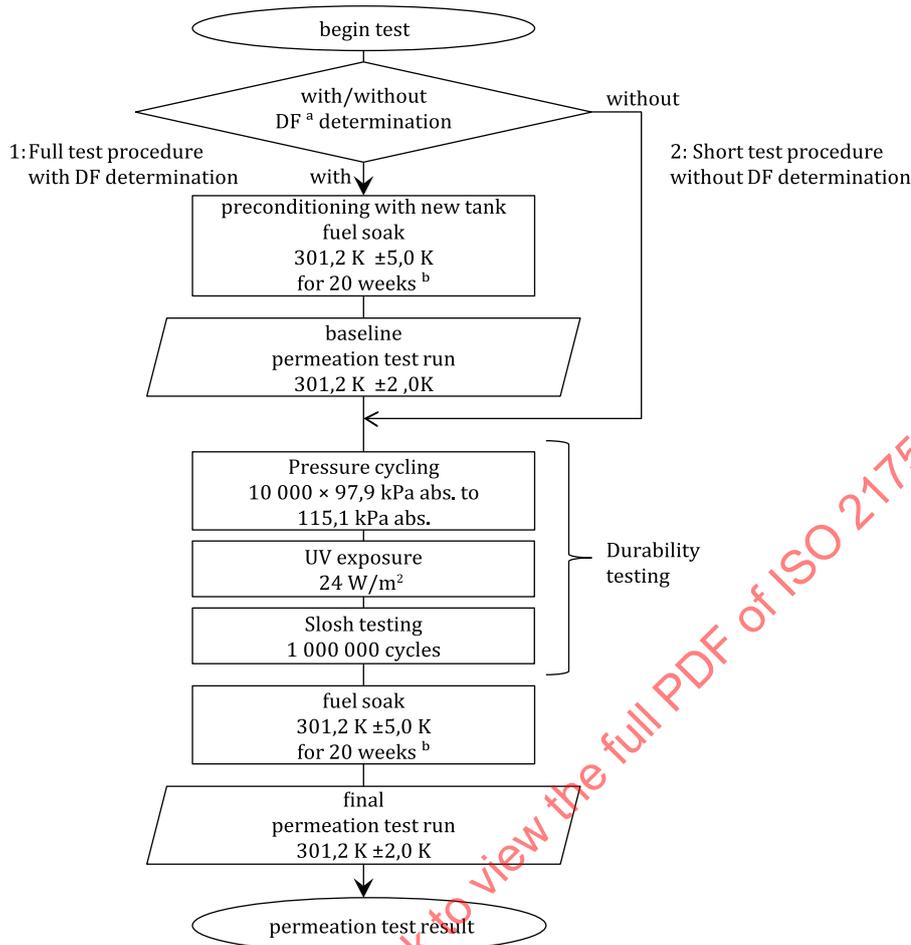
losses through the walls of the fuel tank and fuel line assembly

4 Fuel tank and fuel line assembly permeation test procedure

4.1 Description of the fuel tank permeation test

4.1.1 Measure permeation emissions by weighing a sealed fuel tank before and after a temperature-controlled soak according to the following flow charts (see [Figure 1](#)).

4.1.2 Fuel tank description shall be described in accordance with B.1.



Key

- a DF is the deterioration factor.
- b The length of "soak" during durability testing may be included in the fuel soak period provided that fuel remains in the tank. Soak periods can be shortened to 10 weeks if performed at 316,2 K ± 5,0 K.

Figure 1 — Flow chart of fuel tank permeation full and short tests

4.2 Test fuel

The test fuel shall be selected in accordance with agreement among the parties involved or the manufacturer's requirements and the specifications of test fuel shall be reported. An example of the record form is given in B.2.

4.3 Preconditioning fuel soak for the fuel tank permeation test

To precondition the fuel tank in the fuel tank permeation test, the following five steps shall be followed:

4.3.1 The tank shall be filled with reference fuel specified in 4.2 and sealed. The filled tank shall be soaked at an ambient temperature of 301,2 K ± 5,0 K for 20 weeks or at 316,2 K ± 5,0 K for 10 weeks.

4.3.2 The fuel tank's internal surface area shall be determined in square metres accurate to at least three significant figures. The manufacturer may use less accurate estimates of the surface area if it is ensured that the surface area will not be overestimated.

4.3.3 The fuel tank shall be filled with the reference fuel to its nominal capacity.

4.3.4 The tank and fuel shall equilibrate to $301,2\text{ K} \pm 5,0\text{ K}$ or $316,2\text{ K} \pm 5,0\text{ K}$ in the case of the alternative short test.

4.3.5 The fuel tank shall be sealed using fuel caps and other fittings (excluding petcocks) that can be used to seal openings in a production fuel tank. In cases where openings are not normally sealed on the fuel tank (such as hose-connection fittings and vents in fuel caps), these openings may be sealed using non-permeable fittings such as metal or fluoropolymer plugs.

4.4 Fuel tank permeation test procedure

To run the test, the following steps shall be taken for a tank preconditioned as specified in [4.3](#).

4.4.1 Weigh the sealed fuel tank and record the weight in milligrams. This measurement shall be taken within 8 h of filling of the tank with test fuel.

4.4.2 The tank shall be placed in a ventilated, temperature-controlled room or enclosure.

4.4.3 The test room or enclosure shall be closed and sealed and the test time shall be recorded.

4.4.4 The test room or enclosure temperature shall be continuously maintained at $301,2\text{ K} \pm 5,0\text{ K}$ for 14 days. This temperature shall be continuously monitored and recorded.

4.5 Fuel tank permeation test result calculation

4.5.1 At the end of the soak period, the weight in milligrams of the sealed fuel tank shall be recorded. Unless the same fuel is used in the preconditioning fuel soak and the permeation test run, weight measurements shall be recorded on five separate days per week of testing. The test is void if a linear plot of tank weight vs. test days for the full soak period for permeation testing yields a linear regression correlation coefficient $r^2 < 0,8$.

4.5.2 The weight of the filled fuel tank at the end of the test shall be subtracted from the weight of the filled fuel tank at the beginning of the test.

4.5.3 The difference in mass shall be divided by the internal surface area of the fuel tank.

4.5.4 The result obtained in [4.5.3](#), expressed in mg/m^2 , shall be divided by the number of test days to calculate the $(\text{mg}/\text{m}^2)/\text{day}$ emission rate and rounded to integer value.

4.5.5 In cases where permeation rates during a soak period of 14 days are not long enough to be able to measure significant weight changes, the period may be extended by a maximum of 14 additional days. In this case, the test steps in [4.5.2](#) to [4.5.4](#) shall be repeated to determine the weight change for the full 28 days.

4.5.6 Determination of the deterioration factor when applying the full permeation test procedure

The deterioration factor (DF) shall be determined from any of the following choices:

- the ratio between the final permeation and baseline test runs;
- fixed DF for total hydrocarbons regulated in each country.

4.5.7 Determination of the final tank permeation test results

4.5.7.1 Full test procedure

To determine the permeation test result, the deterioration factor determined in 4.5.6 shall be multiplied by the measured permeation test result determined in 4.5.4.

4.6 Fuel tank durability testing

4.6.1 A separate durability demonstration for each substantially different combination of treatment approaches and fuel tank materials shall be performed by taking the following steps.

4.6.1.1 Pressure cycling

A pressure test shall be conducted by sealing the tank and cycling it between 115,1 kPa absolute pressure and 97,9 kPa absolute pressure and back to 115,1 kPa absolute pressure for 10 000 cycles at a rate of 60 s per cycle.

4.6.1.2 UV exposure

A sunlight exposure test shall be conducted by exposing the fuel tank to an ultraviolet light of at least 24 W/m² (0,40 (W·h/m²)/min) on the tank surface for at least 450 h. Alternatively, the non-metallic fuel tank may be exposed to direct natural sunlight for an equivalent period of time, as long as it is ensured that it is exposed to at least 450 daylight hours.

4.6.1.3 Slosh testing

A slosh test shall be conducted by filling the non-metallic fuel tank to 40 % of its capacity with the reference fuel set out in 4.2 or with a commercial premium-grade fuel at the choice of the manufacturer. The fuel tank assembly shall be rocked at a rate of 15 cycles per minute until 1 000 000 total cycles are reached. An angle deviation of +15° to -15° from level shall be used and the slosh test shall be conducted at an ambient temperature of 301,2 K ± 5,0 K.

4.6.2 Final fuel tank durability test results

Following the durability testing, the fuel tank shall be soaked according to the requirements specified in 4.3 to ensure that the permeation rate is stable. The period of slosh testing and the period of ultraviolet testing may be considered to be part of this soak, provided that the soak begins immediately after the slosh testing. To determine the final permeation rate, the fuel tank shall be drained and refilled with fresh reference fuel set out in 4.2. The permeation test run laid down in 4.4 shall be repeated immediately after this soak period. The same test fuel requirement shall be used for this permeation test run as for the permeation test run conducted prior to the durability testing. The final test results shall be calculated in accordance with 4.5.

4.6.3 The length of 'soak' during durability testing may be included in the fuel soak period provided that fuel remains in the tank. Soak periods may be shortened to 10 weeks if performed at 316,2 K ± 5,0 K.

4.7 Fuel line assembly test requirements

4.7.1 Fuel line assembly permeation physical testing procedure

The manufacturer shall conduct a fuel line assembly test, including the fuel hose clamps and the material to which the fuel lines are connected on both sides, by performing a physical test in accordance with the requirements in 4.6.2 to 4.6.3. The piping material to which the fuel lines are connected at both sides of the fuel line shall be plugged with impermeable material. The fuel hose clamps shall be tightened with the torque specified for series production.

4.7.2 Final fuel line assembly durability test results

Following the durability testing, the fuel line assembly shall be soaked according to the requirements specified in 4.3 to ensure that the permeation rate is stable. The period of slosh testing and the period of ultraviolet testing may be considered to be part of this soak, provided that the soak begins immediately after the slosh testing. To determine the final permeation rate, the fuel line assembly shall be drained and refilled with fresh reference fuel set out in 4.2. The permeation test run laid down in 4.4 shall be repeated immediately after this soak period. The same test fuel requirement shall be used for this permeation test run as for the permeation test run conducted prior to the durability testing. The final test results shall be calculated in accordance with 4.5.

4.7.3 The length of 'soak' during durability testing may be included in the fuel soak period provided that fuel remains in the tank. Soak periods may be shortened to 10 weeks if performed at $316,2 \text{ K} \pm 5,0 \text{ K}$.

5 Presentation of results

Results of permeation test shall be reported in B.3.

6 Fuel tank permeability test procedure (optional)

Fuel tank permeability test procedure (optional) is shown in Annex A. Results of permeability test shall be reported in B.4.

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Annex A (informative)

Fuel tank permeability test procedure

A.1 General

This annex specifies an optional permeability test procedure solely for non-metallic fuel tanks.

A.2 Fuel tank permeability test

A.2.1 Test method

A.2.1.1 Test temperature

The fuel tank shall be tested at a temperature of $313,2 \text{ K} \pm 2,0 \text{ K}$.

A.2.1.2 Test fuel

The test fuel shall be selected in accordance with agreement among the parties involved or the manufacturer's requirements and the specifications of test fuel shall be reported. An example of the record form is given in [B.2](#).

A.2.1.3 Test conditions

The motorcycle is mechanically prepared before the test as follows:

- a) close the fuel outlet and fill the tank with standard fuel up to 50 % of the nominal capacity;
- b) close the fuel cap and leave the breather valve open;
- c) store the fuel tank inside a constant-temperature oven with an ambient temperature of $313,2 \text{ K} \pm 2,0 \text{ K}$ for a minimum of 4 weeks;
- d) empty the tank and refill it with new standard fuel to 50 % the nominal capacity;
- e) close the fuel cap and leave the breather valve open;
- f) store the fuel tank inside a constant-temperature oven with an ambient temperature of $313,2 \text{ K} \pm 2,0 \text{ K}$ and monitor the fuel temperature inside the tank;
- g) when the fuel temperature reaches $313,2 \text{ K} \pm 2,0 \text{ K}$, open the fuel cap once, and then, close both the cap and the breather valve.

A.2.1.4 Test method

- a) Store the tank at an ambient temperature of $313,2 \text{ K} \pm 2,0 \text{ K}$ and measure fuel loss taking place during the test period of 8 weeks;
- b) Pressure increase inside the tank during testing may be corrected. Fuel loss caused by pressure compensation shall be included in the loss under [A.2.1.4 a\)](#);
- c) Measure fuel loss in milligrams or grams at the beginning and at the end of the 8-week test;

- d) When the results of the test specified in [A.2.1.4](#) a) do not satisfy the target, repeat the test on the same fuel tank at an ambient temperature of $296,2 \text{ K} \pm 2,0 \text{ K}$.

A.2.2 Fuel tank permeability test conducted with internal pressure compensation

If the fuel tank permeability test is conducted with internal pressure compensation, which shall be noted in the test report, the fuel loss resulting from the pressure compensation shall be taken into account when the diffusion loss is calculated.

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Annex B (normative)

Presentation of the results

B.1 Fuel tank description

Tradename (-mark):

Model:

Test motorcycle manufacturer:

Fuel tank manufacturer:

Fuel tank manufacturing method:

Material of fuel tank:

Total rated capacity:

B.2 Test fuel

Make and name:

Research octane number (RON) or motor octane number (MON):

Relative density at 288 K: g/cm³

Reid vapour pressure: kPa

Distillation:

Initial boiling point: K

10 % (volume): K

50 % (volume): K

90 % (volume): K

Final boiling point: K

Residue: volume %

Oxidation stability: minute

Existent gum: mg/100 mL

Sulphur content: mg/kg

Lead content: mg/L

Benzene: volume %