
**Road vehicles — Detection of exhaust
system leaks — Helium test method and
detection device specification**

*Véhicules routiers — Détection des fuites du dispositif
d'échappement — Méthode d'essai à l'hélium et spécification du
dispositif de détection*

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ISO 16247 was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 5, *Engine tests*.

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Road vehicles — Detection of exhaust system leaks — Helium test method and detection device specification

1 Scope

This International Standard specifies a helium test method for detecting and localizing gas leaks in the exhaust systems of road vehicles equipped with an internal combustion engine, in order to improve the quality of exhaust gas measurements. In doing so, it completes the requirements of ISO 3929, applicable regulations and, depending on the leak rate to be detected, ISO 13556. The method is particularly applicable for use in automotive workshops, by end-of-line of automotive and exhaust parts manufacturers, in laboratories prior to exhaust emission tests, and in testing and diagnosis stations.

2 Normative references

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

ISO 3929, *Road vehicles — Measurement methods for exhaust gas emissions during inspection or maintenance*

3 Terms and definitions

ISO 16247:2004

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

3.1

exhaust system

all parts between the joint face of the cylinder head(s) and the outlet pipe(s)

3.2

leak

outward exhaust gas flow or inward air flow which can affect the exhaust emissions measurement result

3.3

tracer gas

gas used for detecting leaks

NOTE The method specified by this International Standard uses helium as the tracer gas.

3.4

detection device

device designed to detect low concentrations of specified tracer gas and so facilitate the location of leaks

3.5

pressurisation device

device used to keep the exhaust system at the pre-determined pressure

3.6

restriction and calibration device

device designed to increase the pressure in the exhaust line, in order to facilitate the detection and localization of leaks, and to gauge the exhaust line involving tracer gas introduced by a plugged outlet

3.7

detection time

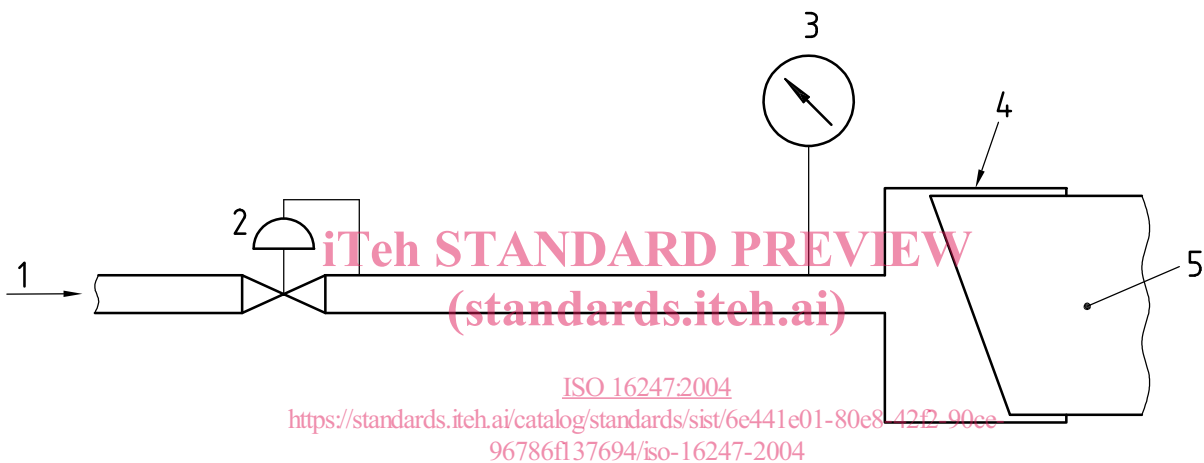
time needed to obtain a signal useful for the operator which indicates a leak equivalent to a 0,1 mm diameter hole with the engine running at idle speed and 2 % helium (He) in the exhaust gas flow

4 Apparatus

4.1 Equipment for auditive detection

This shall consist of the following.

4.1.1 Pressurization device, comprising the following (see Figure 1).



Key

- 1 air
- 2 pressure regulator
- 3 manometer
- 4 flexible connecting device
- 5 exhaust outlet

Figure 1 — Pressurization device

4.1.1.1 Supply of clean, dry, oil-free and compressed air, capable of maintaining the pressure given in 5.2 b).

4.1.1.2 Adjustable pressure regulator, with a limit of 40 kPa(= 0,4 bar)¹⁾.

4.1.1.3 Manometer, suitable and having an accuracy of ± 2 %.

4.1.1.4 Flexible, leak-proof connecting device, used to connect the pressurization device to the exhaust outlet, and adaptable to external or internal exhaust outlet tubing.

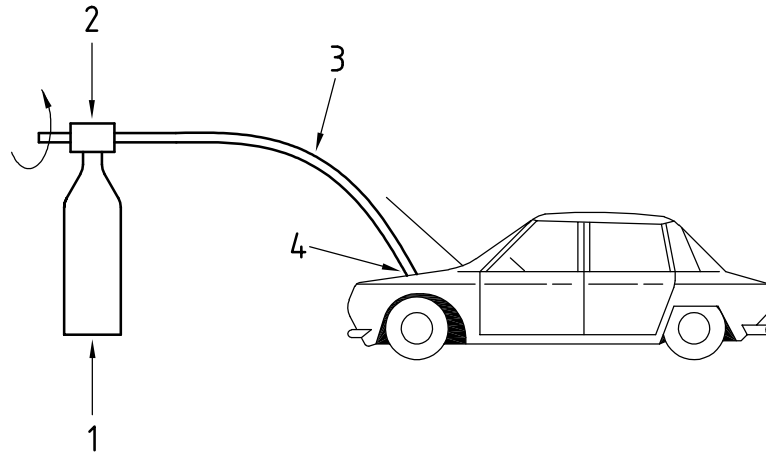
For exhaust systems with multiple outlets, each outlet shall be pressurized and tested separately. Outlets not pressurized shall be plugged.

1) 1 bar = 0,1 MPa = 10⁵ Pa; 1 MPa = 1 N/mm²

4.2 Equipment for helium detection

This shall consist of the following.

4.2.1 Tracer gas injection device, comprising the following (see Figure 2).



Key

- 1 gas bottle
- 2 flow-rate adjusting device
- 3 gas injection pipe
- 4 engine air intake

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Figure 2 — Helium injection device

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4.2.1.1 Industrial helium gas bottle, with gas flow-rate adjusting device.

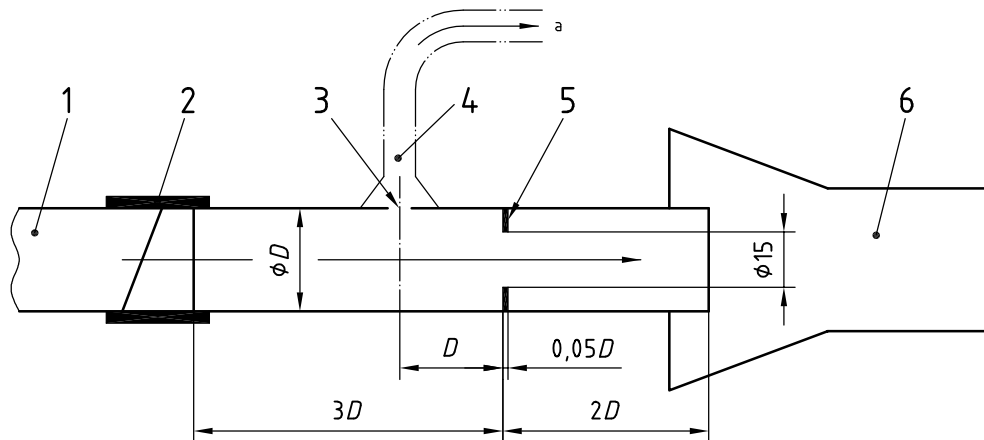
4.2.1.2 Gas injection pipe, to be connected to the engine air intake.

4.2.2 Connecting device for connecting the restriction and calibration device (4.2.3), adaptable to external or internal exhaust outlet tubing, and sufficiently flexible and leak-proof.

4.2.3 Restriction and calibration device, its restriction part being used to add 3 kPa (= 0,03 bar) pressure in the exhaust line, in order to make all leaks from the exhaust line positive compared to the initial state and render the detection more convenient, and its calibration part constituted by a 1 mm diameter calibrated hole for adjusting the helium concentration needed during the leak check.

NOTE Generally, in order to obtain a pressure increase of 3 kPa (= 0,03 bar), it is sufficient to reduce the exhaust outlet section to 15 mm with a section reducer.

See Figure 3.



Key

- 1 exhaust outlet
- 2 flexible connecting device
- 3 1 mm diameter calibrated hole
- 4 sampling line
- 5 restriction device
- 6 gas outlet

^a To the helium detector.

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Figure 3 — Restriction and calibration device

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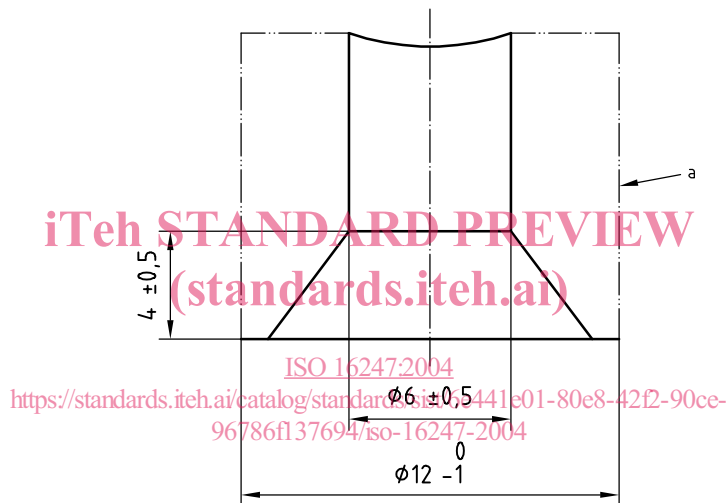
4.2.4 Detection device, having the following characteristics and requirements.

- All components of its gas handling system shall be made of corrosion-resistant material, the material employed for the line shall not retain helium, and the material of the sampling probe shall withstand the exhaust gas temperature (200 °C) and shall be rigid.
- It shall have both a handheld display and an audio leak indicator.
- The sampling line tube length shall be at least 6 m.
- The sampling probe (see Figure 4) shall guarantee the accessibility to any area around the exhaust system.
- The sampled gas flow shall be filtered to remove any water and dust.
- The equipment shall provide a warning message to the operator when the sampled flow is insufficient.
- There shall be a 20 000 µl/l (= 20 000 ppm by volume)²⁾ helium (He) mark on the display (see Figure 5).
- The detection device shall have
 - 1) a detection time ≤ 5 s,
 - 2) sensitivity only to helium,
 - 3) a capacity to detect a calibrated leak of 1 mm diameter under optimal detection conditions, with the engine running at the idle speed and 20 000 µl/l (= 20 000 ppm by volume) helium in the exhaust gas flow,

2) "Parts per million (ppm)" is a deprecated unit, i.e. not accepted by the International System of Units, SI. It is used exceptionally in this International Standard, in parentheses, immediately following the SI unit of equivalent value in order to correspond to other, closely related and already published, standards. The accepted SI form for the expression of a volume fraction is in units of microlitres per litre (µl/l), or, alternatively, as 10⁻⁶ or as a percentage volume fraction (% volume fraction). See ISO 31-0:1992, 2.3.3, and ISO 31-8:1992.

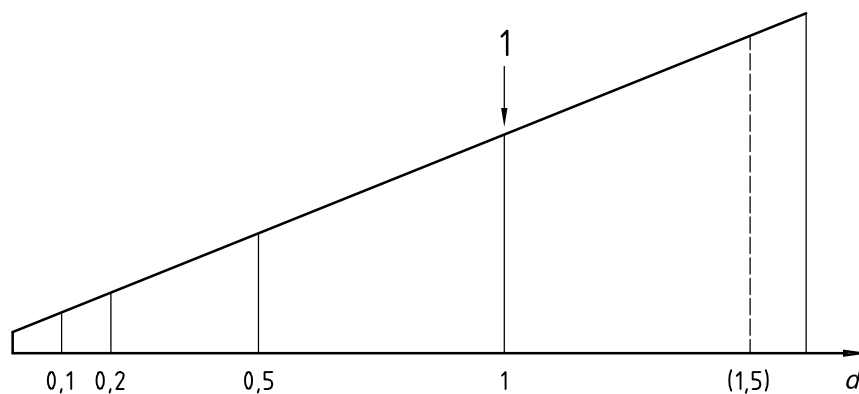
- 4) a constant flow chosen to obtain the maximum reading sensitivity, and
 - 5) when using a car running at idle speed or an equivalent gas generator, under optimal measurement conditions, the conventional calibration curve given in Figure 6, using a pipe with calibrated leaks of 0,1 mm, 0,2 mm, 0,5 mm, 0,8 mm and 1 mm.
- The detection device shall operate under the following conditions:
- 1) power supply appropriated to local standards and the user's needs;
 - 2) ambient temperature of 5 °C to 40 °C;
 - 3) relative ambient humidity of 90 % max;
 - 4) ambient pressure of 860 hPa to 1 060 hPa.

Dimensions in millimetres



^a Dimensions and external shapes are free choice.

Figure 4 — Sampling probe



Key

- d* leak diameter, in mm
- 1 20 000 µl/l (= 20 000 ppm) mark

Figure 5 — Display scheme