

# INTERNATIONAL STANDARD

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## **Road vehicles — Measurement methods for exhaust gas emissions during inspection or maintenance**

*Véhicules routiers — Méthodes de mesure des émissions gazeuses au  
cours des inspections ou de la maintenance*



Reference number  
ISO 3929:1995(E)

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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.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 3929 was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 5, *Engine tests*.

This second edition cancels and replaces the first edition (ISO 3929:1976), of which it constitutes a technical revision.

Annexes A and B of this International Standard are for information only.

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# Road vehicles — Measurement methods for exhaust gas emissions during inspection or maintenance

## 1 Scope

This International Standard establishes the test procedures for direct measurement of the concentration of exhaust gas emissions from road vehicles with a maximum authorized total mass (ISO-M08)<sup>1)</sup> not exceeding 3,5 t, equipped with controlled ignition engines, excluding those which are supplied with fuel/oil mixture.

It defines the recommended test procedure for

- periodic inspections in official garages;
- official roadside checks (e.g. by police);
- maintenance and diagnostic operations.

These procedures may be used totally or partially.

## 2 Normative reference

The following standard contains provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the edition indicated was valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent edition of the standard indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 3930:1993, *Road vehicles — Measurement equipment for exhaust gas emissions during inspection or maintenance — Technical specifications*.

## 3 Definitions

For the purposes of this International Standard, the following definitions apply.

**3.1 idle speed rotational frequency:** Engine rotational frequency with

- fuel system controls (accelerator, choke, etc.) non-operative;
- the gearshift lever in neutral and the clutch engaged for vehicles with manually operated or semi-automatic transmission;
- the gear selector in neutral or park for vehicles with automatic transmission;
- accessories and optional equipment which modify the rotational frequency used in accordance with the manufacturer's recommendations or regulatory requirements.

**3.2 accelerated idle speed rotational frequency:** Engine rotational frequency specified by the manufacturer or regulatory requirements with

- fuel system controls (accelerator, choke, etc.) in the position to run at accelerated idle;

1) In accordance with ISO 1176:1990, *Road vehicles — Masses — Vocabulary and codes*.

- the gearshift lever in neutral and the clutch engaged for vehicles with manually operated or semi-automatic transmission;
- the gear selector in neutral or park for vehicles with automatic transmission;
- accessories and optional equipment which modify the rotational frequency used in accordance with the manufacturer's recommendations or regulatory requirements.

**3.3 after treatment system (ATS):** Additional device intended to reduce the exhaust emission level.

## 4 Instrumentation

**4.1 Analyser** that conforms to ISO 3930, suitable for the concentrations of exhaust gas emissions from the vehicle under test.

**4.2 Engine lubricant temperature meter** in the sump or lubricant reservoir with a measurement accuracy of at least  $\pm 2$  K between 343 K and 373 K. Readings outside this range shall also be possible.

**4.3 Revolution counter (tachometer)** to measure engine rotational frequency from the ignition system. Under control conditions the measurement accuracy shall be at least  $\pm 20 \text{ min}^{-1}$  between  $600 \text{ min}^{-1}$  and  $1\,000 \text{ min}^{-1}$ , and  $\pm 50 \text{ min}^{-1}$  outside this range.

**4.4 Ambient temperature meter** with a measurement accuracy of at least  $\pm 2$  K between 278 K and 313 K.

## 5 Check, maintenance periodicity and precautions for use of instruments

### 5.1 Check before use

The power supply to the instruments shall conform to the manufacturer's specifications.

Check that the instruments are ready for testing according to the manufacturer's operating instructions in the owner's handbook:

- at least at the beginning of a day of tests;
- when the ambient conditions have changed;
- at the beginning of the tests in each new test site, for official roadside checks.

For the analyser, the zero and span calibration check shall be performed with reference gases or with electronic or electromechanical devices (see ISO 3930:1993, subclause 4.1.4).

### 5.2 Maintenance periodicity

All accuracy checks shall be carried out according to national regulations.

Periodic maintenance shall be carried out in accordance with the manufacturer's instructions in the maintenance handbook. Operations shall be recorded in this handbook.

### 5.3 Precautions for use

The working area shall be a firm, horizontal surface. Ambient conditions shall be those defined in ISO 3930:1993, subclauses 4.1.20, 4.1.21 and 4.1.22.

The working area shall not be directly exposed to

- rain, snow or sunlight;
- significant vibration;
- a corrosive and/or polluted atmosphere which might influence the measurement results;
- electromagnetic interference which might influence the measurement results.

## 6 General verification of vehicle

The exhaust system of the vehicle shall be leakproof. Verify this condition by sealing the exhaust pipe outlet while the engine is idling. No significant leakage of exhaust gases from pipe connections shall be found.

All accessories and optional equipment which modify the idle speed rotational frequency shall be used in accordance with the manufacturer's recommendations or regulatory requirements.

The sampling probe shall be inserted at least 300 mm into the exhaust outlet pipe. If the exhaust pipe shape does not allow such insertion, an exhaust extension pipe shall be provided.

In the case of several exhaust pipes, they shall be connected in a single outlet unless specified otherwise by the manufacturer. If this type of connection is not practicable, the arithmetic average of the concentration values, measured at each outlet, shall be used. In all cases, the device exhaust adaptor used shall not influence engine running.

## 7 Normal conditioning of vehicle

### 7.1 Warming up

The engine shall have attained normal thermal conditions, i.e. the temperature attained by the engine and its drive-line after running at least 15 min under normal urban traffic conditions over a minimum of 5 km or in accordance with manufacturer's specifications. If these specifications are not available, a minimum lubricant temperature of 353 K in the sump or the lubricant reservoir shall be achieved. Any disconnectable fan shall be stationary.

### 7.2 Test conditions

The choke shall be non-operative.

The air inlet ductwork shall be positioned in accordance with the manufacturer's instructions.

The oil sump dipstick hole shall be blocked during exhaust gas emission measurements.

The vehicle shall be located on a substantially horizontal site.

## 8 Measured value corrections

For engines fitted with a secondary air injection system, CO and HC emission measurements shall be corrected in accordance with national requirements.

## 9 Measurement methods for exhaust gas emissions at idle speed

### 9.1 Vehicles with or without exhaust emission treatment systems

See table 1.

### 9.2 Vehicles with exhaust emission treatment systems

See table 2.

Table 1

| Step | Operations                                                                                                                                                                                                       | Time lapse |      |         |         |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|------|---------|---------|
| 1    | Warm up the vehicle in accordance with 7.1                                                                                                                                                                       | See 7.1    |      |         |         |
| 2    | Equip the vehicle with<br><br>— a revolution counter (4.3);<br><br>— a lubricant temperature meter (4.2);<br><br>— an exhaust extension pipe, if necessary.<br><br>Select the highest analyser scale (4.1).      | —          | —    | ≤ 4 min | ≤ 6 min |
| 3    | Warm up the motor in accordance with the manufacturer's specifications or at $3\,000\text{ min}^{-1} \pm 100\text{ min}^{-1}$ , then return to idle speed.                                                       | 60 s       | 15 s |         |         |
| 4    | Switch on the sampling pump.                                                                                                                                                                                     | —          |      |         |         |
| 5    | Insert the probe into the exhaust pipe or its extension.                                                                                                                                                         | 10 s       |      |         |         |
| 6    | Check that the appropriate scale has been selected and change it if necessary.                                                                                                                                   | ≤ 30 s     | —    |         |         |
| 7    | Over sufficient time but not exceeding 30 s, carry out the measurements to obtain minimum and maximum values. Calculate the arithmetic mean of these two values. If the result is printed, print the mean value. |            |      |         |         |
| 8    | If one step fails, repeat steps 3 to 7.                                                                                                                                                                          | —          | —    | —       |         |

Table 2

| Step | Operations                                                                                                                                                                                                       | Time lapse |         |         |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|---------|---------|
| 1    | Warm up the vehicle in accordance with 7.1.                                                                                                                                                                      | See 7.1    |         |         |
| 2    | Equip the vehicle with<br><br>— a revolution counter (4.3);<br><br>— a lubricant temperature meter (4.2);<br><br>— an exhaust extension pipe, if necessary.<br><br>Select the highest analyser scale (4.1).      | —          | ≤ 4 min | ≤ 6 min |
| 3    | Warm up the motor in accordance with the manufacturer's specifications or at $3\,000\text{ min}^{-1} \pm 100\text{ min}^{-1}$ , then return to accelerated idle speed.                                           | 60 s       |         |         |
| 4    | Switch on the sampling pump.                                                                                                                                                                                     | 10 s       |         |         |
| 5    | Insert the probe into the exhaust pipe or its extension.                                                                                                                                                         |            |         |         |
| 6    | Check that the appropriate scale has been selected and change it if necessary.                                                                                                                                   | 40 s       |         |         |
| 7    | Over sufficient time but not exceeding 30 s, carry out the measurements to obtain minimum and maximum values. Calculate the arithmetic mean of these two values. If the result is printed, print the mean value. |            |         |         |
| 8    | If one step fails, repeat steps 3 to 7.                                                                                                                                                                          | —          | —       | —       |
| 9    | Return to idle speed.                                                                                                                                                                                            |            |         |         |
| 10   | Check that the appropriate scale has been selected and change it if necessary.                                                                                                                                   |            |         |         |
| 11   | Over sufficient time but not exceeding 30 s, carry out the measurements to obtain minimum and maximum values. Calculate the arithmetic mean of these two values. If the result is printed, print the mean value. | 40 s       | ≤ 2 min |         |
| 12   | If one step fails, repeat steps 3, 9, 10 and 11.                                                                                                                                                                 |            |         |         |

## Annex A (informative)

### Measurement method for converter efficiency

This test method only applies to the checking of the efficiency of the oxidation function of the converter or ATS.

**A.1** Warm up the vehicle in accordance with 7.1.

**A.2** Equip the vehicle with

- a revolution counter (4.3);
- a lubricant temperature meter (4.2);
- an exhaust extension pipe, if necessary.

Select the highest analyser scale (4.1).

**A.3** Warm up the motor for 60 s in accordance with the manufacturer's specifications or at  $3\,000\text{ min}^{-1} \pm 100\text{ min}^{-1}$ , then return to accelerated idle speed.

**A.4** Switch on the sampling pump.

**A.5** Insert the probe into the exhaust pipe or its extension.

**A.6** After 10 s, check that the appropriate scale has been selected and change it if necessary.

**A.7** Over sufficient time but not exceeding 30 s, carry out the measurements to obtain minimum and maximum values. Calculate the arithmetic mean of these two values. If the result is printed, print the mean value. The elapsed time from the beginning of A.2 operations shall not exceed 4 min.

**A.8** If one step fails, repeat steps A.3 to A.7. The elapsed time from the beginning of A.2 operations shall not exceed 6 min.

**A.9** Connect the probe to the sampling device upstream of the converter.

**A.10** Warm up the motor for 30 s in accordance with the manufacturer's specifications or at  $3\,000\text{ min}^{-1} \pm 100\text{ min}^{-1}$ , then return to accelerated idle speed.

**A.11** Select the highest analyser scale.

**A.12** After 10 s, check that the appropriate scale has been selected and change it if necessary.

**A.13** Over sufficient time but not exceeding 30 s, carry out the measurements to obtain minimum and maximum values. Calculate the arithmetic mean of these two values. If the result is printed, print the mean value.

**A.14** If one step fails, repeat steps A.10 to A.13.

**A.15** Calculate the efficiency of the converter or the ATS,  $E$ , as a percentage, with the following formula:

$$E = \frac{c_U - c_D}{c_U} \times 100$$

where

- $c_U$  is the concentration of a specific pollutant upstream of the ATS;
- $c_D$  is the concentration of the same pollutant downstream of the ATS.

**NOTE 1** When the efficiency of the converter or the ATS is measured with an analyser that conforms to the requirements of ISO 3929, the accuracy of the recorded value is expected to be  $\pm 6\%$ .