DRAFT AMENDMENT

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Reciprocating internal combustion engines — Exhaust emission measurement —

Part 1:
Test-bed measurement systems of gaseous and particulate emissions

AMENDMENT 1: Update of certain instrument and measurement provisions and of the carbon flow check

AMENDEMENT 1

ICS: 27.020; 13.040.50

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This document was prepared by Technical Committee ISO/TC 70, *Internal combustion engines*, Subcommittee SC 8, *Exhaust emission measurement*.

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Reciprocating internal combustion engines — Exhaust emission measurement —

Part 1: Test-bed measurement systems of gaseous and particulate emissions

AMENDMENT 1: Update of certain instrument and measurement provisions and of the carbon flow check

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5.3

Replace the title with the following

Measurement instruments

5.3.1

Replace the existing 5.3.1 with the following

5.3.1 General

5.3.1.1 Overview

This subclause specifies measurement instruments and associated system requirements related to emission testing. This includes laboratory instruments for measuring engine parameters, ambient conditions, flow-related parameters, and emission concentrations (raw or diluted).

5.3.1.2 Instrument types

Any instrument mentioned in ISO 8178 (all parts) shall be used as described in the standard itself (see Table 7 for measurement quantities provided by these instruments). Whenever an instrument mentioned in this document is used in a way that is not specified, or another instrument is used in its place, the requirements for equivalency provisions shall apply as specified in Clause 5. Where more than one instrument for a particular measurement is specified, one of them will be identified by the type approval or certifying authority upon application as the reference for showing that an alternative procedure is equivalent to the specified procedure.

5.3.1.3 Redundant systems

Data from multiple instruments to calculate test results for a single test may be used for all measurement instruments described in this subclause, with prior approval of the type approval or certification authority. Results from all measurements shall be recorded and the raw data shall be retained. This requirement applies whether or not the measurements are actually used in the calculations.

5.3.2

Designate the existing 5.3.3 as 5.3.2

Replace the title with the following

Performance specifications for measurement instruments

5.3.3.1

Designate the existing 5.3.1 as 5.3.3.1

5.3.3.2

Designate the existing 5.3.2 as 5.3.3.2

6.4.7

Add the following subclause after 6.4.6

6.4.7 Use of gas dividers

A gas divider may be used to blend calibration gases.

If a gas divider is used, it shall blend gases to the specifications of 9.2 and to the concentrations expected during testing. Critical-flow gas dividers, capillary-tube gas dividers, or thermal-mass-meter gas dividers may be used. Viscosity corrections shall be applied as necessary (if not done by gas divider internal software) to appropriately ensure correct gas division. The gas-divider system shall meet the linearity verification in 9.1.4.5. Optionally, the blending device may be checked with an instrument which by nature is linear, e.g. using NO gas with a CLD. The span value of the instrument shall be adjusted with the span gas directly connected to the instrument. The gas divider shall be checked at the settings used and the nominal value shall be compared to the measured concentration of the instrument.

7.4.3.4.2.8, paragraph j)

Replace the paragraph with the following:

Analyser shall have combined interference within ± 2 ppm or as specified by the parties involved.

7.4.3.4.2.9

Add the following paragraph after 7.4.2.4.2.8, before 7.4.4:

7.4.3.4.2.9 Alternative systems

Other systems or analysers may be approved by the approval authority, if it is found that they yield equivalent results in accordance with Clause 5. In this case, „Results" in that point shall refer to mean NH3 concentration calculated for the applicable cycle.

8.1.5

Replace the text with the following

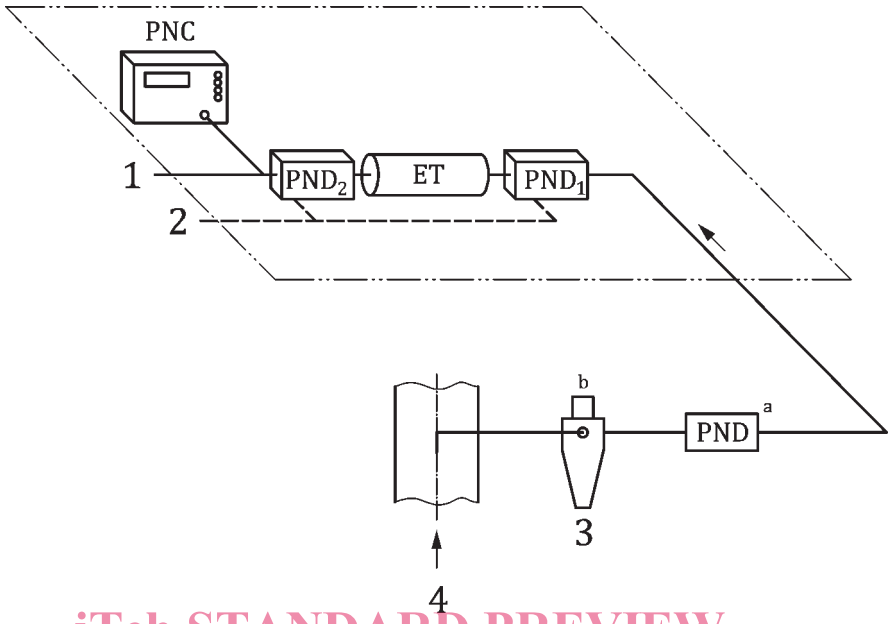
This subclause describes the two environments required to stabilize and weigh PM for gravimetric analysis: the PM stabilization environment, where filters are stored before weighing; and the weighing environment, where the balance is located. The two environments may share a common space. Both the stabilization and the weighing environments shall be kept free of ambient contaminants, such as dust, aerosols, or semi-volatile material that could contaminate PM samples.

The cleanliness of the PM-stabilization environment using reference filters shall be verified, as described in 9.6.3.4.

The temperature of the chamber (or room) in which the particulate filters are conditioned and weighed shall be maintained to within 295 ± 1 K (22 °C ± 1 °C) during all filter conditioning and weighing. The humidity shall be maintained to a dew point of 282,5 ± 1 K (9,5 °C ± 1 °C) and a relative humidity of 45 % ± 8 %. If the stabilization and weighing environments are separate, the stabilization environment shall be maintained at a tolerance of 295 ± 3 K (22 °C ± 3 °C).

8.4.1.4, Figure 14

Replace Figure 14 with the following figure:



Key

1 excess air
2 filtered air
3 pre-classifier or sample probe according to Figure 7
4 from engine exhaust

a Optional.
b In case a pre-classifier is used, it can be installed everywhere upstream of PND 1.

8.4.1.4.2.1

Designate the existing 8.4.1.4.2.2 as 8.4.1.4.2.1

8.4.1.4.2.2

Replace the text with the following:

8.4.1.4.2.2 Raw particle sampling

The dimension of the particle sampling probe shall be sized not to interfere with the operation of other exhaust gas measurement instruments.

The particle number counting system may include a primary dilution stage in order to maintain the temperature within the limits specified by the manufacturer of the device.

Particle number concentration is not a conserved quantity like particulate mass. Therefore, PN measurements strongly depend on sample location and sampling method due to e.g. coagulation and diffusion effects. As an alternative to diluted particle sampling, raw particle sampling can be applied, if agreed by the parties involved.

It should be noted that PN results determined with raw particle sampling will not necessarily be comparable to PN results determined with diluted particle sampling.

9.2

Replace the text with the following

9.2 Analytical gases

Analytical gases shall meet the accuracy and purity specifications of this section.

9.2.1

Designate the existing 9.2.2 as 9.2.1

9.2.2.

Replace the text with the following:

9.2.2 Concentration and expiration date

The concentration of any calibration gas standard and its expiration date specified by the gas supplier shall be recorded.

(a) No calibration gas standard may be used after its expiration date, except as allowed by paragraph (b) of this point.

(b) Calibration gases may be relabelled and used after their expiration date if it is approved in advance by type approval or certification authority.

9.2.3

Replace the text with the following:

9.2.3 Gas transfer

Gases shall be transferred from their source to analyzers using components that are dedicated to controlling and transferring only those gases. The shelf life of all calibration gases shall be respected. The expiration date of the calibration gases stated by the manufacturer shall be recorded.

9.5.8.2.3

Replace the text with the following:

A CO NDIR analyser shall have combined H_2O and CO_2 interference that is within ± 2 % of the expected flow-weighted mean concentration of CO corresponding to the applicable limit specified by the parties concerned.

C.1, first paragraph

Add the following text at the end of the first paragraph:

In the case of SI engines without control of excess air ratio λ or SI engines operating outside the range 0,97 ≤ λ ≤ 1,03, the procedure shall additionally include measurement of HC and CO.

C.1, second paragraph

Replace the text with the following:

The flow of carbon into the exhaust gas measurement systems is determined from the fuel flow rate. The flow of carbon at various sampling points in the emissions and particulate sampling systems is determined from the CO2 (or CO2, HC and CO) concentrations and gas flow rates at those points.

C.2

Add the following subclause after C.1

C.2 Carbon flow rate into the engine (location 1)

The carbon mass flow rate into the engine q_{mCf} [kg/s] for a fuel CHαOε shall be calculated by means of equation (C.1):

$$q_{mCf} = \frac{12{,}011}{12{,}011 + \alpha + 15{,}9994 \cdot \varepsilon} \cdot q_{mf} \quad \text{(C.1)}$$

where

q_{mf} fuel mass flow rate [kg/s]

C.3

Add the following subclause after newly added C.2

C.3 Carbon flow rate in the raw exhaust gas (location 2)

C.3.1 Based on CO_2

The carbon mass flow rate in the exhaust pipe of the engine q_{mCe} [kg/s] shall be determined from the raw CO_2 concentration and the exhaust gas mass flow rate by means of equation (C.2):

$$q_{mCe} = \left(\frac{c_{CO2,r} - c_{CO2,a}}{100} \right) \cdot q_{mew} \cdot \frac{12{,}011}{M_e} \quad \text{(C.2)}$$

where

$C_{CO2,r}$ is the wet CO_2 concentration in the raw exhaust gas [%];

$C_{CO2,a}$ is the wet CO_2 concentration in the ambient air [%];

q_{mew} is the exhaust gas mass flow rate on wet basis [kg/s];

M_e is the molar mass of exhaust gas [g/mol].

If CO_2 is measured on a dry basis it shall be converted to a wet basis in accordance with ISO 8178-4, 9.1.4 or ISO 8178-4, H.5.2

C.3.2 Based on CO_2, HC and CO

As an alternative to performing the calculation solely based upon CO_2 in paragraph C.3.1, the carbon mass flow rate in the exhaust pipe of the engine q_{mCe} [kg/s] shall be determined from the raw CO_2, HC and CO concentration and the exhaust gas mass flow rate by means of equation (C.3):

$$q_{mCe} = \left(\frac{c_{CO2,r} - c_{CO2,a}}{100} + \frac{c_{THC(C1),r} - c_{THC(C1),a}}{100} + \frac{c_{CO,r} - c_{CO,a}}{100} \right) \cdot q_{mew} \cdot \frac{12{,}011}{M_e} \quad \text{(C.3)}$$

where

$C_{CO2,r}$ is the wet CO_2 concentration in the raw exhaust gas [%];

$C_{CO2,a}$ is the wet CO_2 concentration in the ambient air [%];

$C_{THC(C1),r}$ is the THC(C1) concentration in the raw exhaust gas [%];

$C_{THC(C1),a}$ is the THC(C1) concentration in the ambient air [%];

$C_{CO,r}$ is the wet CO concentration in the raw exhaust gas [%];