

ANNEX XII

EXHAUST GAS ANALYSERS (MI-010)

The relevant requirements of Annex I, the specific requirements of this Annex and the conformity assessment procedures listed in this Annex, apply to exhaust gas analysers defined below intended for inspection and professional maintenance of motor vehicles in use.

DEFINITIONS

Exhaust gas analyser	<p>An exhaust gas analyser is a measuring instrument that serves to determine the volume fractions of specified components of the exhaust gas of a motor vehicle engine with spark ignition at the moisture level of the sample analysed.</p> <p>These gas components are carbon monoxide (CO), carbon dioxide (CO₂), oxygen (O₂) and hydrocarbons (HC).</p> <p>The content of hydrocarbons has to be expressed as concentration of n-hexane (C₆H₁₄), measured with near-infrared absorption techniques.</p> <p>The volume fractions of the gas components are expressed as a percentage (% vol) for CO, CO₂ and O₂ and in parts per million (ppm vol) for HC.</p> <p>Moreover, an exhaust gas analyser calculates the lambda value from the volume fractions of the components of the exhaust gas.</p>
Lambda	<p>Lambda is a dimensionless value representative of the burning efficiency of an engine in terms of air/fuel ratio in the exhaust gases. It is determined with a reference standardised formula.</p>

SPECIFIC REQUIREMENTS

Instrument Classes

- Two classes (0 and I) are being defined for exhaust gas analysers. The relevant minimum measuring ranges for these classes are shown in Table 1.

Table 1

Classes and measuring ranges	
Parameter	Classes 0 and I
CO fraction	from 0 to 5 % vol
CO ₂ fraction	from 0 to 16 % vol
HC fraction	from 0 to 2 000 ppm vol
O ₂ fraction	from 0 to 21 % vol

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Table 1

λ	from 0,8 to 1,2
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Rated operating conditions

2. The values of the operating conditions shall be specified by the manufacturer as follows:
 - 2.1. For the climatic and mechanical influence quantities:
 - a minimum temperature range of 35 °C for the climatic environment;
 - the mechanical environment class that applies is M1.
 - 2.2. For the electrical power influence quantities:
 - the voltage and frequency range for the AC voltage supply;
 - the limits of the DC voltage supply.
 - 2.3. For the ambient pressure:
 - the minimum and the maximum values of the ambient pressure are for both classes: $p_{\min} \leq 860 \text{ hPa}$, $p_{\max} \geq 1\,060 \text{ hPa}$.

Maximum permissible errors (MPEs)

3. The MPEs are defined as follows:
 - 3.1. For each of the fractions measured, the maximum error value permitted under rated operating conditions according to point 1.1 of Annex I is the greater of the two values shown in Table 2. Absolute values are expressed in % vol or ppm vol, percentage values are percent of the true value.

Table 2

MPEs

Parameter	Class 0	Class I
CO fraction	$\pm 0,03 \text{ % vol}$ $\pm 5 \text{ %}$	$\pm 0,06 \text{ % vol}$ $\pm 5 \text{ %}$
CO ₂ fraction	$\pm 0,5 \text{ % vol}$ $\pm 5 \text{ %}$	$\pm 0,5 \text{ % vol}$ $\pm 5 \text{ %}$
HC fraction	$\pm 10 \text{ ppm vol}$ $\pm 5 \text{ %}$	$\pm 12 \text{ ppm vol}$ $\pm 5 \text{ %}$
O ₂ fraction	$\pm 0,1 \text{ % vol}$ $\pm 5 \text{ %}$	$\pm 0,1 \text{ % vol}$ $\pm 5 \text{ %}$

- 3.2. The MPE on lambda calculation is 0,3 %. The conventional true value is calculated according to the formula set out in point 5.3.7.3 of Regulation No 83 of the Economic Commission for Europe of the United Nations (UN/ECE)⁽¹⁾.

For this purpose, the values displayed by the instrument are used for calculation.

Permissible effect of disturbances

4. For each of the volume fractions measured by the instrument, the critical change value is equal to the MPE for the parameter concerned.
5. The effect of an electromagnetic disturbance shall be such that:

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- either the change in the measurement result is not greater than the critical change value laid down in point 4;
- or the presentation of the measurement result is such that it cannot be taken for a valid result.

Other requirements

6. The resolution shall be equal to or of one order of magnitude higher than the values shown in Table 3.

Table 3

Resolution				
	CO	CO ₂	O ₂	HC
Class 0 and class I	0,01 % vol	0,1 % vol	^a	1 ppm vol

^a 0,01 % vol for measurand values below or equal to 4 % vol, otherwise 0,1 % vol.

The lambda value shall be displayed with a resolution of 0,001.

7. The standard deviation of 20 measurements shall not be greater than one third of the modulus of the MPE for each applicable gas volume fraction.
8. For measuring CO, CO₂ and HC, the instrument, including the specified gas handling system, must indicate 95 % of the final value as determined with calibration gases within 15 seconds after changing from a gas with zero content, e.g. fresh air. For measuring O₂, the instrument under similar conditions must indicate a value differing less than 0,1 % vol from zero within 60 seconds after changing from fresh air to an oxygen-free gas.
9. The components in the exhaust gas, other than the components whose values are subject to the measurement, shall not affect the measurement results by more than the half of the modulus of the MPEs when those components are present in the following maximum volume fractions:
 - 6 % vol CO,
 - 16 % vol CO₂,
 - 10 % vol O₂,
 - 5 % vol H₂,
 - 0,3 % vol NO,
 - 2 000 ppm vol HC (as n-hexane),

water vapor up to saturation.

10. An exhaust gas analyser shall have an adjustment facility that provides operations for zero-setting, gas calibration and internal adjustment. The adjustment facility for zero-setting and internal adjustment shall be automatic.
11. For automatic or semi-automatic adjustment facilities, the instrument shall be unable to make a measurement as long as the adjustments have not been made.
12. An exhaust gas analyser shall detect hydrocarbon residues in the gas handling system. It shall not be possible to carry out a measurement if the hydrocarbon residues, present before any measurement, exceed 20 ppm vol.

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13. An exhaust gas analyser shall have a device for automatically recognising any malfunctioning of the sensor of the oxygen channel due to wear or a break in the connecting line.
14. If the exhaust gas analyser is capable to operate with different fuels (e.g. petrol or liquefied gas), there shall be the possibility to select the suitable coefficients for the Lambda calculation without ambiguity concerning the appropriate formula.

CONFORMITY ASSESSMENT

The conformity assessment procedures referred to in Article 17 that the manufacturer can choose between are:

B + F or B + D or H1.

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(1) [OJ L 42, 15.2.2012, p. 1.](#)