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WELMEC

European cooperation in legal metrology

Measuring Instruments Directive 2004/22/EC Exhaust Gas Analysers Corresponding Tables OIML R 99 2000 – MID-010



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WELMEC is a cooperation between the legal metrology services of the Member States of the European Union and EFTA. This document is one of a number of Guides published by WELMEC to provide guidance to manufacturers of measuring instruments and to notified bodies responsible for conformity assessment of their products. The Guides are purely advisory and do not themselves impose any restrictions or additional technical requirements beyond those contained in relevant EC Directives. Alternative approaches may be acceptable, but the guidance provided in this document represents the considered view of WELMEC as to the best practice to be followed.

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The Measuring Instruments Directive (MID) 2004/22/EC entered into force on the 30th October 2006. In this new approach directive the presumption of conformity is mentioned in Article 13. In addition to the use of harmonised standards (Art. 13 point 1) a new route is open for the presumption of conformity by using OIML recommendations (Art. 13 point 2).

“Member States shall presume conformity with the essential requirements referred to in Annex I and in the relevant instrument-specific Annexes in respect of a measuring instruments that complies with the corresponding parts of the normative documents and lists referred to in Article 16(1)(a), the references in respect of which have been published in the Official Journal of the European Union, C series.”

Article 4(i) defines that

“normative document” means a document containing technical specifications adopted by the Organisation International de Métrologie Légale (OIML), subject to the procedure stipulated in Article 16(1)”.

In Article 16 (1) (a) the functions of the Measuring Instruments Committee are described as follows:

“identify normative documents drawn up by OIML and, in a list, indicate the parts thereof compliance with which gives rise to a presumption of conformity with the corresponding essential requirements of this Directive”.

In the WELMEC Committee Meeting in May 2005 WELMEC agreed to support the work of the Commission on this issue and the MI-xxx Annexes of the MID has been given to the Working Groups of WELMEC to develop corresponding tables including comments as a basis for the publication foreseen in the Directive. A timetable has been established and rules for drawing up these tables have been given by the WELMEC Committee. To prepare a proposal at least 3 experts has been involved. The drafts have been discussed in the responsible Working Group (including industry). The results have been sent do the WELMEC Secretariat and the WELMEC Committee Members has been asked for Comments. These drafts have been discussed during the WELMEC Committee Meeting in May 2006 and have been adopted as WELMEC guides.

The documents have been sent to the European Commission for further consideration and for drafting the publication required in the directive. This has been done in a small Working Group with the European Commission (June, July 2006).

The European Commission presented the simplified tables to the Commission Working Group on Measuring Instruments for further comment and subsequently obtained a positive advice from the Measuring Instruments Committee on 25 September 2006.

The simplified tables are published In the Official Journal of the European Union, series C n° 269, p I of 4 November 2006. As guidance, WELMEC is publishing the full tables with all the comments and detailed information underlying the simplified tables to aid all interested and concerned parties.

The European Commission webpage gives the link to the documents of WELMEC.

REQUIREMENTS and correspondence
Gas exhausts analysers

Directive 2004/22/EC Essential requirements of Annex 1 and Annex MI-010	OIML R99	Comment
A measuring instrument shall provide a high level of metrological protection in order that any party affected can have confidence in the result of measurement, and shall be designed and manufactured to a high level of quality in respect of the measurement technology and security of the measurement data.	See details in chapter 5,6,7,8,9 of R 99 Especially 6.2 and 6.3	Also objective of OIML
The requirements that shall be met by measuring instruments are set out below and are supplemented, where appropriate, by specific instrument requirements in Annexes MI-001 to MI-010 that provide more detail on certain aspects of the general requirements. The solutions adopted in the pursuit of the requirements shall take account of the intended use of the instrument and any foreseeable misuse thereof.		Comment only, so see below the details of correspondence Also objective of OIML
<p>DEFINITIONS</p> <p>Measurand The measurand is the particular quantity subject to measurement.</p> <p>Influence quantity An influence quantity is a quantity that is not the measurand but that affects the result of measurement.</p> <p>Rated Operating Conditions The rated operating conditions are the values for the measurand and influence quantities making up the normal working conditions of an instrument.</p> <p>Disturbance An influence quantity having a value within the limits specified in the appropriate requirement but outside the specified rated operating conditions of the measuring instrument. An influence quantity is a disturbance if for that influence quantity the rated operating conditions are not specified.</p> <p>Critical change value The critical change value is the value at which the change in the measurement result is considered undesirable.</p>	<p>VIM</p> <p>VIM2.6</p> <p>VIM 2.7 R 99 3.21</p> <p>VIM 5.5 + R99 3.22</p> <p>R 99 3.24</p> <p>3.20</p>	<p>VIM (reference document shared by BIPM, IEC,IFCC,ISO,IUPAC,IUAPP, OIML)</p> <p>Slight difference in wording</p> <p>2nd sentence is a comment CCV corresponds to significant fault With the editorial difference that CCV is a limit where SF corresponds to all errors beyond the limit</p> <p>Not applicable</p>

<p>Material Measure A material measure is a device intended to reproduce or supply in a permanent manner during its use one or more known values of a given quantity.</p> <p>Direct sales</p> <p>A trading transaction is direct sales if:</p> <ul style="list-style-type: none"> – the measurement result serves as the basis for the price to pay and; – at least one of the parties involved in the transaction related to measurement is a consumer or any other party requiring a similar level of protection and; – all the parties in the transaction accept the measurement result at that time and place. <p>Climatic environments</p> <p>Climatic environments are the conditions in which measuring instruments may be used. To cope with climatic differences between the Member States, a range of temperature limits has been defined.</p> <p>Utility</p> <p>A utility is regarded as a supplier of electricity, gas, heat or water.</p>		<p>Not applicable</p> <p>Comment only</p> <p>Not applicable</p>
<p>1. Allowable Errors</p> <p>1.1. Under rated operating conditions and in the absence of a disturbance, the error of measurement shall not exceed the maximum permissible error(MPE) value as laid down in the appropriate instrument-specific requirements.</p> <p>Unless stated otherwise in the instrument-specific annexes, MPE is expressed as a bilateral value of the deviation from the true measurement value.</p>	<p>3.22 5.4.1+5.4.2</p>	<p>(class II excluded)</p> <p>See also 3.15 to 3.18 for definition of errors</p> <p>Comment only</p>
<p>1.2. Under rated operating conditions and in the presence of a disturbance, the performance requirement shall be as laid down in the appropriate instrument specific requirements.</p> <p>Where the instrument is intended to be used in a specified permanent continuous electromagnetic field the permitted performance during the radiated</p>	<p>A.16</p>	<p>Comment only</p> <p>Comment only</p>

electromagnetic field-amplitude modulated test shall be within MPE.																	
1.3. The manufacturer shall specify the climatic, mechanical and electromagnetic environments in which the instrument is intended to be used, power supply and other influence quantities likely to affect its accuracy, taking account of the requirements laid down in the appropriate instrument-specific annexes.		Certain limits are made mandatory in R 99															
<p>1.3.1. Climatic environments</p> <p>The manufacturer shall specify the upper temperature limit and the lower temperature limit from any of the values in Table 1 unless otherwise specified in the annexes MI-001 to MI-010, and indicate whether the instrument is designed for condensing or non-condensing humidity as well as the intended location for the instrument, i.e. open or closed.</p> <p>Table 1</p> <table border="0" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th></th> <th colspan="4" style="text-align: center;">Temperature Limits</th> </tr> </thead> <tbody> <tr> <td>Upper temperature limit</td> <td style="text-align: center;">30</td> <td style="text-align: center;">40</td> <td style="text-align: center;">55</td> <td style="text-align: center;">70</td> </tr> <tr> <td>Lower temperature limit</td> <td style="text-align: center;">5</td> <td style="text-align: center;">- 10</td> <td style="text-align: center;">- 25</td> <td style="text-align: center;">- 40</td> </tr> </tbody> </table>		Temperature Limits				Upper temperature limit	30	40	55	70	Lower temperature limit	5	- 10	- 25	- 40	5.5.2	In 5.5.2 5 °C to 40 °C
	Temperature Limits																
Upper temperature limit	30	40	55	70													
Lower temperature limit	5	- 10	- 25	- 40													
<p>1.3.2. (a) Mechanical environments are classified into classes M1 to M3 as described below.</p> <p>M1 This class applies to instruments used in locations with vibration and shocks of low significance, e.g. for instruments fastened to light supporting structures subject to negligible vibrations and shocks transmitted from local blasting or pile-driving activities, slamming doors, etc.</p> <p>M2 This class applies to instruments used in locations with significant or high levels of vibration and shock, e.g. transmitted from machines and passing vehicles in the vicinity or adjacent to heavy machines, conveyor belts, etc.</p> <p>M3 This class applies to instruments used in</p>	<p>5.6 + A.11.1</p> <p>+ A.11.2</p> <p>see below</p>	<p>Definition in MID</p> <p>OIML does not refer to the abbreviations used in MID but the principle is identical</p> <p>A.11.2 for instrument under 3.32</p> <p>Shocks , vibrations and electric perturbations are covered in R 99</p>															

<p>locations where the level of vibration and shock is high and very high, e.g. for instruments mounted directly on machines, conveyor belts, etc.</p> <p>(b) The following influence quantities shall be considered in relation with mechanical environments:</p> <ul style="list-style-type: none"> – Vibration; – Mechanical shock. 		
<p>1.3.3. (a) Electromagnetic environments are classified into classes E1, E2 or E3 as described below, unless otherwise laid down in the appropriate instrument-specific annexes.</p> <p>E1 This class applies to instruments used in locations with electromagnetic disturbances corresponding to those likely to be found in residential, commercial and light industrial buildings.</p> <p>E2 This class applies to instruments used in locations with electromagnetic disturbances corresponding to those likely to be found in other industrial buildings.</p> <p>E3 This class applies to instruments supplied by the battery of a vehicle. Such instruments shall comply with the requirements of E 2 and the following additional requirements:</p> <ul style="list-style-type: none"> – voltage reductions caused by energising the starter-motor circuits of internal combustion engines – load dump transients occurring in the 	<p>5.6 + A.12 + A.13 + A.14+A.15+A.16</p> <p>5.5.2</p>	<p>OIML does not use the symbols used in MID</p> <p>For instrument powered by the battery of a car or a truck see note 1 of A.9 in R99</p>

<p>event of a discharged battery being disconnected while the engine is running.</p> <p>(b) The following influence quantities shall be considered in relation with electromagnetic environments:</p> <ul style="list-style-type: none"> – Voltage interruptions, – Short voltage reductions, – Voltage transients on supply lines and/or signal lines, – Electrostatic discharges, – Radio frequency electromagnetic fields, – Conducted radio frequency electromagnetic fields on supply lines and/or signal lines, – Surges on supply lines and/or signal lines. 	<p>5.6 + A.12</p> <p>A.12</p> <p>A.13</p> <p>A14</p> <p>A16</p> <p>A15</p>	<p>Slight difference in wording</p>
<p>1.3.4. Other influence quantities to be considered, where appropriate, are:</p> <ul style="list-style-type: none"> – Voltage variation, – Mains frequency variation, – Power frequency magnetic fields, – any other quantity likely to influence in a significant way the accuracy of the instrument. 	<p>5.5.1, 5.5.2, 5.5.3, 5.6, 5.7, 5.8 + 6.1.7 + 6.1.8 + 6.1.3 + 6.1.4 + 6.3.2 + 9.6 + A.17 to A.24</p>	
<p>1.4. When carrying out the tests as envisaged in this Directive, the following paragraphs apply:</p> <p>1.4.1. Basic rules for testing and the determination of errors</p>	<p>8.1, 9, Annex A</p>	<p>R 99 is in conformity with the philosophy</p>

<p>Essential requirements specified in 1.1 and 1.2 shall be verified for each relevant influence quantity.</p> <p>Unless otherwise specified in the appropriate instrument-specific annex, these essential requirements apply when each influence quantity is applied and its effect evaluated separately, all other influence quantities being kept relatively constant at their reference value.</p> <p>Metrological tests shall be carried out during or after the application of the influence quantity, whichever condition corresponds to the normal operational status of the instrument when that influence quantity is likely to occur.</p>		in MID
<p>1.4.2;. Ambient humidity</p> <ul style="list-style-type: none"> – According to the climatic operating environment in which the instrument is intended to be used either the damp heat-steady state (non-condensing) or damp heat cyclic (condensing) test may be appropriate. – The damp heat cyclic test is appropriate where condensation is important or when penetration of vapour will be accelerated by the effect of breathing. In conditions where non-condensing humidity is a factor the damp-heat steady state is appropriate. 		In R 99 only steady state is foreseen (without condensation)
<p>2. Reproducibility</p> <p>The application of the same measurand in a different location or by a different user, all other conditions being the same, shall result in the close agreement of successive measurements. The difference between the measurement results shall be small when compared with the MPE</p>		Not applicable as such. Covered by other elements of R99.
<p>3. Repeatability</p> <p>The application of the same measurand under the same conditions of measurement shall result in the close agreement of successive measurements. The difference between the measurement results shall be small when compared with the MPE.</p>	5.12 + 9.3 Annex A.4	

4.	<p>Discrimination and Sensitivity</p> <p>A measuring instrument shall be sufficiently sensitive and the discrimination threshold shall be sufficiently low for the intended measurement task.</p>	5.2 + 5.5.3 + 5.3.2	
5.	<p>Durability</p> <p>A measuring instrument shall be designed to maintain an adequate stability of its metrological characteristics over a period of time estimated by the manufacturer, provided that it is properly installed, maintained and used according to the manufacturer's instruction when in the environmental conditions for which it is intended.</p>	5.11 + 6 + 9.2 Annex A.3	
6.	<p>Reliability</p> <p>A measuring instrument shall be designed to reduce as far as possible the effect of a defect that would lead to an inaccurate measurement result, unless the presence of such a defect is obvious.</p>	6.3	
7.	<p>Suitability</p> <p>7.1. A measuring instrument shall have no feature likely to facilitate fraudulent use, whereas possibilities for unintentional misuse shall be minimal.</p>	6.3	
7.2.	<p>A measuring instrument shall be suitable for its intended use taking account of the practical working conditions and shall not require unreasonable demands of the user in order to obtain a correct measurement result.</p>	6 + 5.5.3 + 5.7 + 5.8 + 5.9 + 6.2 (6.2.3 excluded).+ 6.3 + 7.2,	
7.3.	<p>The errors of a utility measuring instrument at flows or currents outside the controlled range shall not be unduly biased.</p>	NA	Not applicable
7.4.	<p>Where a measuring instrument is designed for the measurement of values of the measurand that are constant over time, the measuring instrument shall be insensitive to small fluctuations of the value of the measurand, or shall take appropriate action.</p>	NA	Not applicable
7.5.	<p>A measuring instrument shall be robust and its materials of construction shall be suitable for the conditions in which it is intended to be used.</p>	6.1	

7.6.	<p>A measuring instrument shall be designed so as to allow the control of the measuring tasks after the instrument has been placed on the market and put into use. If necessary, special equipment or software for this control shall be part of the instrument. The test procedure shall be described in the operation manual.</p> <p>When a measuring instrument has associated software which provides other functions besides the measuring function, the software that is critical for the metrological characteristics shall be identifiable and shall not be inadmissibly influenced by the associated software.</p>	6.1 + 6.2.1 + 6.3.5	No corresponding point in R 99
8.	Protection against corruption		
8.1.	<p>The metrological characteristics of a measuring instrument shall not be influenced in any inadmissible way by the connection to it of another device, by any feature of the connected device itself or by any remote device that communicates with the measuring instrument.</p>	6.1.9	
8.2.	<p>A hardware component that is critical for metrological characteristics shall be designed so that it can be secured. Security measures foreseen shall provide for evidence of an intervention.</p>	6.3.9	
8.3.	<p>Software that is critical for metrological characteristics shall be identified as such and shall be secured.</p> <p>Software identification shall be easily provided by the measuring instrument.</p> <p>Evidence of an intervention shall be available for a reasonable period of time.</p>	7.1.3	No corresponding point in R 99
8.4.	<p>Measurement data, software that is critical for measurement characteristics and metrologically important parameters stored or transmitted shall be adequately protected against accidental or intentional corruption.</p>		No corresponding point in R 99
8.5.	<p>For utility measuring instruments the display of the total quantity supplied or the displays from which the total quantity supplied can be derived, whole or partial reference to which is the basis for payment, shall not be able to be reset during use.</p>	NA	Not applicable
9.	<p>Information to be borne by and to accompany the instrument</p>		

9.1.	<p>A measuring instrument shall bear the following inscriptions:</p> <ul style="list-style-type: none"> – manufacturer's mark or name; – information in respect of its accuracy, <p>plus, when applicable:</p> <ul style="list-style-type: none"> – information in respect of the conditions of use; – measuring capacity; – measuring range; – identity marking; – number of the EC-type examination certificate or the EC design examination certificate; – information whether or not additional devices providing metrological results comply with the provisions of this Directive on legal metrological control. 	7.1.1 + 7.1.2	<p>In the case of EGA the measuring range for each component and calculation for lambda are part of the inscriptions</p> <p>No equivalent requirement in OIML</p>
9.2.	<p>An instrument of dimensions too small or of too sensitive a composition to allow it to bear the relevant information shall have its packaging, if any, and the accompanying documents required by the provisions of this Directive suitably marked.</p>	NA	Not applicable
9.3.	<p>The instrument shall be accompanied by information on its operation, unless the simplicity of the measuring instrument makes this unnecessary. Information shall be easily understandable and shall include where relevant:</p> <ul style="list-style-type: none"> – rated operating conditions; – mechanical and electromagnetic environment classes; – the upper and lower temperature limit, whether condensation is possible or not, open or closed location; – instructions for installation, maintenance, repairs, permissible adjustments; – instructions for correct operation and any special conditions of use; – conditions for compatibility with interfaces, sub-assemblies or measuring instruments. 	7.2	<p>No corresponding requirement in OIML</p>
9.4.	<p>Groups of identical measuring instruments used in the same location or used for utility measurements do not necessarily require individual instruction manuals.</p>	NA	Not applicable
9.5.	<p>Unless specified otherwise in an instrument-specific annex, the scale interval for a measured value shall</p>	5.3.2	See in MI O10 definition and

	be in the form 1×10^n , 2×10^n , or 5×10^n , where n is any integer or zero. The unit of measurement or its symbol shall be shown close to the numerical value.		article 6
9.6	A material measure shall be marked with a nominal value or a scale, accompanied by the unit of measurement used.	NA	Non relevant
9.7.	The units of measurement used and their symbols shall be in accordance with the provisions of Community legislation on units of measurement and their symbols.	5.1	
9.8.	All marks and inscriptions required under any requirement shall be clear, non-erasable, unambiguous and non-transferable.	7.1.1	“Non transferable” not covered in R99
10.	Indication of result	4.3	
10.1.	Indication of the result shall be by means of a display or hard copy.		
10.2.	The indication of any result shall be clear and unambiguous and accompanied by such marks and inscriptions necessary to inform the user of the significance of the result. Easy reading of the presented result shall be permitted under normal conditions of use. Additional indications may be shown provided they cannot be confused with the metrologically controlled indications.	5.1+ 5.3	
10.3.	In the case of hard copy the print or record shall also be easily legible and non-erasable.	6.1.9	6.1.9 covers transmission but not “easily legible and non-erasable”
10.4.	A measuring instrument for direct sales trading transactions shall be designed to present the measurement result to both parties in the transaction when installed as intended. When critical in case of direct sales, any ticket provided to the consumer by an ancillary device not complying with the appropriate requirements of this Directive shall bear an appropriate restrictive information.	NA	Not applicable
10.5.	Whether or not a measuring instrument intended for utility measurement purposes can be remotely read it shall in any case be fitted with a metrologically controlled display accessible without tools to the consumer. The reading of this display is the measurement result that serves as the basis for the price to pay.	NA	Not applicable

11. Further processing of data to conclude the trading transaction		Not applicable
11.1. A measuring instrument other than a utility measuring instrument shall record by a durable means the measurement result accompanied by information to identify the particular transaction, when: <ul style="list-style-type: none"> – the measurement is non-repeatable and; – the measuring instrument is normally intended for use in the absence of one of the trading parties; 		
11.2. Additionally, a durable proof of the measurement result and the information to identify the transaction shall be available on request at the time the measurement is concluded.		Not applicable
12. Conformity evaluation A measuring instrument shall be designed so as to allow ready evaluation of its conformity with the appropriate requirements of this Directive.		No equivalent specific requirement in R99 but an instrument in conformity with R99 (chapter 4) allows its ready evaluation
EXHAUST GAS ANALYSERS 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 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. These gas components are carbon monoxide (CO), carbon dioxide (CO ₂), oxygen (O ₂) and hydrocarbons (HC). The content of hydrocarbons has to be expressed as) 1 1, 5.9 5.1 4.1	In MID there is necessity to calculate lambda which requires the 4 channels R99 allows inst for less than 4 gases MID requires determination of 4 components Instruments determining

<p>concentration of n-hexane (C₆ H₁₄), 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).</p> <p>Moreover, an exhaust gas analyser calculates the lambda value from the volume fractions of the components of the exhaust gas.</p> <p>Lambda 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>	<p>3.29 + standardised formula in Annex F</p>	<p>only 2 gases for motorcycles are not included in MID</p> <p>3.29 (plus standardised formula in Annex F of R 99)</p> <p>Instruments that do not calculate lambda are not in conformity with MID</p>												
<p>SPECIFIC REQUIREMENTS</p>														
<p>Instrument Classes</p> <p>1. 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</p> <p>Table 1 – Classes and measuring ranges</p>	<p>5.2 , 5.10</p>	<p>OIML and ISO include a class II in addition not allowed by MID</p>												
<table border="1"> <thead> <tr> <th>Parameter</th> <th>Classes 0 and I</th> </tr> </thead> <tbody> <tr> <td>CO fraction</td> <td>From 0 to 5% vol</td> </tr> <tr> <td>CO₂ fraction</td> <td>From 0 to 16% vol</td> </tr> <tr> <td>HC fraction</td> <td>from 0 to 2 000 ppm vol</td> </tr> <tr> <td>O₂ fraction</td> <td>From 0 to 21% vol</td> </tr> <tr> <td>Λ</td> <td>From 0,8 to 1,2</td> </tr> </tbody> </table>	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	Λ	From 0,8 to 1,2		<p>Lambda limits are not included in table 1 of OIML and ISO but in 5.10</p>
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													
Λ	From 0,8 to 1,2													
<p>Rated operating conditions</p> <p>2. The values of the operating conditions shall be specified by the manufacturer as follows:</p> <p>2.1. For the climatic and mechanical influence quantities:</p> <ul style="list-style-type: none"> – A minimum temperature range of 35°C for the climatic environment; – The mechanical environment class that applies is M1. 	<p>5.5.2</p> <p>5.6 + A.11.1 + A.11.2</p>	<p>5.5.2 fixes range from 5 °C to 40 °C</p> <p>A.11.2 for instrument under 3.32</p>												
<p>2.2. For the electrical power influence quantities:</p> <ul style="list-style-type: none"> – The voltage and frequency range for the AC voltage supply; 	<p>5.6 + A.12 + A.13 + A.14+A.15+A.16</p>													

<p>– The limits of the DC voltage supply.</p>	5.5.2 + .9																															
<p>2.3. For the ambient pressure:</p> <p>– The minimum and the maximum values of the ambient pressure are for both classes: $p_{\min} \leq 860 \text{ hPa}$, $p_{\max} \geq 1060 \text{ hPa}$.</p>	5.5.2																															
<p>Maximum permissible errors (MPEs)</p> <p>3. The MPEs are defined as follows:</p> <p>3.1. For each of the fractions measured, the maximum error value permitted under rated operating conditions according to paragraph 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.</p>	5.4.1 5.4.2 + 9.1+ A.2																															
<table border="1"> <thead> <tr> <th data-bbox="178 965 443 999">Table 2</th> <th colspan="2" data-bbox="443 965 967 999"></th> </tr> <tr> <th data-bbox="178 999 443 1032">Parameter</th> <th data-bbox="443 999 707 1032">Class 0</th> <th data-bbox="707 999 967 1032">Class I</th> </tr> </thead> <tbody> <tr> <td data-bbox="178 1032 443 1099">CO fraction</td> <td data-bbox="443 1032 707 1099">$\pm 0,03\% \text{ vol}$</td> <td data-bbox="707 1032 967 1099">$\pm 0,06\% \text{ vol}$</td> </tr> <tr> <td data-bbox="178 1099 443 1133"></td> <td data-bbox="443 1099 707 1133">$\pm 5\%$</td> <td data-bbox="707 1099 967 1133">$\pm 5\%$</td> </tr> <tr> <td data-bbox="178 1133 443 1167">CO₂ fraction</td> <td data-bbox="443 1133 707 1167">$\pm 0,5\% \text{ vol}$</td> <td data-bbox="707 1133 967 1167">$\pm 0,5\% \text{ vol}$</td> </tr> <tr> <td data-bbox="178 1167 443 1200"></td> <td data-bbox="443 1167 707 1200">$\pm 5\%$</td> <td data-bbox="707 1167 967 1200">$\pm 5\%$</td> </tr> <tr> <td data-bbox="178 1200 443 1234">HC fraction</td> <td data-bbox="443 1200 707 1234">$\pm 10 \text{ ppm vol}$</td> <td data-bbox="707 1200 967 1234">$\pm 12 \text{ ppm vol}$</td> </tr> <tr> <td data-bbox="178 1234 443 1267"></td> <td data-bbox="443 1234 707 1267">$\pm 5\%$</td> <td data-bbox="707 1234 967 1267">$\pm 5\%$</td> </tr> <tr> <td data-bbox="178 1267 443 1301">O₂ fraction</td> <td data-bbox="443 1267 707 1301">$\pm 0,1\% \text{ vol}$</td> <td data-bbox="707 1267 967 1301">$\pm 0,1\% \text{ vol}$</td> </tr> <tr> <td data-bbox="178 1301 443 1402"></td> <td data-bbox="443 1301 707 1402">$\pm 5\%$</td> <td data-bbox="707 1301 967 1402">$\pm 5\%$</td> </tr> </tbody> </table>	Table 2			Parameter	Class 0	Class I	CO fraction	$\pm 0,03\% \text{ vol}$	$\pm 0,06\% \text{ vol}$		$\pm 5\%$	$\pm 5\%$	CO ₂ fraction	$\pm 0,5\% \text{ vol}$	$\pm 0,5\% \text{ vol}$		$\pm 5\%$	$\pm 5\%$	HC fraction	$\pm 10 \text{ ppm vol}$	$\pm 12 \text{ ppm vol}$		$\pm 5\%$	$\pm 5\%$	O ₂ fraction	$\pm 0,1\% \text{ vol}$	$\pm 0,1\% \text{ vol}$		$\pm 5\%$	$\pm 5\%$	5.4.2 table 4 class II excluded	Class II of OIML and ISO is not allowed by MID
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<p>3.2. The MPE on lambda calculation is 0,3%. The conventional true value is calculated according to the formula defined in point 5.3.7.3 of Annex I of Directive 98/69/EC of the EP and the Council relating to measures to be taken against air pollution by emissions from motor vehicles and amending Council Directive 70/220/EEC.¹</p> <p>For this purpose, the values displayed by the instrument are used for calculation.</p>	5.10																															
<p>Permissible effect of disturbances</p> <p>4. For each of the volume fractions measured by the instrument, the critical change value is equal to the MPE</p>	3.20 9.4.1 + 9.4.2 + 9.5																															

¹ OJ L 350, 28.12.1998, p. 17.

for the parameter concerned.						
5. The effect of an electromagnetic disturbance shall be such that:					9.5	
<ul style="list-style-type: none"> – either the change in the measurement result is not greater than the critical change value laid down in paragraph 4; – or the presentation of the measurement result is such that it cannot be taken for a valid result. 						
Other requirements					5.3.2 table 2	OIML includes also class II not allowed by MID For O ₂ , 0,02 % possible according to R99 (to be checked if the value 0,02 % is maintained in OIML in the revision)
6. The resolution shall be equal to or of one order of magnitude higher than the values shown in Table 3. Table 3						
	CO	CO ₂	O ₂	HC		
Class 0 and class I	0,01% vol	0,1% vol	*	1 ppm vol		
* 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.					5.10	
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.					5.12	
8. For measuring CO, CO ₂ 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 O ₂ , 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.					5.7	The gas referred in A18 .2 is only for testing CO, CO ₂ and HC (for testing O ₂ it shall be free of O ₂)
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:					5.5.3	
6% vol CO,						
16% vol CO ₂ ,						
10% vol O ₂ ,						

<p>5% vol H₂,</p> <p>0,3% vol NO,</p> <p>2 000 ppm vol HC (as n-hexane),</p> <p>water vapour up to saturation.</p>		
<p>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.</p>	6.2.1, 6.2.2	
<p>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.</p>	6.3.6	
<p>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, exceeds 20 ppm vol.</p>	6.3.2, 6.3.3	
<p>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.</p>	6.3.4	Slight different wording
<p>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.</p>	Annex F	Typical formula in Annex F might not fulfil all cases foreseen in 14 of MID (revision of R99 will consider new formula relevant for LPG)
<p>CONFORMITY ASSESSMENT</p> <p>The conformity assessment procedures referred to in Article 9 that the manufacturer can choose between are:</p> <p>B+F or B+D or H1.</p>		