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European cooperation in legal metrology

Exhaust gas analyser Cross Reference Table 2004/22/EC vs. OIML R 99-1 & 2 - 2008



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European cooperation in legal metrology

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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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Exhaust gas analyser
Cross Reference Table 2004/22/EC vs. OIML R 99-1 & 2 - 2008
Draft for a WELMEC guide

Notes:

1. The column “Comments” indicates when necessary the relevant text of OIML R 99-1 & 2 and related explanations concerning the compliance with the relevant requirements in Directive 2004/22/EC.
2. The column “Conclusion” gives the conclusion on the compliance between OIML R 99-1 & 2 and the relevant requirement in Directive 2004/22/EC.

The indication “Covered” means that:

- the requirement of OIML R 99-1 & 2 is identical to the one of Directive 2004/22/EC ; or
- the requirement of OIML R 99-1 & 2 is more severe than the one of Directive 2004/22/EC ; or
- All the requirement of OIML R 99-1 & 2 fulfils the requirements in Directive 2004/22/EC (even when Directive 2004/22/EC allows other alternatives),
- In case the requirement is not fully covered, a short statement explains what is covered.

The indication “Not Covered” means that the requirement in Directive 2004/22/EC is either not compatible with the relevant OIML R 99-1 & 2 requirement or not included in OIML R 99-1 & 2.

The indication “Not relevant” means that the requirement in Annex I of Directive 2004/22/EC is not relevant for exhaust gas analyser. .

The text in *italic* is an extract from the relevant clause of the OIML Recommendation.

Directive 2004/22/EC Essential requirements of Annex I and Annex MI-010	OIML R 99-1 & 2 (2008)	Comments	Conclusion
ANNEX 1			
<p>1.1 Allowable Errors Under rated operation conditions and in 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>2.4 3.17 to 3.19 3.25 5.5.2 9.4.1 A.5 to A.9</p>	<p>The definition of “maximum permissible error” is not repeated in OIML R 99-1 & 2 since it is defined in VIM which is referred to in 2.4.</p>	<p>Covered</p>
<p>1.2 Under rated operating conditions and in 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 electromagnetic field-amplitude modulated test shall be within MPE.</p>	<p>3.20 3.21 3.27 5.7 9.5 A.11 to A.18</p>	<p>See correspondence between critical change value (MID) and significant fault (OIML) in WELMEC Guide 8.1.</p> <p><i>Gas exhaust analysers are not intended to be used in a specified permanent continuous electromagnetic field</i></p>	<p>Covered for disturbances</p> <p>Permanent continuous electromagnetic field not relevant</p>

<p align="center">Directive 2004/22/EC</p> <p align="center">Essential requirements of Annex I and Annex MI-010</p>	<p align="center">OIML R 99-1 & 2 (2008)</p>	<p align="center">Comments</p>	<p align="center">Conclusion</p>
<p>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 into account of the requirements laid down in the appropriate instrument-specific annexes.</p>	<p align="center">5.6.2</p>	<p>The rated operating conditions are defined in 5.6.2. However, for some of them the manufacturer may specify other values.</p> <p>“.....</p> <p><i>(1) Unless otherwise specified by the manufacturer, these are the standardized ranges for the ambient temperature. The manufacturer, however, can specify different ranges under the following conditions:</i></p> <ul style="list-style-type: none"> - the lower temperature shall be 5 °C; - the higher temperature shall be either 40 °C or 55 °C. <p><i>(2) Unless otherwise specified by the manufacturer, this is the standardized range for the atmospheric pressure. The manufacturer, however, can specify an extended range for atmospheric pressure, but this shall include the standardized range.</i></p> <p>....”</p>	<p>Covered</p>

<p align="center">Directive 2004/22/EC</p> <p align="center">Essential requirements of Annex I and Annex MI-010</p>	<p align="center">OIML R 99-1 & 2 (2008)</p>	<p align="center">Comments</p>	<p align="center">Conclusion</p>
<p>1.3.1 Climatic environments 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 align="center">Temperature limits:</p> <p>Upper temperature limit</p> <p>30 °C</p> <p>40 °C</p> <p>55 °C</p> <p>70 °C</p> <p>Lower temperature limit</p> <p>5 °C</p> <p>-10 °C</p> <p>-25 °C</p> <p>-40 °C</p>	<p>5.6.2</p> <p>9.4.1</p>	<p>“Rated operation conditions</p> <p>a) <i>ambient temperature + 5 °C to + 40 °C⁽¹⁾</i></p> <p>.....</p> <p><i>(1) Unless otherwise specified by the manufacturer, these are the standardized ranges for the ambient temperature. The manufacturer, however, can specify different ranges under the following conditions:</i></p> <ul style="list-style-type: none"> ▪ <i>the lower temperature shall be 5 °C;</i> ▪ <i>the higher temperature shall be either 40 °C or 55 °C.</i> <p>...”</p> <p>Damp heat steady-state test is mandatory and described in Annex A (A.7).</p> <p>Cyclic test is not relevant for this category of measuring instrument regarding their conditions of use.</p>	<p>Covered</p>

<p align="center">Directive 2004/22/EC</p> <p align="center">Essential requirements of Annex I and Annex MI-010</p>	<p align="center">OIML R 99-1 & 2 (2008)</p>	<p align="center">Comments</p>	<p align="center">Conclusion</p>
<p>1.3.2 (a) Mechanical environments are classified into classes M1 to M3 as described below</p>			
<p>1.3.2 (a) M1 and M2</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 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>5.7 a) and b)</p> <p>9.5 a)</p> <p>A.11</p>	<p>Severity levels of OIML R 99-1 & 2 correspond to level M2 of MID and OIML D 11.</p>	<p>Covered</p>
<p>1.3.2 (a) M3</p> <p>M3: This class applies to instruments used in 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>Level M3 is not relevant for this category of measuring instrument regarding their conditions of use.</p>	<p>Not relevant</p>
<p>1.3.2. (b) The following influence quantities shall be considered in relation with mechanical environments:</p> <ul style="list-style-type: none"> - Vibration - Mechanical shock 	<p>5.7 a) and b)</p> <p>9.5 a)</p> <p>A.11</p>		<p>Covered</p>

<p align="center">Directive 2004/22/EC</p> <p align="center">Essential requirements of Annex I and Annex MI-010</p>	<p align="center">OIML R 99-1 & 2 (2008)</p>	<p align="center">Comments</p>	<p align="center">Conclusion</p>
<p>1.3.3 (a) Electromagnetic environments are classified into E1, E2 or E3 as described below, unless otherwise laid down in the appropriate instrument-specific annexes.</p>			
<p>1.3.3 (a) E1 E2</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>5.7 c) to e) 5.7 g) to k) 9.5 b) and c) 9.5 e) to h) A.12, A 13, and A.15 to A.18</p>	<p>Severity levels for electromagnetic environment tests of OIML R 99-1 & 2 correspond to level E2 of MID and of OIML D 11 except for power frequency magnetic fields and voltage transient on supply lines and/or signal lines.</p>	<p>Covered except for power frequency magnetic fields and voltage transient on supply lines and/or signal lines</p>
<p>1.3.3 (a) E3</p> <p>E3: This class applies to instruments supplied by the battery of a vehicle. Such instruments shall comply with the requirements of E2 and the following additional requirements</p> <ul style="list-style-type: none"> - voltage reductions caused by energizing the starter-motor circuits of internal combustion engines, - load dump transients occurring in the event of a discharged battery being disconnected while the engine is running. 	<p>5.7 c) to k) 9.5 b) to h) A.12 to A.18</p>	<p>See above comment concerning E2.</p> <p>Pulse 5 corresponding to load dump transient is not mentioned in OIML R 99-1 & 2.</p>	<p>Covered except for power frequency magnetic fields and voltage transient on supply lines and/or signal lines and for load dump transient.</p>

<p align="center">Directive 2004/22/EC</p> <p align="center">Essential requirements of Annex I and Annex MI-010</p>	<p align="center">OIML R 99-1 & 2 (2008)</p>	<p align="center">Comments</p>	<p align="center">Conclusion</p>
<p>1.4.1 <i>Basic rules for testing and the determination of errors</i> Essential requirements specified in 1.1 and 1.2 shall be verified for each relevant influence quantity. 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. 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>	<p>8.1.2</p> <p>8.1.3</p> <p>Annex A</p>	<p>As a general principle, effects of each influence factor and each disturbance are evaluated separately.</p> <p>The various sections of Annex A indicates, for each influence quantity when the metrological tests applies (during or after the application of the influence quantity).</p>	<p>Covered</p>
<p>1.4.2 <i>Ambient humidity</i> - 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.</p>	<p>9.4.1 c)</p> <p>A.7</p>	<p>Only the damp heat - steady state is appropriate and applies to this category of measuring instrument.</p>	<p>Covered for damp heat steady state. Damp heat cyclic not relevant.</p>

<p align="center">Directive 2004/22/EC</p> <p align="center">Essential requirements of Annex I and Annex MI-010</p>	<p align="center">OIML R 99-1 & 2 (2008)</p>	<p align="center">Comments</p>	<p align="center">Conclusion</p>
<p>2</p> <p>Reproducibility The application of the same measurand in a different location or by 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>			<p align="center">Not relevant</p>
<p>3</p> <p>Repeatability 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>	<p align="center">5.13</p> <p align="center">9.3</p> <p align="center">A.4</p>		<p align="center">Covered</p>
<p>4</p> <p>Discrimination and sensitivity A measuring instrument shall be sufficiently sensitive and the discrimination threshold shall be sufficiently low for the intended measurement task.</p>	<p align="center">5.2</p> <p align="center">5.3</p> <p align="center">5.6.3</p> <p align="center">5.8</p>	<p>Minimum values of all the measuring ranges are 0.</p> <p>Resolution of indication</p> <p>Influence of other gas components on the measurand</p> <p>Response time</p>	<p align="center">Covered</p>
<p>5</p> <p>Durability A measuring instrument shall be designed to maintain an adequate stability of its metrological characteristics over a period of time estimated by the manufacturer's instruction when in the environmental conditions for which it is intended.</p>	<p align="center">5.12</p> <p align="center">6</p> <p align="center">9.2</p>	<p>Sections 5.12 and 9.2 are related to stability of the instrument with time.</p> <p>Section 6 defines technical requirements which are part of durability requirements.</p>	<p align="center">Covered</p>

Directive 2004/22/EC Essential requirements of Annex I and Annex MI-010		OIML R 99-1 & 2 (2008)	Comments	Conclusion
6	Reliability 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.	6.3	Security of operation	Covered
7	Suitability			
7.1	A measuring instrument shall have no feature likely to facilitate fraudulent use, whereas possibilities for unintentional misuse shall be minimal.	6.3.9 6.3.10		Covered
7.2	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.	5.1 5.9 5.10 5.11 6.2 6.3	Indication of the measurement result Warm-up time Propane/hexane equivalency factor Lambda calculation Adjustment facilities Security of operation	Covered
7.3	The errors of a utility measuring instrument at flows or currents outside the controlled range shall not be unduly biased.			Not relevant

<p align="center">Directive 2004/22/EC</p> <p align="center">Essential requirements of Annex I and Annex MI-010</p>	<p align="center">OIML R 99-1 & 2 (2008)</p>	<p align="center">Comments</p>	<p align="center">Conclusion</p>
<p>7.4 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>			<p align="center">Not relevant</p>
<p>7.5 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>	<p align="center">6.1</p>	<p>Constructional requirements</p>	<p align="center">Covered</p>

<p align="center">Directive 2004/22/EC</p> <p align="center">Essential requirements of Annex I and Annex MI-010</p>	<p align="center">OIML R 99-1 & 2 (2008)</p>	<p align="center">Comments</p>	<p align="center">Conclusion</p>
<p>7.6 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>	<p>6.1.4.2</p> <p>6.2.1</p> <p>6.3.2</p> <p>6.3.4</p> <p>6.3.5</p> <p>6.3.6</p> <p>6.3.7</p> <p>6.3.9</p> <p>6.3.12</p> <p>6.3.10</p>		<p>Covered except for the description of test procedure in the operational manual.</p>

8	Protection against corruption		
8.1	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</p> <p><i>“The instrument may be equipped with an interface permitting coupling to any peripheral device(s) or other instrument(s).</i></p> <p><i>An interface shall not allow the metrological functions of the instrument(s) or their measurement data to be influenced by the peripheral devices, by other interconnected instruments or by disturbances acting on the interface.</i></p> <p><i>Functions that are performed or initiated via an interface shall meet the relevant requirements and conditions of clause 6.</i></p> <p><i>If the instrument is connected to a data printer or an external data storage device, then the data transmission from the instrument to the printer shall be designed so that the results cannot be falsified.</i></p> <p><i>It shall not be possible to print out a document or store the measuring data in an external device for legal purposes if the instrument checking facility(ies) detect(s) a significant fault or a malfunction....”</i></p> <p>6.3.11</p> <p><i>“The metrological characteristics of an 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.”</i></p>	Covered
8.2	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</p> <p><i>“Effective sealing devices shall be provided on all parts of the instrument that are not materially protected in another way against operations liable to affect the accuracy or the integrity of the instrument.</i></p> <p><i>This applies in particular to:</i></p> <ul style="list-style-type: none"> ▪ <i>adjustment means;</i> ▪ <i>software integrity;</i> ▪ <i>replaceable oxygen fuel cell.”</i> 	Covered

<p>8.3 Software that is critical for metrological characteristics shall be identified as such and shall be secured. Software identification shall be easily provided by the measuring instrument. Evidence of an intervention shall be available for a reasonable period of time.</p>	<p>6.3.10 7.1.1 7.1.3</p>		<p>Covered except for the evidence of an intervention</p>
<p>8.4 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>	<p>6.3.10</p>		<p>Covered</p>
<p>8.5 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>			<p>Not relevant</p>

9	Information to be borne by and to accompany the instrument		
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, plus, when applicable - information in respect of the conditions of use - measuring capacity - measuring range - identity marking - number of 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	<p>All the listed inscriptions are included in the § 7.1 of R 99-1 & 2 except information related to the presence of additional device.</p> <p>Covered except for the information related to additional devices</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>		<p>Not relevant</p>

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 use - conditions for compatibility with interfaces, sub-assemblies or measuring instruments. 	7.2	Covered
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>		Not relevant
9.5	<p>Unless specified otherwise in an instrument-specific annex, the scale interval for a measured value shall 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.</p>	5.1 5.3	Covered
9.6	<p>A material measure shall be marked with a nominal value or a scale, accompanied by the unit of measurement used.</p>		Not 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		Covered
9.8	All marks and inscriptions required under any requirement shall be clear, non-erasable, unambiguous and non-transferable.	7.1.1	<i>"The instrument shall have a permanent, non-transferable, and easily readable label or labels giving the following information:.."</i>	Covered
10	Indication of result			
10.1	Indication of the result shall be by means of a display or a hard copy.	4.1 4.3		Covered
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 present 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	<i>"The volume fractions of the gas components shall be expressed as a percentage (% vol) for CO, CO₂ and O₂ and in parts per million (ppm vol) for HC. The inscriptions for these units shall be assigned unambiguously to the indication, for example "% vol CO", "% vol CO₂", "% vol O₂" and "ppm vol HC". It shall be possible to display the indication of the measurement results of the different components simultaneously."</i>	Covered
10.3	In the case of hard copy the print or record shall also be easily legible and non-erasable.	5.4		Covered
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.		Not for direct sales trading.	Not relevant

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 customer. The reading of this display is the measurement result that serves as the basis for the price to pay.			Not relevant
11	Further processing of data to conclude the trading transaction			
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: - the measurement is non-repeatable - the measuring instrument is normally intended for use in the absence of one of the trading parties.	5.4	<i>"The measurement results shall be recorded by a durable means, accompanied by information to identify the particular measurement."</i>	Covered
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.	5.4		Covered
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 but an instrument in conformity with the OIML Recommendation allows its ready evaluation.	Covered

<p>Lambda</p> <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>	<p>3.33</p>		<p>Covered</p>
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<p>1 Instrument Classes</p> <p>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 style="text-align: center;"><i>Table 1</i></p> <p style="text-align: center;">Classes and measuring ranges</p> <p style="text-align: center;">Parameter</p> <p style="text-align: center;">Classes 0 and I</p> <p style="text-align: center;">CO fraction</p> <p style="text-align: center;">from 0 to 5 %</p> <p style="text-align: center;">CO₂ fraction</p> <p style="text-align: center;">From 0 to 16 %</p> <p style="text-align: center;">HC fraction</p> <p style="text-align: center;">From 0 to 2 000 ppm vol</p> <p style="text-align: center;">O₂ fraction</p> <p style="text-align: center;">From 0 to 21 %</p> <p style="text-align: center;">Λ lambda</p> <p style="text-align: center;">0,8 to 1,2</p>	<p style="text-align: center;">5.2</p> <p style="text-align: center;">5.11</p>	<p>OIML R 99-1 & 2 allows more types of exhaust gas analysers than the MID (e.g. instruments which measure less than the four components).</p>	<p>Covered</p>
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<p>2 Rated operating conditions</p> <p>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>5.6.2</p> <p>5.7 a) and b)</p>		<p>Covered</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; ▪ The limits of the DC voltage supply. 	<p>5.6.2 d) to g)</p>	<p>In the OIML R 99 the values are not "specified by the manufacturer" but they are defined in the text itself . So if a manufacturer uses OIML R 99 for presumption of conformity it means that he is using the values fixed in R 99.</p>	<p>Covered for the values fixed in R 99.</p>
<p>2.3 For the ambient pressure:</p> <ul style="list-style-type: none"> ▪ The minimum and the maximum values of the ambient pressure are for both classes: $p_{\min} \leq 860 \text{ hPa}$, $p_{\max} \geq 1\ 060 \text{ hPa}$. 	<p>5.6.2 c)</p>		<p>Covered</p>
<p>Maximum permissible error (MPEs)</p> <p>3 The MPEs are defined as follows:</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.

Table 2

MPEs

Parameter

Class 0

Class I

CO fraction

± 0,03 % vol

± 5 %

± 0,06 % vol

± 5 %

CO₂ fraction

± 0,5 % vol

± 5 %

± 0,5 % vol

± 5 %

HC fraction

± 10 ppm vol

± 5 %

± 12 ppm vol

± 5 %

O₂ fraction

± 0,1 % vol

5.5.1

5.5.2

Covered

<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>	<p>5.11 Annex D</p>		<p>Covered</p>
<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 for the parameter concerned.</p>	<p>3.21</p>		<p>Covered</p>
<p>5 The effect of an electromagnetic disturbance shall be such that:</p> <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. 	<p>9.5</p>	<p>“9.5 Disturbances <i>Significant faults shall either not occur or shall be detected by means of checking facilities,...”</i></p>	<p>Covered</p>
<p>Other requirements</p>			

6	<p>The resolution shall be equal to or of one order of magnitude higher than the values shown in Table 3.</p> <p style="text-align: center;"><i>Table 3</i> Resolution</p> <p style="text-align: center;">CO CO₂ O₂ HC</p> <p style="text-align: center;">Class 0 and class I 0,01 % vol 0,1 % vol ⁽¹⁾ 1 ppm vol</p> <p>⁽¹⁾ 0,01 % vol for measurand value below or equal to 4 % vol, otherwise 0,1 % vol.</p> <p>The lambda value shall be displayed with a resolution of 0,001.</p>	5.3		Covered
7	<p>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.</p>	5.13		Covered
8	<p>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.</p>	5.8		Covered

9	<p>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:</p> <p>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.</p>	5.6.3		Covered
10	<p>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		Covered
11	<p>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		Covered
12	<p>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		Covered

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.	6.3.4	Covered
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.	5.11 Annex D	Covered provided that coefficients are available for the relevant fuels