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Heavy duty vehicles: UN Regulations Nos. 49 (Emissions of compression ignition and positive ignition (LPG and CNG) engines) and 132 (Retrofit Emissions Control devices (REC))

Proposal for a new Supplement to the 05 series of amendments to UN Regulation No. 49 (Emissions of compression ignition and positive ignition (LPG and CNG) engines)

Submitted by the expert from the International Organization of Motor Vehicle Manufacturers*

The text reproduced below was prepared by the expert from the International Organization of Motor Vehicle Manufacturers (OICA). This document proposes to correct the provisions described in current text of 05 series of Amendments to UN Regulation No. 49. The modifications of the current text of the Regulation are marked in bold for new or strikethrough for deleted characters.

* In accordance with the programme of work of the Inland Transport Committee for 2021 as outlined in proposed programme budget for 2021 (A/75/6 (Sect.20), para 20.51), the World Forum will develop, harmonize and update UN Regulations in order to enhance the performance of vehicles. The present document is submitted in conformity with that mandate.

I. Proposal

Annex 4B, paragraph 8.2.; amend to read:

"8.2. NOx correction for humidity

As the NOx emission depends on ambient air conditions, the NOx concentration shall be corrected for humidity with the factors given in paragraph 8.2.1. or 8.2.2. The intake air humidity Ha may be derived from relative humidity measurement, dew point measurement, vapour pressure measurement or dry/wet bulb measurement using generally accepted equations.

For all humidity calculations (for example Ha, Hd) using generally accepted equations the saturation vapour pressure is required. For calculating the saturation vapour pressure which is in general a function of the temperature (at the humidity measurement point) the equation D.15 specified in Annex D to ISO Standard 8178-4 should be used."

Annex 4B - Scope, paragraph 9.2.; amend to read:

"9.2. Linearity requirements

…..

Table 7

Linearity requirements of instruments and measurement systems

"

Measurement system	$\chi min \times (a1 - 1) + a0$	Slope a1	Standard error SEE	*Coefficient of Determination* r^2
Engine speed	≤ 0.05 % max	0.98 - 1.02	≤ 2 % max	≥ 0.990
Engine torque	≤ 1 % max	0.98 - 1.02	≤ 2 % max	≥ 0.990
Fuel flow	≤ 1 % max	0.98 - 1.02	≤ 2 % max	≥ 0.990
Airflow	≤ 1 % max	0.98 - 1.02	≤ 2 % max	≥ 0.990
Exhaust gas flow	≤ 1 % max	0.98 - 1.02	≤ 2 % max	≥ 0.990
Diluent flow	≤ 1 % max	0.98 - 1.02	≤ 2 % max	≥ 0.990
Diluted exhaust gas flow	≤ 1 % max	0.98 - 1.02	≤ 2 % max	≥ 0.990
Sample flow	≤ 1 % max	0.98 - 1.02	≤ 2 % max	≥ 0.990
Gas analyzers	≤ 0.5 % max	0.99 - 1.01	≤ 1 % max	≥ 0.998
Gas dividers	≤ 0.5 % max	0.98 - 1.02	≤ 2 % max	≥ 0.990
Temperatures	≤ 1 % max	0.99 - 1.01	≤ 1 % max	≥ 0.998
Pressures	≤ 1 % max	0.99 - 1.01	≤ 1 % max	≥ 0.998
PM balance	≤ 1 % max	0.99 - 1.01	≤ 1 % max	≥ 0.998
Humidity measurement device	**≤ 2 % max.**	**0.98 – 1.02**	**≤ 2 %**	**≥ 0.95**

"

Annex 4A, Appendix 1 paragraph 5.3.; amend to read:

"5.3. NOx correction for humidity and temperature

As the NOx emission depends on ambient air conditions, the NOx concentration shall be corrected for ambient air temperature and humidity with

the factors given in the following formulae. The factors are valid in the range between 0 and 25 g/kg dry air.

(a) For compression ignition engines:

$$k_{h,D} = \frac{1}{1 - 0.0182 \times (H_a - 10.71) + 0.0045 \times (T_a - 298)}$$

With:

Ta = temperature of the intake air, K

Ha = humidity of the intake air, g water per kg dry air

Where:

Ha may be derived from relative humidity measurement, dewpoint measurement, vapour pressure measurement or dry/wet bulb measurement using the generally accepted formulae.

(b) For spark ignition engines

$k_{h,G} = 0.6272 + 44.030 \times 10^{-3} \times H_a - 0.862 \times 10^{-3} \times H_a^2$

Where:

Ha may be derived from relative humidity measurement, dew point measurement, vapour pressure measurement or dry/wet bulb measurement using the generally accepted formulae**.**

For all humidity calculations (for example Ha, Hd) using generally accepted equations the saturation vapour pressure is required. For calculating the saturation vapour pressure which is in general a function of the temperature (at the humidity measurement point) the equation D.15 specified in Annex D to ISO Standard 8178-4 should be used."

Annex 4A. Appendix 5

Paragraph 1.2.1., amend to read:

"1.2.1. Pure gas

……

Hydrogen~~-helium~~ mixture (FID burner fuel)

(40 ± 1 per cent hydrogen, balance helium **or alternatively nitrogen**)

(Contamination ≤ 1 ppm C1, ≤ 400 ppm CO2)"

Paragraph 1.7.2., amend to read:

"1.7.2. Calibration

The CLD and the HCLD shall be calibrated in the most common operating range following the manufacturer's specifications using zero and span gas (the NO content of which shall amount to about 80 per cent of the operating range and the NO2 concentration of the gas mixture to less than 5 per cent of the NO concentration). **With the ozonator deactivated**, the NOx analyzer shall be in the NO mode so that the span gas does not pass through the converter. The indicated concentration has to be recorded."

Paragraph 1.7.8., amend to read:

"1.7.8. NO**x** mode

~~Switched to~~ **Keeping** NO**x** mode with the ozonator deactivated, the flow of oxygen or synthetic air is also shut off. The NOx reading of the analyzer shall not deviate by more than ±5 per cent from the value measured according to paragraph 1.7.2. (the analyzer is in the NO**x** mode)".

II. Justification

1. Annex 4B, paragraph 8.2.; amendments related to the NOx correction for humidity

The reasoning is derived from the experience, and the need for the amendment has been raised by technical service.

2. Annex 4B – Amendments to paragraph 9.2.

3. The reasoning for adding a row is the following.

Regulation 49 defines no linearity requirements for humidity sensors. As the humidity content of the intake air is an essential measure for the calculation of the specific exhaust emission, it is important to add requirement for humidity sensor (Reference: ISO 16183 the accuracy of the absolute humidity shall be +- 5%).

4. Annex 4B – Amendments to paragraph 9.3.3.1.

Helium is produced with high energy consumption by fractioning natural gas. It is already classified as a critical resource by the EU as well as USA. In the automotive industry Helium is used as so fuel gas for flame ionization detectors (FID) to measure Hydrocarbon emissions. In the FID fuel gas Helium is mixed with Hydrogen in a ratio of 40 % H2 and 60 % He. The annual fluctuations of the helium global market lead to an insufficient supply with FID fuel gas, like happened lately during summer 2018. In order to prevent the industry from the fluctuations of the global helium market, the US legislation reacted already in 2014 and allowed the usage of Nitrogen as batch gas for the FID fuel gas (§1065.750 (2i) [https://ecfr.io/Title-40/pt40.37.1065#se40.37.1065_1260].

5. Annex 4A. Appendix 5, Amendments to paragraph 1.2.1.

Same reasoning as previous for Annex 4B, paragraph 9.3.3.1.

6. Annex 4A, Appendix 5, Amendments to paragraph 1.7.2.

To clarify the operation procedure, make the text easier to be understood.

7. Annex 4A, Appendix 5, Amendments to paragraphs 1.7.7. and 1.7.8.

Typo error, the instrument should be now in NOx mode.