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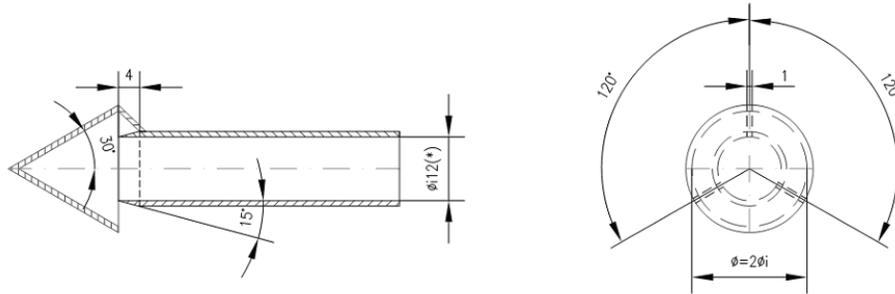
Particle Measurement Programme**Proposal for a Corrigendum to Supplement 7 to the 05 series
of amendments to Regulation No. 83
(Emissions of M₁ and N₁ vehicles)****Submitted by the expert from the United Kingdom ***

The text reproduced below was prepared by the expert from the United Kingdom to clarify, correct and update elements of the provisions of Annex 4a to Regulation No. 83. The proposal is based on informal document No. GRPE-59-04, distributed during the fifty-ninth session of the Working Party on Pollution and Energy (GRPE) (see report ECE/TRANS/WP.29/GRPE/59, para. 14). Modifications to the current text of the Regulation are marked in bold characters for new or as strikethrough for deleted text.

* In accordance with the programme of work of the Inland Transport Committee for 2006–2010 (ECE/TRANS/166/Add.1, programme activity 02.4), the World Forum will develop, harmonize and update Regulations in order to enhance the performance of vehicles. The present document is submitted in conformity with that mandate.

Annex 4a, Appendix 4, Figure 13, replace with:

“Figure 13
Particulate sampling probe configuration”



(*) Minimum internal diameter
 Wall thickness ~ 1 mm - Material: stainless steel

”

Annex 4a, Appendix 5

Insert a new paragraph 1.3.3.3., to read:

“**1.3.3.3. Control heated stages to constant nominal operating temperatures, within the range specified in paragraph 1.3.3.2., to a tolerance of ± 10 °C. Provide an indication of whether or not heated stages are at their correct operating temperatures.**”

Paragraphs 1.3.3.3. and 1.3.3.4. (former), renumber as paragraphs 1.3.3.4. and 1.3.3.5.

Insert a new paragraph 1.3.5., to read:

“**1.3.5. Where they are not held at a known constant level at the point at which PNC flow rate is controlled, the pressure and/or temperature at inlet to the PNC must be measured and reported for the purposes of correcting particle concentration measurements to standard conditions.**”

Paragraph 1.3.5. (former), renumber as paragraph 1.3.6.

Paragraph 1.4.4., correct to read:

“1.4.4. Volatile Particle Remover (VPR)

The VPR shall comprise one particle number diluter (PND1), an evaporation tube and a second diluter (PND2) in series. This dilution function is to reduce the number concentration of the sample entering the particle concentration measurement unit to less than the upper threshold of the single particle count mode of the PNC and to suppress nucleation within the sample. **The VPR shall provide an indication of whether or not PND1 and the evaporation tube are at their correct operating temperatures.**”

The VPR shall achieve > 99.0 per cent vaporisation of 30 nm tetracontane ($\text{CH}_3(\text{CH}_2)_{38}\text{CH}_3$) particles, with an inlet concentration of $\geq 10,000 \text{ cm}^{-3}$, by means of heating and reduction of partial pressures of the tetracontane. It shall also achieve a particle concentration reduction factor (f_r) for particles of 30 nm and 50 nm electrical mobility diameters, that is no more than 30 per cent and 20 per cent respectively higher, and no more than 5 per cent lower

than that for particles of 100 nm electrical mobility diameter for the VPR as a whole.”

Paragraphs 1.4.4.1. and 1.4.4.2., correct to read:

“1.4.4.1. First Particle Number Dilution Device (PND₁)

The first particle number dilution device shall be specifically designed to dilute particle number concentration and operate at a (wall) temperature of 150 °C – 400 °C. The wall temperature setpoint should **be held at a constant nominal operating temperature, within this range, to a tolerance of ±10 °C** and not exceed the wall temperature of the ET (paragraph 1.4.4.2.). The diluter should be supplied with HEPA filtered dilution air and be capable of a dilution factor of 10 to 200 times.

1.4.4.2. Evaporation Tube

The entire length of the ET shall be controlled to a wall temperature greater than or equal to that of the first particle number dilution device and the wall temperature held at a fixed **nominal operating temperature** value between 300 °C and 400 °C, **to a tolerance of ±10 °C.**”

Paragraph 2., footnote 1/, correct to read:

“1/ Example calibration/validation methods are available at <http://www.unece.org/trans/main/wp29/wp29wgs/wp29grpe/pmpFCP.html>”

Paragraph 2.1.3., correct to read:

“2.1.3. Calibration shall be traceable to a standard calibration method:

- (a) By comparison of the response of the PNC under calibration with that of a calibrated aerosol electrometer when simultaneously sampling electrostatically classified calibration particles, or
- (b) By comparison of the response of the PNC under calibration with that of a second PNC which has been directly calibrated by the above method.

In the electrometer case, calibration shall be undertaken using at least six standard concentrations spaced as uniformly as possible across the PNC’s measurement range. These points will include a nominal zero concentration point produced by attaching HEPA filters of at least class H13 of EN 1822:2008, **or equivalent performance**, to the inlet of each instrument. With no calibration factor applied to the PNC under calibration, measured concentrations shall be within ±10 per cent of the standard concentration for each concentration used, with the exception of the zero point, otherwise the PNC under calibration shall be rejected. The gradient from a linear regression of the two data sets shall be calculated and recorded. A calibration factor equal to the reciprocal of the gradient shall be applied to the PNC under calibration. Linearity of response is calculated as the square of the Pearson product moment correlation coefficient (R^2) of the two data sets and shall be equal to or greater than 0.97. In calculating both the gradient and R^2 the linear regression shall be forced through the origin (zero concentration on both instruments).

In the reference PNC case, calibration shall be undertaken using at least six standard concentrations across the PNC’s measurement range. At least three points shall be at concentrations below 1,000 cm⁻³, the remaining concentrations shall be linearly spaced between 1,000 cm⁻³ and the maximum

of the PNC's range in single particle count mode. These points will include a nominal zero concentration point produced by attaching HEPA filters of at least class H13 of EN 1822:2008, or equivalent performance, to the inlet of each instrument. With no calibration factor applied to the PNC under calibration, measured concentrations shall be within ± 10 per cent of the standard concentration for each concentration, with the exception of the zero point, otherwise the PNC under calibration shall be rejected. The gradient from a linear regression of the two data sets shall be calculated and recorded. A calibration factor equal to the reciprocal of the gradient shall be applied to the PNC under calibration. Linearity of response is calculated as the square of the Pearson product moment correlation coefficient (R^2) of the two data sets and shall be equal to or greater than 0.97. In calculating both the gradient and R^2 the linear regression shall be forced through the origin (zero concentration on both instruments)."

Paragraph 2.2.1., correct to read:

"2.2.1. Calibration of the VPR's particle concentration reduction factors across its full range of dilution settings, at the instrument's **fixed nominal manufacturer's recommended** operating temperatures, shall be required when the unit is new and following any major maintenance. The periodic validation requirement for the VPR's particle concentration reduction factor is limited to a check at a single setting, typical of that used for measurement on diesel particulate filter equipped vehicles. The Technical Service shall ensure the existence of a calibration or validation certificate for the volatile particle remover within a 6 month period prior to the emissions test. If the volatile particle remover incorporates temperature monitoring alarms a 12 month validation interval shall be permissible.

The VPR shall be characterised for particle concentration reduction factor with solid particles of 30 nm, 50 nm and 100 nm electrical mobility diameter. Particle concentration reduction factors ($f_r(d)$) for particles of 30 nm and 50 nm electrical mobility diameters shall be no more than 30 per cent and 20 per cent higher respectively, and no more than 5 per cent lower than that for particles of 100 nm electrical mobility diameter. For the purposes of validation, the mean particle concentration reduction factor shall be within ± 10 per cent of the mean particle concentration reduction factor (\bar{f}_r) determined during the primary calibration of the VPR."

Paragraph 2.2.2., correct to read:

"2.2.2. The test aerosol for these measurements shall be solid particles of 30, 50 and 100 nm electrical mobility diameter and a minimum concentration of 5,000 particles cm^{-3} at the VPR inlet. Particle concentrations shall be measured upstream and downstream of the components.

The particle concentration reduction factor at each particle size ($f_r(d_i)$) shall be calculated as follows;

$$f_r(d_i) = \frac{N_{in}(d_i)}{N_{out}(d_i)}$$

where:

$N_{in}(d_i)$ = upstream particle number concentration for particles of diameter d_i ;

$N_{out}(d_i)$ = downstream particle number concentration for particles of diameter d_i ; and

d_i = particle electrical mobility diameter (30, 50 or 100 nm).

$N_{in}(d_i)$ and $N_{out}(d_i)$ shall be corrected to the same conditions.

The mean particle concentration reduction ($\overline{f_r}$) at a given dilution setting shall be calculated as follows;

$$\overline{f_r} = \frac{f_r(30nm) + f_r(50nm) + f_r(100nm)}{3}$$

It is recommended that the VPR is calibrated and validated as a complete unit.”

Paragraph 2.3.1., correct to read:

“2.3.1. Prior to each test, the particle counter shall report a measured concentration of less than 0.5 particles cm^{-3} when a HEPA filter of at least class H13 of EN 1822:2008, or equivalent performance, is attached to the inlet of the entire particle sampling system (VPR and PNC).”

Paragraphs 2.3.3. to 2.3.5., correct to read:

“2.3.3. Each day, following the application of a HEPA filter of at least class H13 of EN 1822:2008, or equivalent performance, to the inlet of the particle counter, the particle counter shall report a concentration of $\leq 0.2 \text{ cm}^{-3}$. Upon removal of this filter, the particle counter shall show an increase in measured concentration to at least 100 particles cm^{-3} when challenged with ambient air and a return to $\leq 0.2 \text{ cm}^{-3}$ on replacement of the HEPA filter.

2.3.4. **Prior to the start of each test, it shall be confirmed that the measurement system indicates that the evaporation tube, where featured in the system, has reached its correct operating temperature** ~~shall indicate a reading of 300 °C to 400 °C.~~

2.3.5. **Prior to the start of each test, it shall be confirmed that the measurement system indicates that the diluter PND₁ has reached its correct operating temperature** ~~shall indicate a wall temperature reading of 150 °C – 400 °C, but less than or equal to the set point of the evaporation tube.”~~