Submitted by the expert of OICA

Informal document **GRPE-80-17**
80th GRPE, 14-17 January 2020
agenda item 4.(b)

Proposal for amendments / corrigendum to UN GTR No. 4 - Summary of correction -

Background and Contents of Proposal

- There are many discrepancy among the amendment version of UN GTR No. 4 and UN Regulation No. 49 which seems to be mistakes in drafting.
- Amendment is only for the correction of the mistake in technical descriptions.
- It is expected to be confirmed by the expert in each area and determined in next GRPE.

If there are any question or suggestion, please contact following address.

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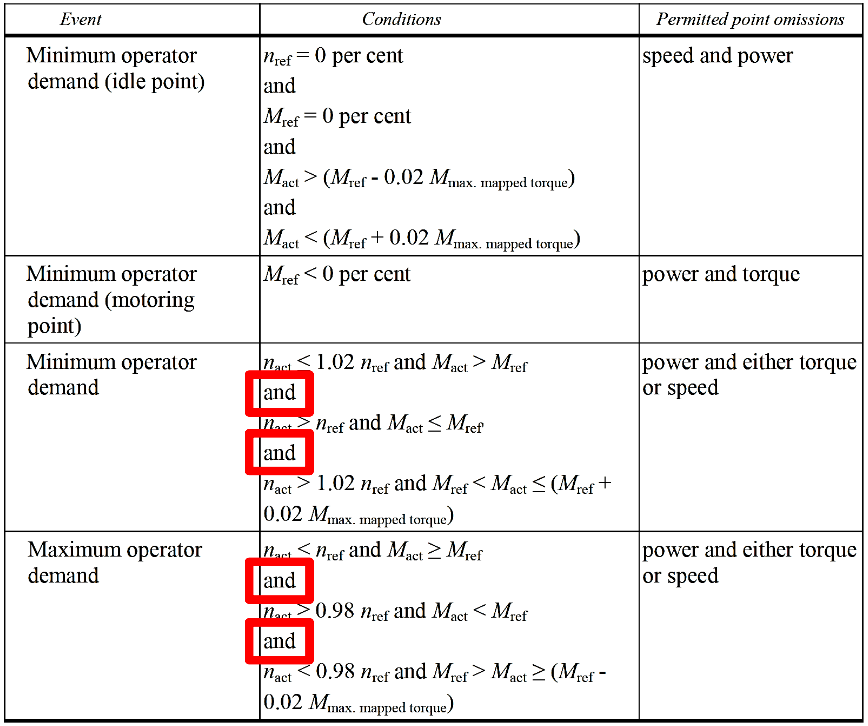
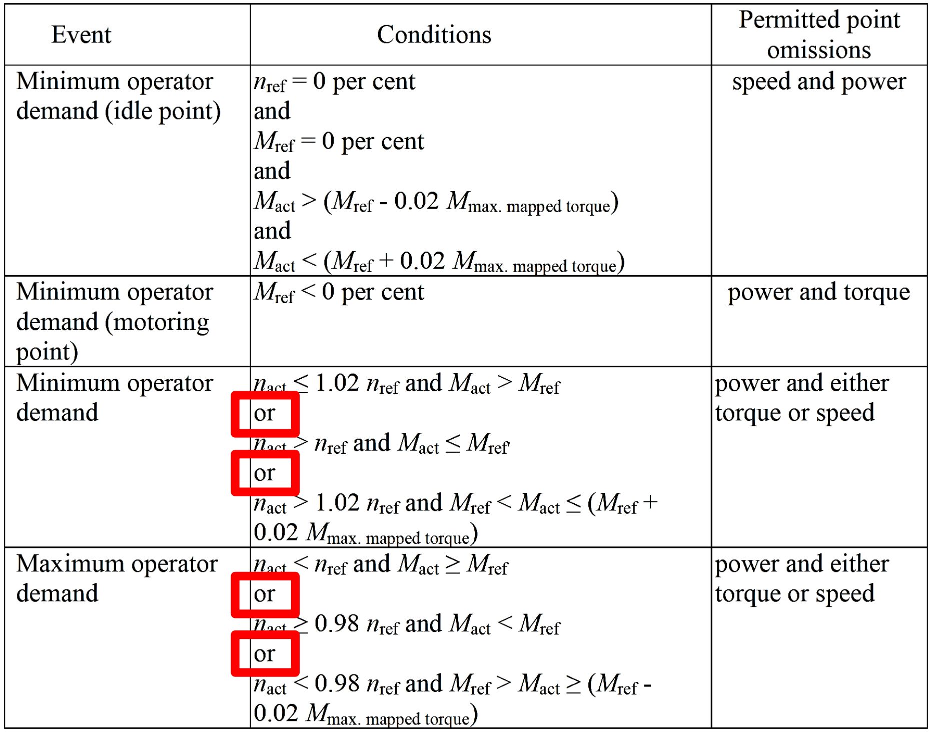
◇Paragraph 7.8.8. Validation statistics of the test cycle -Table4-

Error



Event	*Conditions*	*Permitted point omissions*
Minimum operator demand (idle point)	$n_{ref} = 0$ per cent and $M_{ref} = 0$ per cent and $M_{act} > (M_{ref} - 0.02\ M_{max.\ mapped\ torque})$ and $M_{act} < (M_{ref} + 0.02\ M_{max.\ mapped\ torque})$	speed and power
Minimum operator demand (motoring point)	$M_{ref} < 0$ per cent	power and torque
Minimum operator demand	$n_{act} \le 1.02\ n_{ref}$ and $M_{act} > M_{ref}$ $\boxed{\text{and}}$ $n_{act} > n_{ref}$ and $M_{act} \le M_{ref}$ $\boxed{\text{and}}$ $n_{act} > 1.02\ n_{ref}$ and $M_{ref} < M_{act} \le (M_{ref} + 0.02\ M_{max.\ mapped\ torque})$	power and either torque or speed
Maximum operator demand	$n_{act} < n_{ref}$ and $M_{act} \ge M_{ref}$ $\boxed{\text{and}}$ $n_{act} > 0.98\ n_{ref}$ and $M_{act} < M_{ref}$ $\boxed{\text{and}}$ $n_{act} < 0.98\ n_{ref}$ and $M_{ref} > M_{act} \ge (M_{ref} - 0.02\ M_{max.\ mapped\ torque})$	power and either torque or speed

Correct



Event	Conditions	Permitted point omissions
Minimum operator demand (idle point)	$n_{ref} = 0$ per cent and $M_{ref} = 0$ per cent and $M_{act} > (M_{ref} - 0.02\ M_{max.\ mapped\ torque})$ and $M_{act} < (M_{ref} + 0.02\ M_{max.\ mapped\ torque})$	speed and power
Minimum operator demand (motoring point)	$M_{ref} < 0$ per cent	power and torque
Minimum operator demand	$n_{act} \le 1.02\ n_{ref}$ and $M_{act} > M_{ref}$ $\boxed{\text{or}}$ $n_{act} > n_{ref}$ and $M_{act} \le M_{ref}$ $\boxed{\text{or}}$ $n_{act} > 1.02\ n_{ref}$ and $M_{ref} < M_{act} \le (M_{ref} + 0.02\ M_{max.\ mapped\ torque})$	power and either torque or speed
Maximum operator demand	$n_{act} < n_{ref}$ and $M_{act} \ge M_{ref}$ $\boxed{\text{or}}$ $n_{act} \ge 0.98\ n_{ref}$ and $M_{act} < M_{ref}$ $\boxed{\text{or}}$ $n_{act} < 0.98\ n_{ref}$ and $M_{ref} > M_{act} \ge (M_{ref} - 0.02\ M_{max.\ mapped\ torque})$	power and either torque or speed

◇Paragraph 8.1.1. Raw exhaust gas –Equation(15)-

Error

$$k_{w,a} = \left(1 - \frac{1.2442 \times H_a + 111.19 \times w_{ALF} \times \frac{q_{mf,i}}{q_{mad,i}}}{773.4 + 1.2442 \times H_a + \frac{q_{mf,i}}{q_{mad,i}} \times \boxed{k_f} \times 1{,}000}\right) \times 1.008$$

Correct

$$k_{w,a} = \left(1 - \frac{1.2442 \times H_a + 111.19 \times w_{ALF} \times \frac{q_{mf,i}}{q_{mad,i}}}{773.4 + 1.2442 \times H_a + \frac{q_{mf,i}}{q_{mad,i}} \times \boxed{k_{f,w}} \times 1{,}000}\right) \times 1.008$$

◇Paragraph 8.1.1. Raw exhaust gas –Equation(16)-

Error	Correct
$k_{\mathrm{w,a}} = \left(1 - \frac{1.2442 \times H_{\mathrm{a}} + 111.19 \times w_{\mathrm{ALF}} \times \frac{q_{m\mathrm{f,i}}}{q_{m\mathrm{ad,i}}}}{773.4 + 1.2442 \times H_{\mathrm{a}} + \frac{q_{m\mathrm{f,i}}}{q_{m\mathrm{ad,i}}} \times \boxed{k_{\mathrm{f}}} \times 1{,}000}\right) \Big/ \left(1 - \frac{p_{\mathrm{r}}}{p_{\mathrm{b}}}\right)$	$k_{\mathrm{w,a}} = \left(1 - \frac{1.2442 \times H_{\mathrm{a}} + 111.19 \times w_{\mathrm{ALF}} \times \frac{q_{m\mathrm{f,i}}}{q_{m\mathrm{ad,i}}}}{773.4 + 1.2442 \times H_{\mathrm{a}} + \frac{q_{m\mathrm{f,i}}}{q_{m\mathrm{ad,i}}} \times \boxed{k_{\mathrm{f,w}}} \times 1{,}000}\right) \Big/ \left(1 - \frac{p_{\mathrm{r}}}{p_{\mathrm{b}}}\right)$

◇Paragraph 8.4.2.3. Calculation of mass emission based on tabulated values –Equation(35)-

Error	Correct
$m_{\mathrm{gas}} = u_{gas} \times \sum_{i=1}^{i=n} c_{\mathrm{gas,i}} \times q_{m\mathrm{ew,i}} \times \frac{1}{f}$ (in g/test)	$\mathrm{m_{gas}} = \mathrm{u_{gas}} \times \sum_{\mathrm{i=1}}^{\mathrm{i=n}} \boxed{(} \mathrm{c_{gas,i}} \times \mathrm{q_{mew,i}} \times \frac{1}{\mathrm{f}} \boxed{)}$ (g/test)

◇Paragraph 8.4.2.4. Calculation of mass emission based on exact emissions –Equation(36)-

Error	Correct
$m_{\mathrm{gas}} = \sum_{i=1}^{i=n} u_{\mathrm{gas,i}} \times c_{\mathrm{gas,i}} \times q_{m\mathrm{ew,i}} \times \frac{1}{f}$ (in g/test)	$\mathrm{m_{gas}} = \sum_{\mathrm{i=1}}^{\mathrm{i=n}} \boxed{(} \mathrm{u_{gas,i}} \times \mathrm{c_{gas,i}} \times \mathrm{q_{mew,i}} \times \frac{1}{\mathrm{f}} \boxed{)}$ (in g/test)

◇Paragraph 8.5.1.4. SSV-CVS system

Error	Correct
The calculation of the mass flow over the cycle shall be as follows, if the temperature of the diluted exhaust is kept within ±11 K over the cycle by using a heat exchanger: $m_{ed} = 1.293 \times Q_{SSV}$ (55)	The calculation of the mass flow over the cycle shall be as follows, if the temperature of the diluted exhaust is kept within ±11 K over the cycle by using a heat exchanger: $m_{ed} = 1.293 \times Q_{SSV}$ (55)
With $Q_{SSV} = \boxed{A_0} d_V^{\,2} C_d p_p \sqrt{\left[\frac{1}{T}\left(r_p^{\,1.4286} - r_p^{\,1.7143}\right) \cdot \left(\frac{1}{1 - r_D^{\,4} r_p^{\,1.4286}}\right)\right]} \quad (56)$	With $Q_{SSV} = \frac{A_0}{60} d_V^{\,2} C_d p_p \sqrt{\left[\frac{1}{T}\left(r_p^{\,1.4286} - r_p^{\,1.7143}\right) \cdot \left(\frac{1}{1 - r_D^{\,4} r_p^{\,1.4286}}\right)\right]} \quad (56)$
Where: A_0 is **0.006111** in SI units of $\left(\frac{m^3}{\min}\right)\left(\frac{K^{\frac{1}{2}}}{kPa}\right)\left(\frac{1}{mm^2}\right)$	Where: A_0 is **0.005692** in SI units of $\left(\frac{m^3}{\min}\right)\left(\frac{K^{\frac{1}{2}}}{kPa}\right)\left(\frac{1}{mm^2}\right)$
d_V is the diameter of the SSV throat, **m**	d_V is the diameter of the SSV throat, **mm**
C_d is the discharge coefficient of the SSV	C_d is the discharge coefficient of the SSV
p_p is the absolute pressure at venturi inlet, kPa	p_p is the absolute pressure at venturi inlet, kPa
T is the temperature at the venturi inlet, K	T is the temperature at the venturi inlet, K
r_p is the ratio of the SSV throat to inlet absolute static pressure, $1 - \frac{\Delta p}{p_a}$	r_p is the ratio of the SSV throat to inlet absolute static pressure, $1 - \frac{\Delta p}{p_a}$
r_D is the ratio of the SSV throat diameter, d, to the inlet pipe inner diameter D	r_D is the ratio of the SSV throat diameter, d, to the inlet pipe inner diameter D

◇Paragraph 8.5.2.3.1. Systems with constant mass flow –Equation(59)-

Error	Correct
$u_{gas} = \frac{M_{gas}}{M_{d} \times \left(1-\frac{1}{D}\right) + M_{e} \times \left(\frac{1}{D}\right)}$	$\mathrm{u}_{gas} = \frac{\mathrm{M}_{gas}}{\mathrm{M}_{d} \times \left(1-\frac{1}{\mathrm{D}}\right) + \mathrm{M}_{e} \times \left(\frac{1}{\mathrm{D}}\right)} \boxed{\times 1/1000}$

◇Paragraph 8.6.1. Drift correction

Error	Correct
Depending on the measurement system and calculation method used, the uncorrected emissions results shall be calculated with equations 38, 39, 58, **59** or 64, respectively. For calculation of the corrected emissions, c_{gas} in equations 38, 39, 58, **59** or 64, respectively, shall be replaced with c_{cor} of equation 68.	Depending on the measurement system and calculation method used, the uncorrected emissions results shall be calculated with equations 38, 39, 58, **60** or 64, respectively. For calculation of the corrected emissions, c_{gas} in equations 38, 39, 58, **60** or 64, respectively, shall be replaced with c_{cor} of equation 68.

◇Paragraph 8.6.1. Drift correction

Error	Correct
If instantaneous concentration values $c_{gas,i}$ are used in the respective equation, the corrected value shall also be applied as instantaneous value $c_{cor,i}$. In equation **64**, the correction shall be applied to both the measured and the background concentration.	If instantaneous concentration values $c_{gas,i}$ are used in the respective equation, the corrected value shall also be applied as instantaneous value $c_{cor,i}$. In equation**s 60,64**, the correction shall be applied to both the measured and the background concentration.

◇Paragraph 9.5.4.1. Data analysis

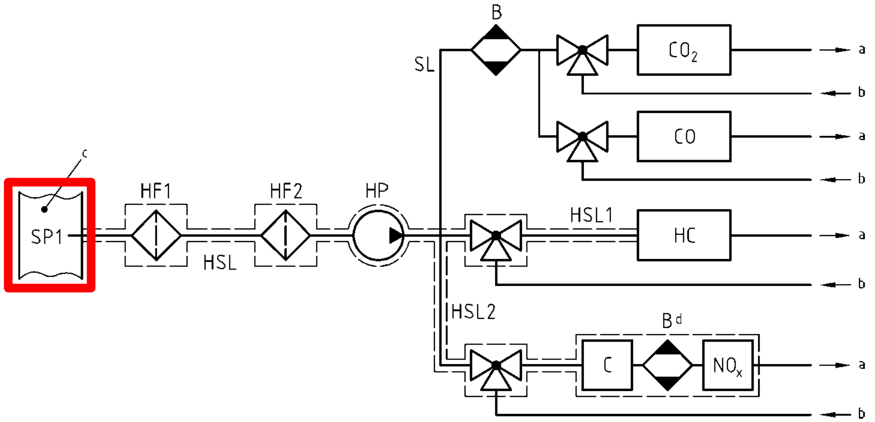
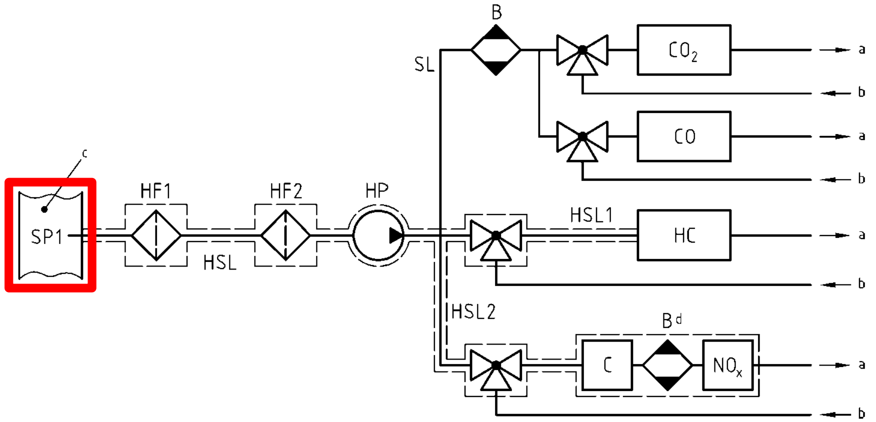
Error	Correct
The gas flow rate (Q_{SSV}) at each restriction setting (minimum 16 settings) shall be calculated in standard m³/s from the flowmeter data using the manufacturer's prescribed method. The discharge coefficient shall be calculated from the calibration data for each setting as follows: $$C_d = \frac{Q_{SSV}}{d_v^2 \times p_p \times \sqrt{\left[\frac{1}{T} \times \left(r_p^{1.4286} - r_p^{1.7143}\right) \times \left(\frac{1}{1 - r_D^4 \times r_p^{1.4286}}\right)\right]}} \quad (89)$$ Where: Q_{SSV} is the airflow rate at standard conditions (101.3 kPa, 273 K), m³/s T is the temperature at the venturi inlet, K d_V is the diameter of the SSV throat, **m** r_p is the ratio of the SSV throat to inlet absolute static pressure = $1 - \frac{\Delta p}{p_a}$ r_D is the ratio of the SSV throat diameter, d_V, to the inlet pipe inner diameter D To determine the range of subsonic flow, C_d shall be plotted as a function of Reynolds number Re, at the SSV throat. The Re at the SSV throat shall be calculated with the following equation:	The gas flow rate (Q_{SSV}) at each restriction setting (minimum 16 settings) shall be calculated in standard m³/s from the flowmeter data using the manufacturer's prescribed method. The discharge coefficient shall be calculated from the calibration data for each setting as follows: $$C_d = \frac{Q_{SSV}}{\boxed{\frac{A_0}{60}} d_V^2 p_p \sqrt{\left[\frac{1}{T_{in,V}} \left(r_p^{1.4286} - r_p^{1.7143}\right) \left(\frac{1}{1 - r_D^4 r_p^{1.4286}}\right)\right]}}$$ Where: Q_{SSV} is the airflow rate at standard conditions (101.3 kPa, 273 K), m³/s T is the temperature at the venturi inlet, K d_V is the diameter of the SSV throat, **mm** r_p is the ratio of the SSV throat to inlet absolute static pressure = $1 - \frac{\Delta p}{p_a}$ r_D is the ratio of the SSV throat diameter, d_V, to the inlet pipe inner diameter D To determine the range of subsonic flow, C_d shall be plotted as a function of Reynolds number Re, at the SSV throat. The Re at the SSV throat shall be calculated with the following equation:

◇Paragraph 9.5.4.1. Data analysis

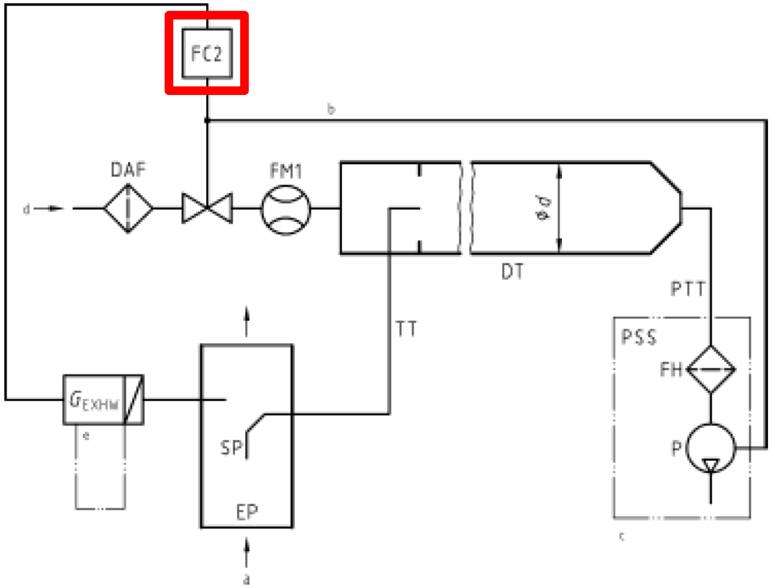
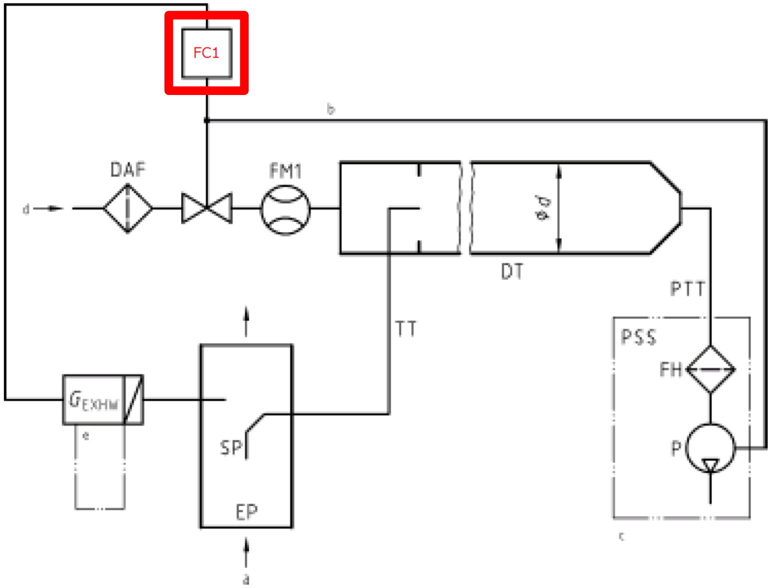
Error	Correct
$\mathrm{Re} = A_1 \times \frac{Q_{SSV}}{d_V \times \mu}$ (94)	
With $\mu = \frac{b \times T^{1.5}}{S+T}$ (95)	With $\mu = \frac{b \times T^{1.5}}{S+T}$ (95)
Where: A_1 is **25.55152** in SI units of $\left(\frac{1}{m^3}\right)\left(\frac{\min}{s}\right)\left(\frac{mm}{m}\right)$	Where: A_1 is **27.43831** in SI units of
Q_{SSV} is the airflow rate at standard conditions (101.3 kPa, 273 K), m^3/s d_V is the diameter of the SSV throat, **m** μ is the absolute or dynamic viscosity of the gas, kg/ms b is 1.458 x 10^6 (empirical constant), kg/ms $K^{0.5}$ S is 110.4 (empirical constant), K	Q_{SSV} is the airflow rate at standard conditions (101.3 kPa, 273 K), m^3/s d_V is the diameter of the SSV throat, **mm** μ is the absolute or dynamic viscosity of the gas, kg/ms b is 1.458 x 10^6 (empirical constant), kg/ms $K^{0.5}$ S is 110.4 (empirical constant), K
Because Q_{SSV} is an input to the Re equation, the calculations shall be started with an initial guess for Q_{SSV} or C_d of the calibration venturi, and repeated until Q_{SSV} converges. The convergence method shall be accurate to 0.1 per cent of point or better. For a minimum of sixteen points in the region of subsonic flow, the calculated values of C_d from the resulting calibration curve fit equation shall be within ±0.5 per cent of the measured C_d for each calibration point.	Because Q_{SSV} is an input to the Re equation, the calculations shall be started with an initial guess for Q_{SSV} or C_d of the calibration venturi, and repeated until Q_{SS}V converges. The convergence method shall be accurate to 0.1 per cent of point or better. For a minimum of sixteen points in the region of subsonic flow, the calculated values of C_d from the resulting calibration curve fit equation shall be within ±0.5 per cent of the measured C_d for each calibration point.

◇Annex 3 Measurement equipment

A.3.1.3. Components of Figures 9 and 10

Error	Correct
Figure 9 **Schematic flow diagram of raw exhaust gas analysis system for CO, CO_2, NO_x, HC**  a = vent b = zero, span gas c = exhaust pipe d = optional A.3.1.3. Components of Figures 9 and 10 EP Exhaust pipe **SP** Raw exhaust gas sampling probe (Figure 9 only)	Figure 9 **Schematic flow diagram of raw exhaust gas analysis system for CO, CO_2, NO_x, HC**  a = vent b = zero, span gas c = exhaust pipe d = optional A.3.1.3. Components of Figures 9 and 10 EP Exhaust pipe **SP1** Raw exhaust gas sampling probe (Figure 9 only)

◇Annex 3 Measurement equipment
A.3.2.1. Description of partial flow system -Figure 12-

Error	Correct
Figure 12 **Scheme of partial flow dilution system (total sampling type)**  a = exhaust b = optional c = details see Figure 16	Figure 12 **Scheme of partial flow dilution system (total sampling type)**  a = exhaust b = optional c = details see Figure 16

◇Annex 3 Measurement equipment

A.3.2.5. Description of particulate sampling system

Error	Correct
The sample is passed through the filter holder(s) FH that contain the particulate sampling filters. The sample flow rate is controlled by the flow controller **FC3**. For of full flow dilution system, a double dilution particulate sampling system shall be used, as shown in figure 17. A sample of the diluted exhaust gas is transferred from the dilution tunnel DT through the particulate sampling probe PSP and the particulate transfer tube PTT to the secondary dilution tunnel SDT, where it is diluted once more. The sample is then passed through the filter holder(s) FH that contain the particulate sampling filters. The dilution airflow rate is usually constant whereas the sample flow rate is controlled by the flow controller **FC3**. If electronic flow compensation EFC (see figure 15) is used, the total diluted exhaust gas flow is used as command signal for **FC3**.	The sample is passed through the filter holder(s) FH that contain the particulate sampling filters. The sample flow rate is controlled by the flow controller **FC2**. For of full flow dilution system, a double dilution particulate sampling system shall be used, as shown in figure 17. A sample of the diluted exhaust gas is transferred from the dilution tunnel DT through the particulate sampling probe PSP and the particulate transfer tube PTT to the secondary dilution tunnel SDT, where it is diluted once more. The sample is then passed through the filter holder(s) FH that contain the particulate sampling filters. The dilution airflow rate is usually constant whereas the sample flow rate is controlled by the flow controller **FC2**. If electronic flow compensation EFC (see figure 15) is used, the total diluted exhaust gas flow is used as command signal for **FC2**.

◇Annex 4 Statistics

A.4.2. Regression analysis -Equation (100)-

Error	Correct
$SEE = \dfrac{\sqrt{\sum_{i=1}^{n}[y_i - a_0 - (a_1 \times x_i)]}^{2}}{n-2}$	$\mathrm{SEE} = \sqrt{\dfrac{\sum_{i=1}^{n}[\mathrm{y}_i - \mathrm{a}_0 - (\mathrm{a}_1 \times \mathrm{x}_i)]^2}{\mathrm{n}-2}}$