

6 August 2013

Agreement

Concerning the Adoption of Uniform Technical Prescriptions for Wheeled Vehicles, Equipment and Parts which can be Fitted and/or be Used on Wheeled Vehicles and the Conditions for Reciprocal Recognition of Approvals Granted on the Basis of these Prescriptions*

(Revision 2, including the amendments which entered into force on 16 October 1995)

Addendum 82 – Regulation No. 83

Revision 4 - Amendment 3

Supplement 3 to the 06 series of amendments – Date of entry into force: 15 July 2013

Uniform provisions concerning the approval of vehicles with regard to the emission of pollutants according to engine fuel requirements



UNITED NATIONS

* Former title of the Agreement: Agreement Concerning the Adoption of Uniform Conditions of Approval and Reciprocal Recognition of Approval for Motor Vehicle Equipment and Parts, done at Geneva on 20 March 1958.

The table of contents, insert new references for Annex 12, appendices 1 and 2, to read:

- "12 ...
Appendix 1 - Bi-fuel gas vehicle - Calculation of LPG energy ratio.....
Appendix 2 - Bi-fuel vehicle - Calculation of NG/biomethane energy ratio....."

The text of the Regulation,

Paragraph 2.4., amend to read:

- "2.4. ...
(d) $C_1H_{1.86}O_{0.005}$ for diesel (B5)
(e) $C_1H_{2.74}O_{0.385}$ for ethanol (E85)
(f) $C_1H_{2.61}O_{0.329}$ for ethanol (E75)."

Paragraphs 2.22.1., 2.23. and 2.23.1., amend to read:

- "2.22.1. "Mono-fuel gas vehicle" means a vehicle that is designed primarily for permanent running on LPG or NG/biomethane or hydrogen, but may also have a petrol system for emergency purposes or starting only, where the capacity of the petrol tank does not exceed 15 litres.
2.23. "Bi-fuel vehicle" means a vehicle with two separate fuel storage systems that is designed to run on only one fuel at a time. The simultaneous use of both fuels is limited in amount and duration.
2.23.1. "Bi-fuel gas vehicle" means a bi-fuel vehicle that can run on petrol (petrol mode) and also on either LPG, NG/biomethane or hydrogen (gas mode)."

Insert a new paragraph 2.27., to read:

- "2.27. In the context of in use performance ratio monitoring (IUPR_M), "cold start" means an engine coolant temperature (or equivalent temperature) at engine start of less than or equal to 35 °C and less than or equal to 7 K higher than ambient temperature (if available) at engine start."

Paragraph 5.2.3., Table A, amend to read:

Table A Requirements

Application of test requirements for type approval and extensions

	Vehicles with positive ignition engines including hybrids								Vehicles with C.I. engines including hybrids	
	Mono-fuel				Bi-fuel ¹			Flex-fuel ¹	Flex-fuel	Mono-fuel
	Petrol (E5)	LPG	NG/Biomethane	Hydrogen	Petrol (E5)	Petrol (E5)	Petrol (E5)	Petrol (E5)	Diesel (B5)	Diesel (B5)
Reference fuel					Petrol (E5) LPG	Petrol (E5) NG/Biomethane	Petrol (E5) Hydrogen	Petrol (E5) Ethanol (E85)	Diesel (B5) Biodiesel	Diesel (B5)
Gaseous pollutants (Type I test)	Yes	Yes	Yes		Yes (both fuels)	Yes (both fuels)	Yes (petrol only) ²	Yes (both fuels)	Yes (B5 only) ²	Yes
Particulate mass (Type I test)	Yes direct injection only	-	-		Yes direct injection only (petrol only)	Yes direct injection only (petrol only)	Yes direct injection only (petrol only) ²	Yes direct injection only (both fuels)	Yes (B5 only) ²	Yes
Particle number (Type I test)					-	-	-	-	Yes (B5 only) ²	Yes
Idle emissions (Type II test)	Yes	Yes	Yes		Yes (both fuels)	Yes (both fuels)	Yes (petrol only) ²	Yes (both fuels)	-	-
Crankcase emissions (Type III test)	Yes	Yes	Yes		Yes (petrol only)	Yes (petrol only)	Yes (petrol only) ²	Yes (petrol)	-	-
Evaporative emissions (Type IV test)	Yes	-	-		Yes (petrol only)	Yes (petrol only)	Yes (petrol only) ²	Yes (petrol)	-	-
Durability (Type V test)	Yes	Yes	Yes		Yes (petrol only)	Yes (petrol only)	Yes (petrol only) ⁽²⁾	Yes (petrol)	Yes (B5 only) ²	Yes
Low temperature emissions (Type VI test)	Yes	-	-		Yes (petrol only)	Yes (petrol only)	Yes (petrol only) ²	Yes (both fuels) ³	-	-
In-service conformity	Yes	Yes	Yes		Yes (both fuels)	Yes (both fuels)	Yes (petrol only) ²	Yes (both fuels)	Yes (B5 only) ²	Yes
On-board diagnostics	Yes	Yes	Yes		Yes	Yes	Yes	Yes	Yes	Yes

¹ When a bi-fuel vehicle is combined with a flex fuel vehicle, both test requirements are applicable.

² This provision is temporary, further requirements for biodiesel and hydrogen shall be proposed later on.

³ The E75 test reference fuel specified in Annex 10 shall be used."

Paragraph 5.3.7.3., the table, the text in the fourth row of the first column, amend to read:

- "(a) for petrol (E5) 1.89
- (b) for LPG 2.53
- (c) for NG/biomethane 4.0
- (d) for ethanol (E85) 2.74
- (e) for ethanol (E75) 2.61"

Paragraph 5.3.7.3., the table, the text in the sixth row of the first column, amend to read:

- "(a) for petrol (E5) 0.016
- (b) for LPG 0.0
- (c) for NG/biomethane 0.0
- (d) for ethanol (E85) 0.39
- (e) for ethanol (E75) 0.329"

Paragraph 9.1., amend to read:

"9.1. Introduction

This paragraph sets out the tailpipe emissions and OBD (including IUPR_M) in-service conformity requirements for vehicles type approved to this Regulation."

Paragraph 9.2.5.4., amend to read:

"9.2.5.4. Where appropriate, the list of vehicle types covered within the manufacturer's information, i.e., for tailpipe emissions, the in-service family group in accordance with paragraph 9.2.1. and, for OBD and IUPR_M, the OBD family, in accordance with Appendix 2 to Annex 11;"

Paragraph 9.2.5.11., amend to read:

"9.2.5.11. The results from the manufacturer's in-service conformity procedure, including:

- (a) Identification of the vehicles included in the programme (whether tested or not). The identification shall include the following:
 - (i) Model name;
 - (ii) Vehicle identification number (VIN);
 - (iii) Vehicle registration number;
 - (iv) Date of manufacture;
 - (v) Region of use (where known);
 - (vi) Tyres fitted (tailpipe emissions only).
- (b) The reason(s) for rejecting a vehicle from the sample;
- (c) Service history for each vehicle in the sample (including any re-works);
- (d) Repair history for each vehicle in the sample (where known);
- (e) Test data, including the following:
 - (i) Date of test/download;
 - (ii) Location of test/download;
 - (iii) Distance indicated on vehicle odometer;for tailpipe emissions only;
 - (iv) Test fuel specifications (e.g. test reference fuel or market fuel);
 - (v) Test conditions (temperature, humidity, dynamometer inertia weight);
 - (vi) Dynamometer settings (e.g. power setting);

- (vii) Test results (from at least three different vehicles per family);
- and, for IUPR_M only:
- (viii) All required data downloaded from the vehicle;
- (ix) For each monitor to be reported the in-use performance ratio IUPR_M."

Insert a new paragraph 9.2.5.13., to read:

- "9.2.5.13. For IUPR_M sampling, the following:
- (a) The average of in-use-performance ratios IUPR_M of all selected vehicles for each monitor according to paragraphs 7.1.4. and 7.1.5. of Appendix 1 to Annex 11;
 - (b) The percentage of selected vehicles, which have an IUPR_M greater or equal to the minimum value applicable to the monitor according to paragraphs 3.1.4. and 3.1.5. of Appendix 1 to Annex 11."

Paragraph 9.3.1., amend to read:

- "9.3.1. The information gathered by the manufacturer shall be sufficiently comprehensive to ensure that in-service performance can be assessed for normal conditions of use as defined in paragraph 9.2. The manufacturer's sampling shall be drawn from at least two Contracting Parties with substantially different vehicle operating conditions. Factors such as differences in fuels, ambient conditions, average road speeds, and urban/highway driving split shall be taken into consideration in the selection of the Contracting Parties.

For OBD IUPR_M testing only, vehicles fulfilling the criteria of paragraph 2.2.1. of Appendix 3 shall be included in the test sample."

Paragraph 9.3.2., amend to read:

- "9.3.2. In selecting the Contracting Parties for sampling vehicles, the manufacturer may select vehicles from a Contracting Party that is considered to be particularly representative. In this case, the manufacturer shall demonstrate to the Type Approval Authority which granted the type approval that the selection is representative (e.g. by the market having the largest annual sales of a vehicle family within the applicable Contracting Party). When a family requires more than one sample lot to be tested as defined in paragraph 9.3.5., the vehicles in the second and third sample lots shall reflect different vehicle operating conditions from those selected for the first sample."

Insert a new paragraph 9.3.5., to read:

- "9.3.5. Sample lots"

Paragraph 9.3.5. (former), renumber as paragraph 9.3.5.1. and amend to read:

- "9.3.5.1. When applying the statistical procedure defined in Appendix 4 (i.e. for tailpipe emissions), the number of sample lots shall depend on the annual sales volume of an in-service family in the territories of a regional organization (e.g. European Community), as defined in the following table:

<i>Registrations per calendar year</i>	<i>Number of sample lots</i>
Up to 100 000	1
100 001 to 200 000	2
Above 200 000	3

Insert a new paragraph 9.3.5.2., to read:

"9.3.5.2. For IUPR, the number of sample lots to be taken is described in the table in paragraph 9.3.5.1. and is based on the number of vehicles of an OBD family that are approved with IUPR (subject to sampling).

For the first sampling period of an OBD family, all of the vehicle types in the family that are approved with IUPR shall be considered to be subject to sampling. For subsequent sampling periods, only vehicle types which have not been previously tested or are covered by emissions approvals that have been extended since the previous sampling period shall be considered to be subject to sampling.

For families consisting of fewer than 5,000 registrations that are subject to sampling within the sampling period, the minimum number of vehicles in a sample lot is six. For all other families, the minimum number of vehicles in a sample lot to be sampled is fifteen.

Each sample lot shall adequately represent the sales pattern, i.e. at least high volume vehicle types (≥ 20 per cent of the family total) shall be represented."

Paragraph 9.4., amend to read:

"9.4. ...

(d) Decide that the in-service conformity of a vehicle type, that is part of an in-service family, is unsatisfactory and proceed to have such vehicle type tested in accordance with Appendix 3.

If, according to the IUPR_M audit, the test criteria of paragraph 6.1.2., subparagraphs (a) or (b) of Appendix 3 are met for the vehicles in a sample lot, the Type Approval Authority must take the further action described in subparagraph (d) of this paragraph."

Appendix 3,

Paragraph 2., amend to read:

"2. Selection criteria

The criteria for acceptance of a selected vehicle are defined for tailpipe emissions in paragraphs 2.1. to 2.8. of this appendix and for IUPR_M in paragraphs 2.1. to 2.5. of this Appendix. Information is collected by vehicle examination and an interview with the owner/driver."

Insert a new paragraph 2.2.1., to read:

"2.2.1. For checking IUPR_M, the test sample shall include only vehicles that:

(a) Have collected sufficient vehicle operation data for the monitor to be tested.

For monitors required to meet the in-use monitor performance ratio and to track and report ratio data pursuant to paragraph 7.6.1. of Appendix 1 to Annex 11 sufficient vehicle operation data shall mean the denominator meets the criteria set forth below. The denominator, as defined in paragraphs 7.3. and 7.5. of Appendix 1 to Annex 11 for the monitor to be tested must have a value equal to or greater than one of the following values:

- (i) 75 for evaporative system monitors, secondary air system monitors, and monitors utilising a denominator incremented in accordance with paragraph 3.3.2, sub-paragraphs (a), (b) or (c) of Appendix 1 to Annex 11 (e.g. cold start monitors, air conditioning system monitors, etc.); or
 - (ii) 25 for particulate filter monitors and oxidation catalyst monitors utilising a denominator incremented in accordance with paragraph 3.3.2., sub-paragraph (d) of Appendix 1 to Annex 11; or
 - (iii) 150 for catalyst, oxygen sensor, EG R, VVT, and all other component monitors.
- (b) Have not been tampered with or equipped with add-on or modified parts that would cause the OBD system not to comply with the requirements of Annex 11."

Insert a new paragraph 6.1., to read:

"6.1. The Type Approval Authority must request the manufacturer to submit a plan of remedial measures to remedy the non-compliance when:"

Paragraph 6.1. (former), renumber as paragraph 6.1.1. and amend to read:

"6.1.1. For tailpipe emissions more than one vehicle is found to be an outlying emitter that meets either of the following conditions:

- (a) The conditions of paragraph 3.2.3. of Appendix 4 and where both the Type Approval Authority and the manufacturer agree that the excess emission is due to the same cause; or
- (b) The conditions of paragraph 3.2.4. of Appendix 4 where the Type Approval Authority has determined that the excess emission is due to the same cause.

The Type Approval Authority must request the manufacturer to submit a plan of remedial measures to remedy the non-compliance."

Insert a new paragraph 6.1.2., to read:

"6.1.2. For $IUPR_M$, of a particular monitor M the following statistical conditions are met in a test sample, the size of which is determined according to paragraph 9.3.5:

- (a) For vehicles certified to a ratio of 0.1 in accordance with paragraphs 7.1.4. and 7.1.5. of Appendix 1 to Annex 11, the data collected from the vehicles indicate for at least one monitor M in the test sample either that the test sample average in-use-performance ratio is less than 0.1 or that 66 per cent or more of the vehicles in the test sample have an in-use monitor performance ratio of less than 0.1.

- (b) For vehicles certified to the full ratios in accordance with paragraphs 7.1.4. and 7.1.5. of Appendix 1 to Annex 11 the data collected from the vehicles indicate for at least one monitor M in the test sample either that the test sample average in-use performance ratio in the test sample is less than the value $Test_{min}(M)$ or that 66 per cent or more of the vehicles in the test sample have an in-use performance ratio of less than $Test_{min}(M)$.

The value of $Test_{min}(M)$ shall be:

- (i) 0.230 if the monitor M is required to have an in-use ratio of 0.26;
- (ii) 0.460 if the monitor M is required to have an in-use ratio of 0.52;
- (iii) 0.297 if the monitor M is required to have an in-use ratio of 0.336;

according to paragraph 7.1.4. of Appendix 1 to Annex 11."

Appendix 6,

Paragraph 6.2., amend to read:

"6.2. The manufacturer shall demonstrate that use of these sensors, and any other sensors on the vehicle, results in the activation of the driver warning system as referred to in paragraph 3., the display of a message indicating an appropriate warning (e.g. "emissions too high – check urea", "emissions too high – check AdBlue", "emissions too high – check reagent"), and the driver inducement system as referred to in paragraph 8.3., when the situations referred to in paragraph 4.2., 5.4. or 5.5. occur.

For the purposes of this point these situations are presumed to occur, if the applicable NO_x emission limit of Table 1 of paragraph 5.3.1.4. of this Regulation, multiplied by a factor of 1.5, is exceeded. NO_x emissions during the test to demonstrate compliance with these requirements shall be not more than 20 per cent higher than the values referred to in the first sentence."

Paragraph 7.1., amend to read:

"7.1. Where reference is made to this paragraph, a non-erasable Parameter Identifier (PID) shall be stored identifying the reason for and the distance travelled by the vehicle during the inducement system activation. The vehicle shall retain a record of the PID for at least 800 days or 30,000 km of vehicle operation. The PID shall be made available via the serial port of a standard diagnostic connector upon request of a generic scan tool according to the provisions of paragraph 6.5.3.1. of Appendix 1 to Annex 11 to this Regulation. The information stored in the PID shall be linked to the period of cumulated vehicle operation, during which it has occurred, with an accuracy of not less than 300 days or 10,000 km."

Annex 4, the amendments included in Supplement 1 and Supplement 2 to the 06 series of amendments, shall be deleted.

Annex 4a,

Paragraph 6.4.1.3., amend to read:

"6.4.1.3. In cases where LPG or NG/biomethane is used as a fuel, it is permissible that the engine is started on petrol and switched to LPG or NG/biomethane after a predetermined period of time which cannot be changed by the driver. This period of time shall not exceed 60 seconds."

Paragraph 6.6.2., amend to read:

"6.6.2. ...
For ethanol (E85) ($C_1H_{2,74}O_{0,385}$) $d = 0.932$ g/l
For Ethanol (E75) ($C_1H_{2,61}O_{0,329}$) $d = 0.886$ g/l
In the case of nitrogen oxides (NO_x): $d = 2.05$ g/l"

Paragraph 6.6.4., amend to read:

"6.6.4. ...
$$DF = \frac{12.5}{C_{CO_2} + (C_{HC} + C_{CO}) \cdot 10^{-4}}$$
 for Ethanol (E85) (5d)

$$DF = \frac{12.7}{C_{CO_2} + (C_{HC} + C_{CO}) \cdot 10^{-4}}$$
 for Ethanol (E75) (5e)

In these equations:

..."

Annex 10,

Paragraph 2., amend to read:

"2. ...

Type: Ethanol (E75)

Parameter	Unit	Limits ¹		Test method ²
		Minimum	Maximum	
Research octane number, RON		95	-	EN ISO 5164
Motor octane number, MON		85	-	EN ISO 5163
Density at 15 °C	kg/m ³	report		EN ISO 12185
Vapour pressure	kPa	50	60	EN ISO 1 30 16-1 (DVPE)
Sulphur content ^{3, 4}	mg/kg	-	10	EN ISO 20846 EN ISO 20884
Oxidation stability	minutes	360	-	EN ISO 7536
Existent gum content (solvent washed)	mg/100ml	-	4	EN ISO 6246
Appearance shall be determined at ambient temperature or 15 °C whichever is higher.		Clear and bright, visibly free of suspended or precipitated contaminants		Visual inspection
Ethanol and higher alcohols ⁷	% (V/V)	70	80	EN 1601 EN 13132

				EN 1451 7
Higher alcohols (C3 - C8)	% (V/V)	-	2	
Methanol		-	0,5	
Petrol ⁵	% (V/V)	Balance		EN 228
Phosphorus	mg/l	0,30 ⁶		EN 15487 ASTM D 3231
Water content	% (V/V)	-	0,3	ASTM E 1064 EN 15 489
Inorganic chloride content	mg/l	-	1	ISO 6227 - EN 15492
pHe		6,50	9	ASTM D 6423 EN 15490
Copper strip corrosion (3h at 50 °C)	Rating	Class I		EN ISO 2160
Acidity (as acetic acid CH ₃ COOH)	% (m/m)		0,005	ASTM 0161 3 EN 15491
	mg/l		40	
Carbon/hydrogen ratio		report		
Carbon/oxygen ratio		report		

¹ The values referred to in the specifications are "true values". When establishing the value limits, the terms of ISO 4259 Petroleum products - Determination and application of precision data in relation to methods of test were applied. When fixing a minimum value, a minimum difference of 2R above zero was taken into account. When fixing a maximum and minimum value, the minimum difference used was 4R (R = reproducibility).

Notwithstanding this procedure, which is necessary for technical reasons, fuel manufacturers shall aim for a zero value where the stipulated maximum value is 2R and for the mean value for quotations of maximum and minimum limits. Where it is necessary to clarify whether fuel meets the requirements of the specifications, the ISO 4259 terms shall be applied.

² In cases of dispute, the procedures for resolving the dispute and interpretation of the results based on test method precision, described in EN ISO 4259 shall be used.

³ In cases of national dispute concerning sulphur content, either EN ISO 20846 or EN ISO 20884 shall be called up similar to the reference in the national annex of EN 228.

⁴ The actual sulphur content of the fuel used for the Type 6 test shall be reported.

⁵ The unleaded petrol content may be determined as 100 minus the sum of the percentage content of water and alcohols.

⁶ There shall be no intentional addition of compounds containing phosphorus, iron, manganese, or lead to this reference fuel.

⁷ Ethanol to meet specification of EN 15376 is the only oxygenate that shall be intentionally added to this reference fuel.

"

Annex 11,

Paragraph 3.3.5., amend to read:

"3.3.5. Manufacturers may demonstrate to the approval authority that certain components or systems need not be monitored if, in the event of their total failure or removal, emissions do not exceed the emission limits given in paragraph 3.3.2.

A particulate trap however, where fitted as a separate unit or integrated into a combined emission control device, shall be monitored at least for total failure or removal if the latter resulted in exceeding the applicable emission limits. It shall also be monitored for any failure that would result in exceeding the applicable OBD threshold limits."

Paragraph 4.2.1., amend to read:

- "4.2.1. The Type Approval Authority will not accept any deficiency request that includes the complete lack of a required diagnostic monitor or of mandated recording and reporting of data related to a monitor."

Appendix 1,

Paragraphs 7.1.6. and 7.1.7., amend to read:

- "7.1.6. The manufacturer shall demonstrate to the Type Approval Authority that these statistical conditions are satisfied all monitors required to be reported by the OBD system according to paragraph 7.6. of this Appendix not later than 18 months thereafter. For this purpose, for OBD families consisting of more than 1,000 registrations in the European Union or non-EU Contracting Party, that are subject to sampling within the sampling period, the process described in Annex 11 shall be used without prejudice to the provisions of paragraph 7.1.8 of this appendix.

In addition to the requirements set out in Annex 11 and regardless of the result of the audit described in paragraph 9.2., the authority granting the approval shall apply the in-service conformity check for IUPR described in Appendix I to Annex 11 in an appropriate number of randomly determined cases. "In an appropriate number of randomly determined cases" means, that this measure has a dissuasive effect on non-compliance with the requirements of paragraph 3. of this annex or the provision of manipulated, false or non-representative data for the audit. If no special circumstances apply and can be demonstrated by the type-approval authorities, random application of the in-service conformity check to 5 per cent of the type approved OBD families shall be considered as sufficient for compliance with this requirement. For this purpose, Type Approval Authorities may find arrangements with the manufacturer for the reduction of double testing of a given OBD family as long as these arrangements do not harm the dissuasive effect of the Type Approval Authority's own in-service conformity check on non-compliance with the requirements of paragraph 3. of this annex. Data collected by EU-member States during surveillance testing programmes may be used for in-service conformity checks. Upon request, Type Approval Authorities shall provide data on the audits and random in-service conformity checks performed, including the methodology used for identifying those cases, which are made subject to the random in-service conformity check, to the European Commission and other Type Approval Authorities.

- 7.1.7. For the entire test sample of vehicles the manufacturer must report to the relevant authorities all of the in-use performance data to be reported by the OBD system according to paragraph 7.6. of Appendix 1 to Annex 11 in conjunction with an identification of the vehicle being tested and the methodology used for the selection of the tested vehicles from the fleet. Upon request, the Type Approval Authority granting the approval shall make these data and the results of the statistical evaluation available to the European Commission and other Type Approval Authorities."

Insert a new paragraph 7.3.2., to read:

- "7.3.2. Without prejudice to requirements for the increment of denominators of other monitors, the denominators of monitors of the following components shall be incremented if and only if the driving cycle started with a cold start:
- (a) Liquid (oil, engine coolant, fuel, SCR reagent) temperature sensors;

- (b) Clean air (ambient air, intake air, charge air, inlet manifold) temperature sensors;
- (c) Exhaust (EGR recirculation/cooling, exhaust gas turbo-charging, catalyst) temperature sensors;

The denominators of monitors of the boost pressure control system shall be incremented if the all of the following conditions are met:

- (a) The general denominator conditions are fulfilled;
- (b) The boost pressure control system is active for a time greater than or equal to 15 seconds."

Paragraphs 7.3.2. to 7.3.3. (former), renumber as paragraphs 7.3.3. to 7.3.4.

Paragraph 7.6.2., amend to read:

"7.6.2. For specific components or systems that have multiple monitors, which are required to be reported by this paragraph (e.g. oxygen sensor bank 1 may have multiple monitors for sensor response or other sensor characteristics), the OBD system shall separately track numerators and denominators for each of the specific monitors except those monitoring for short circuit or open circuit failures and report only the corresponding numerator and denominator for the specific monitor that has the lowest numerical ratio. If two or more specific monitors have identical ratios, the corresponding numerator and denominator for the specific monitor that has the highest denominator shall be reported for the specific component."

Annex 12,

Paragraph 3.2.5., amend to read:

"3.2.5. Without prejudice to paragraph 6.4.1.3. of Annex 4a, during the Type I test, it is permissible to use petrol only or simultaneously with gas when operating in gas mode provided that the energy consumption of gas is higher than 80 per cent of the total amount of energy consumed during the test. This percentage shall be calculated in accordance with the method set out in Appendix 1 (LPG) or Appendix 2 (NG/biomethane) of this annex."

Annex 12, insert a new Appendix 1, to read:

"Annex 12 - Appendix 1

Bi-fuel gas vehicle - Calculation of LPG energy ratio

1. Measurement of the LPG mass consumed during the Type I test cycle
Measurement of the LPG mass consumed during the Type 1 test cycle shall be done by a fuel weighing system capable of measuring the weight of the LPG storage container during the test in accordance with the following:
An accuracy of ± 2 per cent of the difference between the readings at the beginning and at the end of the test or better.
Precautions shall be taken to avoid measurement errors.

Such precautions shall, at least, include the careful installation of the device according to the instrument manufacturers' recommendations and to good engineering practice.

Other measurement methods are permitted if an equivalent accuracy can be demonstrated.

2. Calculation of the LPG energy ratio

The fuel consumption value shall be calculated from the emissions of hydrocarbons, carbon monoxide, and carbon dioxide determined from the measurement results assuming that only LPG is burned during the test.

The LPG ratio of the energy consumed in the cycle is then determined as follows:

$$G_{LPG} = M_{LPG} * 10,000 / (FC_{norm} * dist * d)$$

Where:

G_{LPG} : the LPG energy ratio (%);

M_{LPG} : the LPG mass consumed during the cycle (kg);

FC_{norm} : the fuel consumption (l/100 km) calculated in accordance with paragraph 1.4.3. (b) of Annex 6 to Regulation No. 101. If applicable, the correction factor cf in the equation used to determine FC_{norm} shall be calculated using the H/C ratio of the gaseous fuel;

$dist$: distance travelled during the cycle (km);

d : density $d = 0.538 \text{ kg/liter}$."

Annex 12, insert a new Appendix 2, to read:

"Annex 12 - Appendix 2

Bi-fuel vehicle - Calculation of NG/biomethane energy ratio

1. Measurement of the CNG mass consumed during the Type I test cycle

Measurement of the CNG mass consumed during the cycle shall be done by a fuel weighing system capable of measuring the CNG storage container during the test in accordance with the following:

An accuracy of ± 2 per cent of the difference between the readings at the beginning and at the end of the test or better.

Precautions shall be taken to avoid measurement errors.

Such precautions shall, at least, include the careful installation of the device according to the instrument manufacturers' recommendations and to good engineering practice.

Other measurement methods are permitted if an equivalent accuracy can be demonstrated.

2. Calculation of the CNG energy ratio

The fuel consumption value shall be calculated from the emissions of hydrocarbons, carbon monoxide, and carbon dioxide determined from the measurement results assuming that only CNG is burned during the test.

The CNG ratio of the energy consumed in the cycle is then determined as follows:

$$G_{\text{CNG}} = M_{\text{CNG}} * \text{cf} * 10,000 / (\text{FC}_{\text{norm}} * \text{dist} * d)$$

Where:

G_{CNG} : the CNG energy ratio (%);

M_{CNG} : the CNG mass consumed during the cycle (kg);

FC_{norm} : the fuel consumption ($\text{m}^3/100 \text{ km}$) calculated in accordance with paragraph 1.4.3. (c) of Annex 6 to Regulation No. 101;

dist: distance travelled during the cycle (km);

d: density $d = 0.654 \text{ kg}/\text{m}^3$;

cf: correction factor, assuming the following values:

cf = 1 in case of G20 reference fuel;

cf = 0.78 in case of G25 reference fuel."
