

31 December 2021

Agreement

Concerning the Adoption of Harmonized Technical United Nations Regulations 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 United Nations Regulations*

(Revision 3, including the amendments which entered into force on 14 September 2017)

Addendum 153 – UN Regulation No. 154

Revision 1 – Amendment 1

Supplement 1 to the 01 series of amendments – Date of entry into force: 30 September 2021

Uniform provisions concerning the approval of light duty passenger and commercial vehicles with regards to criteria emissions, emissions of carbon dioxide and fuel consumption and/or the measurement of electric energy consumption and electric range (WLTP)

This document is meant purely as documentation tool. The authentic and legal binding text is: ECE/TRANS/WP.29/2021/57.



UNITED NATIONS

* Former titles 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 (original version); 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, done at Geneva on 5 October 1995 (Revision 2).

Paragraph 2.1., amend to read:

"...	
SSV	Subsonic venturi
UBE	Usable Battery (REESS) Energy
USFM	Ultrasonic flow meter
V _H	Vehicle High
V _L	Vehicle Low
VPR	Volatile particle remover
..."	

Paragraph 4.1.2.(a), amend to read:

- "(a) In the case of vehicles equipped with positive ignition engines, a declaration by the manufacturer of the minimum percentage of misfires out of a total number of firing events that would either result in emissions exceeding the OBD thresholds given in paragraph 6.8.2., if that percentage of misfire had been present from the start of a Type 1 test as described in Annexes Part B to this Regulation, or that could lead to an exhaust catalyst, or catalysts, overheating prior to causing irreversible damage;"

Paragraph 5.2.2., amend to read:

"5.2.2. Example of an Approval Number to this Regulation:

E11*[XXX]R01/01/02*0123*01

The first extension of the Approval numbered 0123, issued by the United Kingdom to Series of Amendments 01, Supplement 01, which is a Level 2 Approval."

Paragraph 5.10.4., amend to read:

"5.10.4. When tested with a defective component in accordance with Appendix 1 to Annex C5 to this Regulation, the OBD system malfunction indicator shall be activated. The OBD system malfunction indicator may also activate during this test at levels of emissions below the OBD thresholds specified in paragraph 6.8."

Paragraph 6.3.2.2.(b), amend to read:

"(b) Type of traction REESS (type of cell, capacity, nominal voltage, nominal power, type of coolant (air, liquid));"

Paragraph 6.3.2.3.(b), amend to read:

"(b) Type of traction REESS (type of cell, capacity, nominal voltage, nominal power, type of coolant (air, liquid));"

Paragraph 6.3.2.4.(c), amend to read:

"(c) Type of traction REESS (type of cell, capacity, nominal voltage, nominal power, type of coolant (air, liquid));"

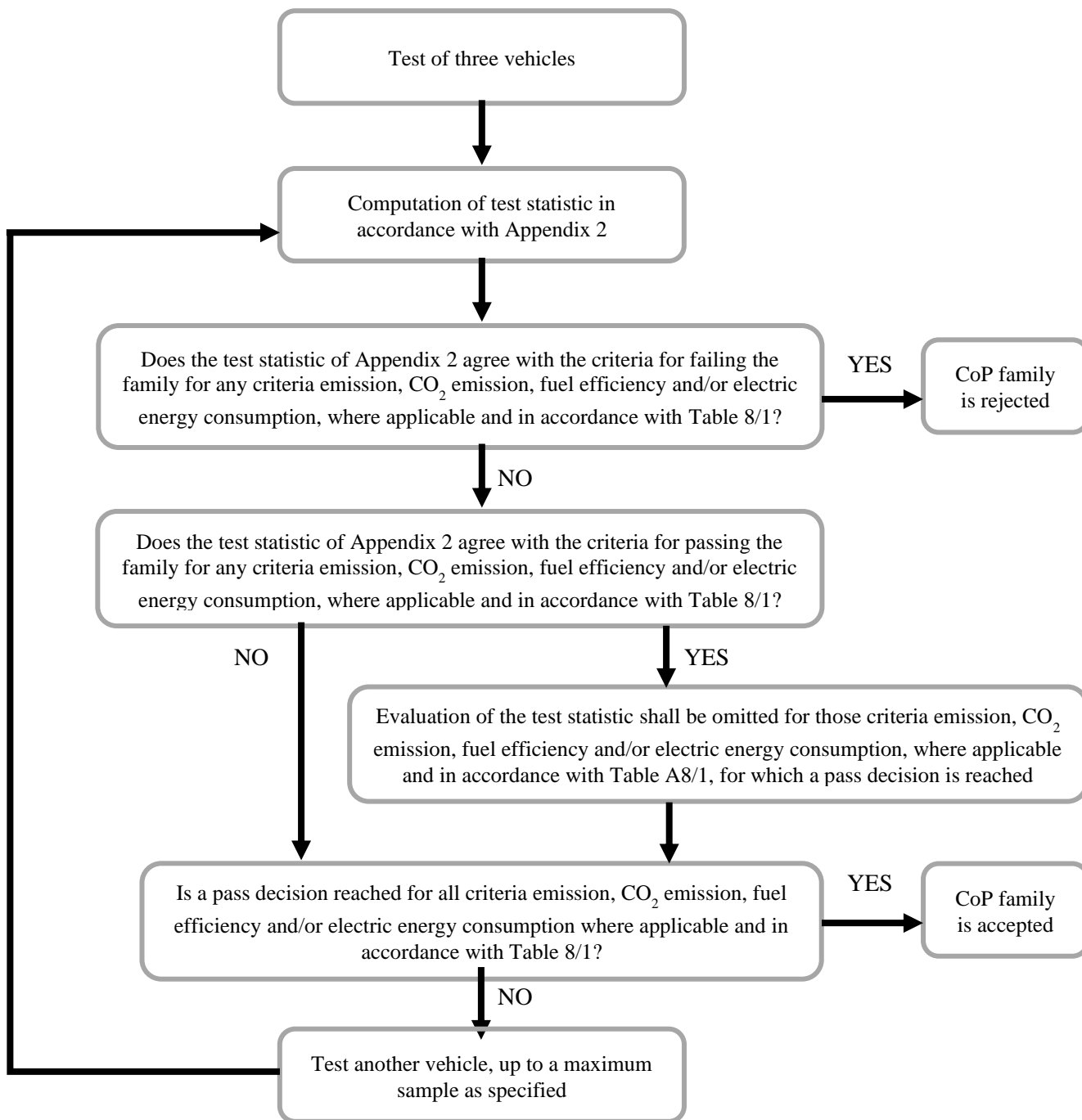
Paragraph 6.8.2., Table 4A, note 1, amend to read:

"¹ Positive ignition particulate mass OBD thresholds apply only to vehicles with direct injection engines"

Paragraph 8.2.3.2., Figure 8/1, amend to read:

"Figure 8/1

Flowchart of the CoP test procedure for the Type 1 test



"

Appendix 1

Paragraph 2.3.1., amend to read:

"2.3.1. CO₂ mass emission values for CoP / Fuel efficiency values for CoP

In the case the interpolation method is not applied, the CO₂ mass emission value after 4 phases $M_{CO_2,c,7}$ according to step 7 of Table A7/1 of Annex B7 shall be used for verifying the conformity of production.

In the case the interpolation method is applied, the CO₂ mass emission value after 4 phases $M_{CO_2,c,ind}$ for the individual vehicle according to step 10 of Table A7/1 of Annex B7 shall be used for verifying the conformity of production.

In the case the interpolation method is not applied, the fuel efficiency value after 3 phases $FE_{c,8}$ according to step 8 of Table A7/1 of Annex B7 shall be used for verifying the conformity of production.

In the case the interpolation method is applied, the fuel efficiency value after 3 phases $FE_{c,ind}$ for the individual vehicle according to step 10 of Table A7/1 of Annex B7 shall be used for verifying the conformity of production."

Paragraph 3.2., amend to read:

"3.2. During this test, the CO₂ mass emission after 4 phases $M_{CO_2,CS,c,6}$ of the NOVC-HEV shall be determined according to step 6 of Table A8/5 of Annex B8.

During this test, the fuel efficiency after 3 phases $FE_{CS,c,4c}$ of the NOVC-HEV shall be determined according to step 4c of Table A8/5 of Annex B8."

Paragraph 5.2.3.1., amend to read:

"5.2.3.1. Charge-Sustaining CO₂ mass emission / fuel efficiency values for CoP

In the case the interpolation method is not applied, the charge-sustaining CO₂ mass emission value after 4 phases $M_{CO_2,CS,c,7}$ according to step 7 of Table A8/5 of Annex B8 shall be used for verifying the conformity of production.

In the case the interpolation method is applied, the charge-sustaining CO₂ mass emission value after 4 phases $M_{CO_2,CS,c,ind}$ for the individual vehicle according to step 9 of Table A8/5 of Annex B8 shall be used for verifying the conformity of production.

In the case that the interpolation method is not applied, the charge-sustaining fuel efficiency value after 3 phases $FE_{CS,c}$ according to step 2 of Table A8/6 of Annex B8 shall be used for verifying the conformity of production.

In the case the interpolation method is applied, the charge-sustaining fuel efficiency value after 3 phases $FE_{CS,c,ind}$ for the individual vehicle according to step 3 of Table A8/6 of Annex B8 shall be used for verifying the conformity of production."

Appendix 6

Paragraph 6.2., amend to read:

"6.2. The manufacturer shall demonstrate that use of the sensors referred to in paragraph 6.1. 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 activation of the driver inducement system as referred to in paragraph 8.3., when the situations referred to in paragraphs 4.2., 5.4., or 5.5. occur.

For the purposes of this paragraph these situations are presumed to occur if the applicable NOx OBD threshold set out in Table 4 of paragraph 6.8.2. is exceeded.

NOx emissions during the test to demonstrate compliance with these requirements shall be no more than 20 per cent higher than the OBD thresholds."

Paragraphs 8.6. to 8.8., amend to read:

- "8.6. Detailed written information fully describing the functional operation characteristics of the driver inducement system shall be provided to the Type Approval Authority at the time of approval.
- 8.7. As part of the application for type approval under this Regulation, the manufacturer shall demonstrate the operation of the driver warning and inducement systems."

Annexes Part A

Annex A2 Addendum

Paragraph 2.5.3.8., amend to read:

- "2.5.3.8. Electric energy consumption
2.5.3.8.1. Electric Energy Consumption EC

EAC(Wh)	
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..."

Annexes Part B

Annex B2

Add new paragraph 6., to read:

- "6. Calculation tools
- Examples of gear shift calculating tools can be found in the same webpage as this Regulation.¹

The following tools are provided:

- (a) ACCESS based tool;
- (b) Matlab code tool;
- (c) NET core tool.

These tools were validated by the comparison of calculation results between the ACCESS tool, the Matlab code and the .NET core code for 115 different vehicle configurations supplemented by additional calculations for 7 of them with additional options like "apply speed cap", "suppress downscaling", "choose other vehicle class cycle" and "choose individual n_{\min_drive} values".

The 115 vehicle configurations cover extreme technical designs for transmission and engines and all vehicle classes.

All three tools deliver identical results with respect to gear use and clutch operation and although only the text in Annexes B1 and B2 is legally binding the tools have achieved a status that qualifies them as reference tools."

¹ [link to be inserted after final notification]

Annex B4

Paragraph 4.5.5.2.1., amend to read:

"4.5.5.2.1. Correction to reference conditions

$$C^* = ((c_0(1 - K_1) - w_2) + c_1v) \times (1 + K_0(T - 20)) + K_2c_2v^2$$

where:

..."

Annex B6

Paragraph 1.2.3.9., Table A6/1 column headings, amend to read:

"

Powertrain	For 4 phase WLTP test only $M_{CO_2}^{(b)}$ (g/km)	For 4 phase WLTP test FC (kg/100 km)	For 3 phase WLTP FE (km/l or km/kg)	Electric energy consumption ^(c) (Wh/km)	All electric range / Pure Electric Range ^(c) (km)
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..."

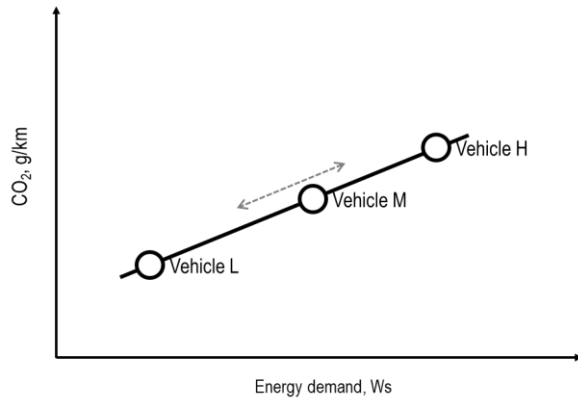
Paragraph 2.3.2.4., amend to read:

"2.3.2.4. Vehicle M is a vehicle within the interpolation family between the vehicles L and H with a cycle energy demand which is preferably closest to the average of vehicles L and H.

The limits of the selection of vehicle M (see Figure A6/4) are such that neither the difference in CO₂ emission values between vehicles H and M nor the difference in CO₂ emission values between vehicles M and L is greater than the allowed CO₂ range in accordance with paragraph 2.3.2.2. of this annex. The defined road load coefficients and the defined test mass shall be recorded.

Figure A6/4

Limits for the selection of vehicle M



For 4-phase WLTP

The linearity of the corrected measured and averaged CO₂ mass emission for vehicle M, $M_{CO_2,c,6,M}$ according to step 6 of Table A7/1 of Annex B7, shall be verified against the linearly interpolated CO₂ mass emission between vehicles L and H over the applicable cycle by using the corrected measured and averaged CO₂ mass emission $M_{CO_2,c,6,H}$ of vehicle H and $M_{CO_2,c,6,L}$ of vehicle L, according to step 6 of Table A7/1 of Annex B7, for the linear CO₂ mass emission interpolation.

For 3-phase WLTP

An additional averaging of tests using the CO₂-output of step 4a is necessary (not described in Table A7/1). The linearity of the corrected measured and averaged CO₂ mass emission for vehicle M, $M_{CO_2,c,4a,M}$ according to step 4a of

Table A7/1 of Annex B7, shall be verified against the linearly interpolated CO₂ mass emission between vehicles L and H over the applicable cycle by using the corrected measured and averaged CO₂ mass emission $M_{CO_2,c,4a,H}$ values of vehicle H and $M_{CO_2,c,4a,L}$ of vehicle L, according to step 4a used in of Table A7/1 of Annex B7, for the linear CO₂ mass emission interpolation.

For 3-phase and 4-phase WLTP

The linearity criterion for vehicle M (see Figure A6/5) shall be considered fulfilled, if the CO₂ mass emission of the vehicle M over the applicable WLTC minus the CO₂ mass emission derived by interpolation is less than 2 g/km or 3 per cent of the interpolated value, whichever value is lower, but at least 1 g/km.

Figure A6/5

..."

Paragraph 2.8.1., amend to read:

"2.8.1. The test cell temperature at the start of the test shall be within ± 3 °C of the set point of 23 °C. The engine oil temperature and coolant temperature, if any, shall be within ± 2 °C of the set point of 23 °C."

Paragraph 3.4.1., amend to read:

"3.4.1. ...

E_{fuel} is the fuel energy according to the following equation:

$$E_{fuel} = 10 \times HV \times FC_{nb} \times d$$

Where

..."

Table A6.App2/3, amend to read:

"Table A6.App2/3

Willans factors (as applicable)

			<i>Naturally aspirated</i>	<i>Pressure-charged</i>
Positive ignition	Petrol (E10H)	l/MJ	0.0756	0.0803
		gCO ₂ /MJ	174	184
	CNG (G20)	m ³ /MJ	0.0719	0.0764
		gCO ₂ /MJ	129	137
	LPG	l/MJ	0.0950	0.101
		gCO ₂ /MJ	155	164
E85	l/MJ	0.102	0.108	
	gCO ₂ /MJ	169	179	
Compression ignition	Diesel (B5H)	l/MJ	0.0611	0.0611
		gCO ₂ /MJ	161	161

Annex B7

Paragraph 1.4., Table A7/1, Step Nos. 4a to 4b, amend to read:

"

4a	Output step 2 Output step 3	$M_{i,c,2}$, g/km; $M_{CO_2,c,3}$, g/km.	Emissions test procedure for all vehicles equipped with periodically regenerating systems, K_i . Annex B6, Appendix 1. $M_{i,c,4a} = K_i \times M_{i,c,2}$ or $M_{i,c,4a} = K_i + M_{i,c,2}$ and $M_{CO_2,c,4a} = K_{CO_2} \times M_{CO_2,c,3}$ or $M_{CO_2,c,4a} = K_{CO_2} + M_{CO_2,c,3}$ Additive offset or multiplicative factor to be used according to K_i determination. If K_i is not applicable: $M_{i,c,4a} = M_{i,c,2}$ $M_{CO_2,c,4a} = M_{CO_2,c,3}$	$M_{i,c,4a}$, g/km; $M_{CO_2,c,4a}$, g/km.
4b	Output step 3 Output step 4a	$M_{CO_2,p,3}$, g/km; $M_{CO_2,c,3}$, g/km; $M_{CO_2,c,4a}$, g/km.	If K_i is applicable, align CO_2 phase values to the combined cycle value: $M_{CO_2,p,4} = M_{CO_2,p,3} \times AF_{K_i}$ for every cycle phase p; where: $AF_{K_i} = \frac{M_{CO_2,c,4a}}{M_{CO_2,c,3}}$ If K_i is not applicable: $M_{CO_2,p,4} = M_{CO_2,p,3}$	$M_{CO_2,p,4}$, g/km.

"

Paragraph 1.4., Table A7/1, Step No. 6, amend to read:

"

6	For results after 4 phases Output step 5	For every test: $M_{i,c,5}$, g/km; $M_{CO_2,c,5}$, g/km; $M_{CO_2,p,5}$, g/km.	Averaging of tests and declared value. Paragraphs 1.2. to 1.2.3. inclusive of Annex B6.	$M_{i,c,6}$, g/km; $M_{CO_2,c,6}$, g/km; $M_{CO_2,p,6}$, g/km. $M_{CO_2,c,declared}$, g/km.
	For results after 3 phases Output step 5	$FE_{c,5}$, km/l;	Averaging of tests and declared value. Paragraphs 1.2. to 1.2.3. inclusive of Annex B6. The conversion from $FE_{c,declared}$ to $M_{CO_2,c,declared}$ shall be performed for the applicable cycle according to paragraph 6. of Annex B7. For that purpose, the criteria emission over the applicable cycle shall be used.	$FE_{c,declared}$, km/l $FE_{c,6}$, km/l $M_{CO_2,c,declared}$, g/km.

"

Paragraph 1.4., Table A7/1, Step No. 9, amend to read:

"

<p>9</p> <p>Interpolation family result.</p> <p>For results after 4 phases</p> <p>Final criteria emission result</p>	<p>Output step 8</p>	<p>For each of the test vehicles H and L:</p> <p>$M_{i,c,8}$, g/km;</p> <p>$M_{CO_2,c,8}$, g/km;</p> <p>$M_{CO_2,p,8}$, g/km;</p> <p>$FC_{c,8}$, l/100 km;</p> <p>$FC_{p,8}$, l/100 km;</p> <p>$FE_{c,8}$, km/l.</p> <p>$FE_{p,8}$, km/l</p>	<p>For results after 4 phases;</p> <p>If in addition to a test vehicle H a test vehicle L and, if applicable vehicle M was also tested, the resulting criteria emission value shall be the highest of the two or, if applicable, three values and referred to as $M_{i,c}$.</p> <p>In the case of the combined THC + NO_x emissions, the highest value of the sum referring to either the vehicle H or vehicle L or, if applicable, vehicle M is to be taken as the type approval value.</p> <p>Otherwise, if no vehicle L was tested, $M_{i,c} = M_{i,c,8}$</p> <p>For CO₂, FE and FC, the values derived in step 8 shall be used, and CO₂ values shall be rounded according to paragraph 6.1.8. of this Regulation to two places of decimal, and FE and FC values shall be rounded according to paragraph 6.1.8. of this Regulation to three places of decimal.</p>	<p>$M_{i,c}$, g/km;</p> <p>$M_{CO_2,c,H}$, g/km;</p> <p>$M_{CO_2,p,H}$, g/km;</p> <p>$FC_{c,H}$, l/100 km;</p> <p>$FC_{p,H}$, l/100 km;</p> <p>$FE_{c,H}$, km/l;</p> <p>$FE_{p,H}$, km/l;</p> <p>and if a vehicle L was tested:</p> <p>$M_{CO_2,c,L}$, g/km;</p> <p>$M_{CO_2,p,L}$, g/km;</p> <p>$FC_{c,L}$, l/100 km;</p> <p>$FC_{p,L}$, l/100 km;</p> <p>$FE_{c,L}$, km/l;</p> <p>$FE_{p,L}$, km/l.</p>
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"

Annex B8

Paragraph 3.1.2., amend to read:

"3.1.2. Forced cooling as described in paragraph 2.7.2. of Annex B6 is only permitted for the charge-sustaining Type 1 test for OVC-HEVs according to paragraph 3.2. of this annex and for testing NOVC-HEVs according to paragraph 3.3. of this annex."

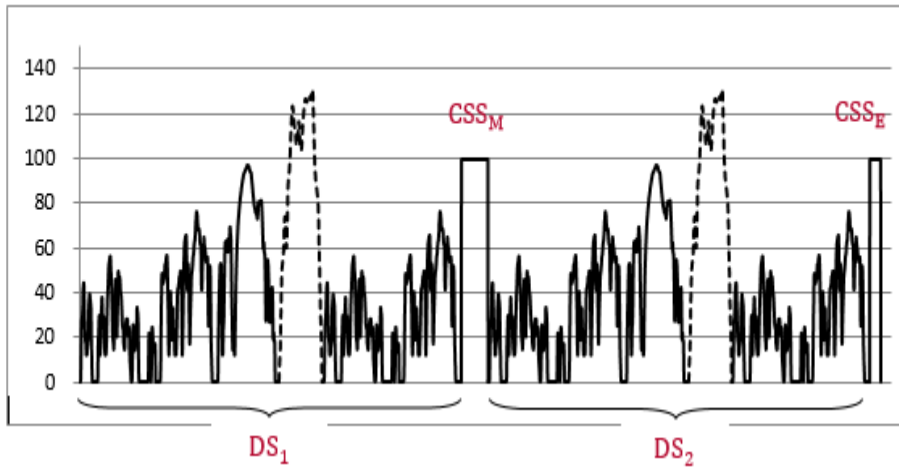
Paragraph 3.4.4.2.1., amend to read:

"3.4.4.2.1. Speed trace

The shortened Type 1 test procedure consists of two dynamic segments (DS₁ and DS₂) combined with two constant speed segments (CSS_M and CSS_E) as shown in Figure A8/2.

Figure A8/2

Shortened Type 1 test procedure speed trace

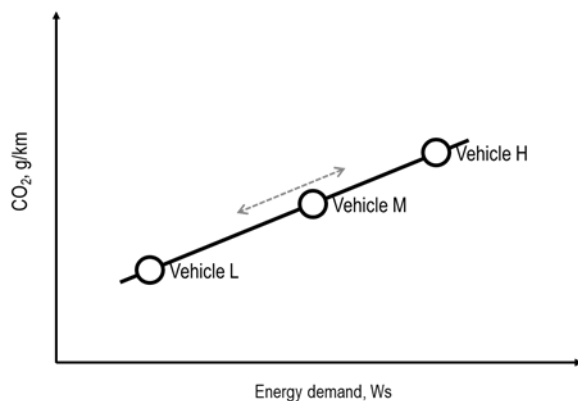


Paragraph 4.1.1.1., Table A8/5, Step Nos. 4b to 8. amend to read:

4b	Output step 3 Output step 4a	$M_{CO_2,CS,p,3}$, g/km; $M_{CO_2,CS,c,3}$, g/km; $M_{CO_2,CS,c,4a}$, g/km.	If K_i is applicable, align CO_2 phase values to combined cycle value: $M_{CO_2,CS,p,4} = M_{CO_2,CS,p,3} \times AF_{K_i}$ for every cycle phase p ; where: $AF_{K_i} = \frac{M_{CO_2,CS,c,4a}}{M_{CO_2,CS,c,3}}$ If K_i is not applicable: $M_{CO_2,CS,p,4} = M_{CO_2,CS,p,3}$	$M_{CO_2,CS,p,4}$, g/km.
4c	Output step 4a	$M_{i,CS,c,4a}$, g/km; $M_{CO_2,CS,c,4a}$, g/km.	In the case these values are used for the purpose of conformity of production, the criteria emission values and CO_2 mass emission values shall be multiplied with the run-in factor RI determined according to paragraph 8.2.4. of this Regulation: $M_{i,CS,c,4c} = RI_C(j) \times M_{i,CS,c,4a}$ $M_{CO_2,CS,c,4c} = RI_{CO_2}(j) \times M_{CO_2,CS,c,4a}$ In the case these values are not used for the purpose of conformity of production: $M_{i,c,4c} = M_{i,c,4a}$ $M_{CO_2,c,4c} = M_{CO_2,c,4a}$ Calculate fuel efficiency ($FE_{c,4c_temp}$) according to paragraph 6.14.1. of Annex B7.	$M_{i,CS,c,4c}$; $M_{CO_2,CS,c,4c}$ $FE_{c,4c}$, km/l;

			<p>In the case this value is used for the purpose of conformity of production, the fuel efficiency value shall be multiplied with the run in factor determined according to paragraph 8.2.4. of this Regulation:</p> $FE_{c,4c} = RI_{FE}(j) \times FE_{c,4c_temp}$ <p>In the case these values are not used for the purpose of conformity of production:</p> $FE_{c,4c} = FE_{c,4c_temp}$	
5 Result of a single test.	Output step 4b and 4c	$M_{CO_2,CS,p,4}$, g/km; $M_{CO_2,CS,c,4c}$, g/km;	<p>For results after 4 phases:</p> <p>ATCT correction of $M_{CO_2,CS,c,4c}$ and $M_{CO_2,CS,p,4}$ in accordance with paragraph 3.8.2. of Annex B6a.</p> <p>For results after 3 phases::</p> $M_{CO_2,c,5} = M_{CO_2,c,4c}$ $M_{CO_2,p,5} = M_{CO_2,p,4}$	$M_{CO_2,CS,c,5}$, g/km; $M_{CO_2,CS,p,5}$, g/km.
		$M_{i,CS,c,4c}$, g/km; $FE_{c,4c}$, km/l;	<p>Apply deterioration factors calculated in accordance with Annex C4 to the criteria emissions values.</p> <p>In the case these values are used for the purpose of conformity of production, the further steps (6 to 9) are not required and the output of this step is the final result.</p>	$M_{i,CS,c,5}$, g/km; $FE_{c,5}$, km/l;
6 $M_{i,CS}$ results of a Type 1 test for a test vehicle.	For results after 4 phases Output step 5	For every test: $M_{i,CS,c,5}$, g/km; $M_{CO_2,CS,c,5}$, g/km; $M_{CO_2,CS,p,5}$, g/km.	Averaging of tests and declared value according to paragraphs 1.2. to 1.2.3. inclusive of Annex B6.	$M_{i,CS,c,6}$, g/km; $M_{CO_2,CS,c,6}$, g/km; $M_{CO_2,CS,p,6}$, g/km; $M_{CO_2,CS,c,declared}$, g/km.
	For results after 3 phases Output step 5	$FE_{c,5}$, km/l;	<p>Averaging of tests and declared value.</p> <p>Paragraphs 1.2. to 1.2.3. inclusive of Annex B6.</p> <p>The conversion from $FE_{c,declared}$ to $M_{CO_2,c,declared}$ shall be performed for the applicable cycle. For that purpose, the criteria emission over the complete cycle shall be used.</p>	$FE_{c,declared}$, km/l $M_{CO_2,c,declared}$, g/km.
7 $M_{CO_2,CS}$ results of a Type 1 test for a test vehicle.	For results after 4 phases: Output step 6	$M_{CO_2,CS,c,6}$, g/km; $M_{CO_2,CS,p,6}$, g/km; $M_{CO_2,CS,c,declared}$, g/km.	<p>Alignment of phase values.</p> <p>Paragraph 1.2.4. of Annex B6,</p> <p>and:</p> $M_{CO_2,CS,c,7} = M_{CO_2,CS,c,declared}$	$M_{CO_2,CS,c,7}$, g/km; $M_{CO_2,CS,p,7}$, g/km.
	For results after 3 phases:	$M_{CO_2,CS,c,5}$, g/km; $M_{CO_2,CS,p,5}$, g/km;	<p>Alignment of phase values.</p> <p>Paragraph 1.2.4. of Annex B6.</p>	$M_{CO_2,CS,p,7}$, g/km.

Figure A8/5

Limits for the selection of vehicle M**For 4-phase WLTP**

The linearity of the corrected measured and averaged charge-sustaining CO₂ mass emission for vehicle M, $M_{CO_2,c,6,M}$ according to step 6 of Table A8/5 of Annex B8, shall be verified against the linearly interpolated charge-sustaining CO₂ mass emission between vehicles L and H over the applicable cycle by using the corrected measured and averaged charge-sustaining CO₂ mass emission $M_{CO_2,c,6,H}$ of vehicle H and $M_{CO_2,c,6,L}$ of vehicle L, according to step 6 of Table A8/5 of Annex B8, for the linear CO₂ mass emission interpolation.

For 3-phase WLTP

An additional averaging of tests using the charge-sustaining CO₂-output of step 4a is necessary (not described in Table A8/5). The linearity of the corrected measured and averaged charge-sustaining CO₂ mass emission for vehicle M, $M_{CO_2,c,4a,M}$ according to step 4a of Table A8/5 of Annex B8, shall be verified against the linearly interpolated CO₂ mass emission between vehicles L and H over the applicable cycle by using the corrected measured and averaged charge-sustaining CO₂ mass emission $M_{CO_2,c,4a,H}$ of vehicle H and $M_{CO_2,c,4a,L}$ of vehicle L, according to step 4a used in of Table A8/5 of Annex B8, for the linear CO₂ mass emission interpolation.

For 3-phase and 4-phase WLTP

The linearity criterion for vehicle M shall be considered fulfilled if the charge-sustaining CO₂ mass emission of vehicle M over the applicable WLTC minus the charge-sustaining CO₂ mass emission derived by interpolation is less than 2 g/km or 3 per cent of the interpolated value, whichever value is less, but at least 1 g/km. See Figure A8/6.

Figure A8/6

..."

Paragraph 4.6.1., Table A8/8, Step No. 16, amend to read:

"

16	Output step 15	If applicable: EC _{DC,CD,COP} , Wh/km;	In the case that the interpolation method is applied, intermediate rounding shall be performed according to paragraph 6.1.8. of this Regulation: M _{CO2,CD} shall be rounded to the second place of decimal. EC _{AC,CD,final} and EC _{AC,weighted,final} shall be rounded to the first place of decimal. If applicable: EC _{DC,CD,COP} shall be rounded to the first place of decimal. FC _{CD} and FE _{CD} shall be rounded to the third place of decimal. Output is available for vehicles H and for vehicle L and, if applicable, for vehicle M. In case that the interpolation method is not applied, final rounding shall be applied according to paragraph 6.1.8. of this Regulation: EC _{AC,CD} , EC _{AC,weighted} and M _{CO2,CD} shall be rounded to the nearest whole number. If applicable: EC _{DC,CD,COP} shall be rounded to the nearest whole number. FC _{CD} and FE _{CD} shall be rounded to the first place of decimal.	If applicable: EC _{DC,CD,COP,final} , Wh/km; For results after 4 phases, EC _{AC,CD,final} , Wh/km; M _{CO2,CD,final} , g/km; EC _{AC,weighted,final} , Wh/km; FC _{CD,final} , l/100 km; For results after 3 phases, FE _{CD,final} , km/l;
	Output step 14	EC _{AC,CD,declared} , Wh/km; EC _{AC,weighted} , Wh/km; FE _{CD,declared} , km/l; M _{CO2,CD,declared} , g/km.		
	Output step 13	FC _{CD,ave} , l/100 km;		
Interpolation family result. If the interpolation method is not applied, step No. 17 is not required and the output of this step is the final result.				

Paragraph 4.6.2., Table A8/9, Step No. 7, amend to read:

7	Output step 1	E _{AC} , Wh;	Calculation of the electric energy consumption based on EAER according to paragraphs 4.3.3.1. and 4.3.3.2. of this annex. Output is available for each CD test. In the case that the interpolation method is applied, the output is available for each vehicle H, vehicle L and, if applicable, vehicle M.	EC, Wh/km; EC _p , Wh/km;
	Output step 3	EAER, km; EAER _p , km;		

Annex B8, Appendix 2

Add a new paragraph 4., to read:

- "4. As an option for the manufacturer, it is allowed to apply $\Delta M_{CO_2,j}$ defined in paragraph 4.5. of Appendix 2 to Annex B6 with the following modification:
- $\eta_{alternator}$ is the efficiency of the alternator
- 0.67 in case $\Delta E_{REESS,p}$ is negative (corresponds to a discharge)
- 1.00 in case $\Delta E_{REESS,p}$ is positive (corresponds to a charge)
- 4.1. In this case, the corrected charge-sustaining CO₂ mass emission defined in paragraphs 4.1.1.3., 4.1.1.4. and 4.1.1.5. of this annex shall be replaced by $\Delta M_{CO_2,j}$ instead of $K_{CO_2,j} \times EC_{DC,CS,j}$."

Annex B8, Appendix 3

Paragraph 3., amend to read:

- "3. REESS voltage
- 3.1. External REESS voltage measurement
- During the tests described in paragraph 3. of this annex, the REESS voltage shall be measured with the equipment and accuracy requirements specified in paragraph 1.1. of this annex. To measure the REESS voltage using external measuring equipment, the manufacturers shall support the Type Approval Authority by providing REESS voltage measurement points and safety instructions.
- 3.2. Nominal REESS voltage
- For NOVC-HEVs, NOVC-FCHVs, OVC-HEVs and OVC-FCHVs, instead of using the measured REESS voltage according to paragraph 3.1. of this appendix, the nominal voltage of the REESS determined according to IEC 60050-482 may be used.
- 3.3. Vehicle on-board REESS voltage data
- As an alternative to paragraphs 3.1. and 3.2. of this appendix, the manufacturer may use the on-board voltage measurement data. The accuracy of these data shall be demonstrated to the Type Approval Authority.

Table A8 App3/1

Test events	Para. 3.1.	Para. 3.2.		Para. 3.3.
		60V or more	Less than 60V	
NOVC-HEV	shall not to be used	shall be used		shall not to be used
OVC-HEV CS condition				
NOVC-FCHV				
OVC-FCHV CS condition				
REESS energy change-based correction procedure (Appendix 2)	shall be used	shall not to be used	allowed to use	allowed to use
OVC-HEV CD condition				
OVC-FCHV CD condition				
PEV				

Annex B8, Appendix 6

Paragraph 1.3., amend to read:

"1.3. On the basis of technical evidence provided by the manufacturer and with the agreement of the Type Approval Authority, the dedicated driver-selectable modes, such as "mountain mode" or "maintenance mode" which are not intended for normal daily operation but only for special limited purposes, shall not be considered. Irrespective of the driver-selectable mode selected for the Type 1 test according to paragraph 2. and 3. of this appendix, the vehicle shall comply with the criteria emissions limits in all remaining driver-selectable modes used for forward driving."

Paragraph 3.2., amend to read:

"3.2. If there is no predominant mode or if there is a predominant mode but this mode does not enable the vehicle to follow the reference test cycle under charge-sustaining operating condition, the mode for the test shall be selected according to the following conditions:

- (a) If there is only one mode which allows the vehicle to follow the reference test cycle under charge-sustaining operating conditions, this mode shall be selected;
- (b) If several modes are capable of following the reference test cycle under charge-sustaining operating conditions and none of those modes is a configurable start mode, the vehicle shall be tested for criteria emissions, CO₂ emissions in the best case mode and worst case mode. Best and worst case modes shall be identified by the evidence provided on the CO₂ emissions in all modes. CO₂ emissions shall be the arithmetic average of the test results in both modes. Test results for both modes shall be recorded.

At the request of the manufacturer, the vehicle may alternatively be tested with the driver-selectable mode in the worst case position for CO₂ emissions.

- (c) If several modes are capable of following the reference test cycle under charge-sustaining operating conditions and at least two or more of those modes are a configurable start mode, the worst case mode for CO₂ emissions and fuel consumption shall be selected from these configurable start modes."
