Commission Implementing Regulation (EU) 2017/1153 of 2 June 2017 setting out a methodology for determining the correlation parameters necessary for reflecting the change in the regulatory test procedure and amending Regulation (EU) No 1014/2010 (Text with EEA relevance)

ANNEX I

1.   INTRODUCTION

This Annex sets out the methodology for determining the NEDC CO_2 value of individual M1 vehicles.

2.   DETERMINATION OF THE NEDC CO_2 VALUE FOR THE WLTP INTERPOLATION FAMILY

2.1.   **Correlation tool**

The type-approval authority shall ensure that the NEDC CO_2 values to be used as reference for the purpose of Section 3 are determined by way of simulations in accordance with the provisions set out in this Annex.

The Commission shall provide a simulation tool for that purpose (hereinafter the 'correlation tool') in the form of downloadable, executable, software. The Commission shall also provide guidance on the capacity of the correlation tool to simulate vehicles with advanced technologies, and, where necessary, recommend the use of physical measurements instead of simulations.

2.1.1.   *Access to the correlation tool*

The correlation tool shall be installed on a computer of the type-approval authority or, where applicable, the technical service, following the instructions provided in the following website:

(http://ec.europa.eu/clima/policies/transport/vehicles/cars/documentation_en.htm)

The type-approval authority shall ensure that the correlation tool is operated in accordance with the requirements of this Regulation and the user instructions set out in the user manual[1].

Support to the approval authorities and technical services using the correlation tool for the purpose of this Regulation shall be provided by the Commission on request. Requests for support shall be addressed to the following functional mailbox:

co2mpas@jrc.ec.europa.eu[2]

The correlation tool shall be accessible to other users, however, support shall only be provided to those users within the limits of available resources.

2.1.2.   *Electronic signature and sealing of the correlation tool output*

An electronic signing-key for the purpose of electronically signing and sealing the original correlation tool output file referred to in point 3.1 shall be made available to the approval authorities and, where applicable, technical services following a request to the Commission. The request shall include the relevant name and contact details (mail address, email address, telephone number) of the person responsible for the execution of the correlation tool output and be sent to the following functional mailbox:

EC-CO2-LDV-IMPLEMENTATION@ec.europa.eu

2.1.3.   *Annual update of the correlation tool*

The performance of the correlation tool shall be continuously reviewed, taking into account information provided, in particular, by the contact persons referred to in point 2.1.2. Where appropriate, the Commission shall prepare a new version of the tool to be released annually

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on 1 September. The new version shall not affect the validity of results provided by previous versions.

The new version may be applied for the purpose of the procedure set out in Section 3 of this Annex from the date of its release. With the agreement of the type-approval authority or the technical service, the previous version of the correlation tool may, however, continue to be used during a maximum period of two months following the release of the new version.

The version used as well as the operating system of the computer on which the correlation tool has been run by the type-approval authority or technical service shall be indicated in the electronically signed correlation tool output report.

Where the applicability of the new version requires the adjustment of any provisions set out in this Regulation, the release of the new version shall not take place until the Regulation has been amended accordingly.

2.1.4.   *Ad-hoc adjustments of the correlation tool*

Notwithstanding point 2.1.3, in case of serious malfunctioning of the correlation tool for the purpose of the procedure set out in Section 3, a new version of the tool shall be prepared and released as soon as possible following the detection of the malfunction. The new version shall apply from the date of its release and shall not affect the validity of results provided by previous versions.

Where the applicability of the new version requires the adjustment of any provisions set out in this Regulation, the release of the new version shall not take place until the Regulation has been amended accordingly.

2.2.   **Identification of the WLTP test results to be used for the purpose of defining the input data for the simulation model**

The input data for the correlation tool simulations shall be taken from the relevant WLTP test results for vehicle H and, where applicable, vehicle L as defined in accordance with point 4.2.1 of Sub-Annex 4 to Annex XXI to Regulation (EU) 2017/1151. Where more than one WLTP type-approval test of vehicle H or L is performed in accordance with Table A6/2 of Annex XXI to that Regulation, the following test results shall be used for the purpose of determining the input data:

(a)   in the case where two type-approval tests are performed, the test results with the highest CO_2 emissions shall be used;

(b)   in the case where three type-approval tests are performed, the test results with the median CO_2 emissions shall be used.

2.3.   **Determination of the input data and conditions for the operation of the correlation tool**

The test conditions referred to in Annex XII to Regulation (EC) No 692/2008 shall be taken into account in the correlation tool simulations, including the precisions provided for in points 2.3.1 to 2.3.7 of this Annex.

The physical vehicle measurements referred to in point 3 shall be performed in accordance with the conditions referred to in that Regulation, with the precisions given in this Annex, and, where applicable, the input data defined in point 2.4.

2.3.1.   *Determination of the NEDC vehicle inertia*

The NEDC reference mass of vehicles H and L shall be determined as follows:

$$RM_{n,L} = (MRO_L - 75 + 100)[kg]$$
$$RM_{n,H} = (MRO_H - 75 + 100)[kg]$$

Where:

MRO is the mass in running order as defined in Article 3(d) of Regulation (EC) No 443/2009 for vehicle H and L respectively.

The reference mass to be used as input for the simulations shall be the inertia value set out in Table 3 of Annex 4a to UN/ECE Regulation No 83 which is equivalent to the reference mass, RM, determined in accordance with this point and referred to as $TM_{n,L}$ and $TM_{n,H}$.

2.3.2.   *Determination of the pre-conditioning effect*

In preparing the chassis-dynamometer for the execution of a type-approval test, the vehicle is pre-conditioned in order to reach similar conditions to those used in the coast-down test. The pre-conditioning procedure used in the WLTP test differs from that used for the purpose of NEDC so that, with equal road loads, the vehicle is considered subject to higher forces under the WLTP. That difference shall be set at 6 Newton and that value shall be used for the calculation of the NEDC road loads in accordance with point 2.3.8.

2.3.3.   *Ambient conditions referred to in point 3.1.1 of UN/ECE Regulation No 83*

For the purpose of the correlation tool, the test cell temperature shall be set at 25 °C.

Also in the case of a physical vehicle measurement pursuant to point 3, the test cell temperature shall be set at 25 °C. However, on request by the manufacturer, the test cell temperature may be set at a value between 20 to 25 °C for the physical measurement.

2.3.4.   *Determination of the initial battery state of charge*

The initial battery state of charge shall be set to at least 99 per cent for the purpose of the correlation tool test. The same shall apply in the case of a physical vehicle test.

2.3.5.   *Determination of the difference in tyre pressure prescriptions*

According to the WLTP, the lowest tyre pressure for the vehicle test mass shall be used, while this is not specified in the NEDC. For the purpose of determining the tyre pressure to be taken into account for the purpose of calculating the NEDC road load in accordance with point 2.3.8, the tyre pressure shall, taking into account the different tyre pressure per vehicle axle, be the average between the two axles of the average between the minimum and maximum tyre pressure permitted for the selected tyres on each axle for the NEDC reference mass of the vehicle. The calculation shall be carried out for both vehicles H and L in accordance with following formulae:

For vehicle H   : $P_{avg,H} = \left(\dfrac{P_{max,H} + P_{min,H}}{2} \right)$

For vehicle L   : $P_{avg,L} = \left(\dfrac{P_{max,L} + P_{min,L}}{2} \right)$

Where:

$P_{max,}$ is the average of the maximum tyre pressures of the selected tyres for the two axles;

$P_{min,}$ is the average of the minimum tyre pressures of the selected tyres for the two axles.

The corresponding effect in terms of resistance applied to the vehicle shall be calculated using the following formulae for the respective vehicle H and L:

$$TP_H = \left(\frac{P_{avg,H}}{P_{min,H}}\right)^{-0,4}$$

$$TP_L = \left(\frac{P_{avg,L}}{P_{min,L}}\right)^{-0,4}$$

2.3.6.   *Determination of the tyre tread depth (TTD)*

According to point 4.2.2.2 of Sub-Annex 4 to Annex XXI to Regulation (EU) 2017/1151 a minimum tyre tread depth of 80 % is to be considered for the WLTP test, while pursuant to point 4.2 of Appendix 7 to Annex 4a to UN/ECE Regulation No 83, the minimum allowed tyre tread depth for the purpose of the NEDC test is to be considered as equal to 50 % of the nominal value. This results in an average difference of 2 mm in tread depth between the two procedures. The corresponding effect in terms of the resistance applied to the vehicle shall be determined for the purpose of the NEDC road load calculation in point 2.3.8 in accordance with the following formulae for the respective vehicle H and L:

$$TTD_H = \left(2 \cdot \frac{0,1 \cdot RM_{n,H} \cdot 9,81}{1000}\right)$$

$$TTD_L = \left(2 \cdot \frac{0,1 \cdot RM_{n,L} \cdot 9,81}{1000}\right)$$

Where:

$RM_{n,H}$ and $RM_{n,L}$ are the reference masses of vehicle H and L determined in accordance with point 2.3.1.

2.3.7.   *Determination of the inertia of rotating parts*

For the purpose of the correlation tool:

During the simulation of the WLTP test four rotating wheels are to be considered, while for the purpose of the NEDC tests only two rotating wheels are to be considered. The effect this has on the forces applied to the vehicle shall be taken into account in accordance with the formulae set out in point 2.3.8.1.1(a)(3).

The acceleration and deceleration forces in the correlation tool shall be calculated for the NEDC simulation by considering the inertia of only two rotating wheels.

For the purpose of a physical test:

During the WLTP coastdown setting, coastdown times are to be transferred to forces and vice versa by taking into account the applicable test mass plus the effect of rotational mass (3 % of the sum of the MRO and 25 kg). For the NEDC coastdown setting, coastdown times are to be transferred to forces and vice versa by neglecting the effect of rotational mass (only NEDC vehicle inertia calculated in point 2.3.1 is used).

2.3.8.   *Determination of the NEDC road loads*

2.3.8.1.   In the case of road loads being determined in accordance with points 1-4 and 6 of Sub-Annex 4 of Annex XXI to Regulation (EU) 2017/1151

2.3.8.1.1. Determination of the NEDC road load coefficients for vehicle H

(a)   The road load coefficient $F_{0,n}$ expressed in Newton (N) for vehicle H shall be determined as follows:

        (1)   Effect of different inertia:
$$F_1^{0n,H} = F_{0w,H} \cdot \left(\frac{RM_{n,H}}{TM_{w,H}}\right)$$

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Where the factors in the formula are as defined in point 2.3.1, with the exception of the following:

$F_{0w,H}$ is the road load coefficient F_0 determined for the WLTP test of vehicle H; $TM_{w,H}$ is the test mass used for the WLTP test of vehicle H.

(2)   Effect of different tyre pressure:

$$F_2^{0n,H} = F_1^{0n,H} \cdot TP_H$$

Where the factors in the formula are as defined in point 2.3.5.

(3)   Effect of the inertia of rotating parts:

$$F_3^{0n,H} = F_2^{0n,H} \cdot \left(\frac{1,015}{1,03} \right)$$

In the case of a physical vehicle test, the following formula applies:

$$F_3^{0n,H} = F_2^{0n,H} \cdot \left(\frac{1}{1,03} \right)$$

(4)   Effect of different tyre tread depth:

$$F_4^{0n,H} = F_3^{0n,H} - TTD_H$$

Where the factors in the formula are as defined in point 2.3.6.

(5)   Effect of preconditioning:

$$F_{0n,H} = F_4^{0n,H} - 6$$

In the case of a physical vehicle test, the correction for the effect of preconditioning shall not be applied

(b)   The road load coefficient F_{1n} for vehicle H shall be determined as follows:

Effect of the inertia of rotating parts

$$F_{1n,H} = F_{1w,H} \cdot \left(\frac{1,015}{1,03} \right)$$

In the case of a physical vehicle test, the following formula applies:

$$F_{1n,H} = F_{1w,H} \cdot \left(\frac{1}{1,03} \right)$$

(c)   The road load coefficient F_{2n} for vehicle H shall be determined as follows:

Effect of the inertia of rotating parts

$$F_{2n,H} = F_*^{2w,H} \cdot \left(\frac{1,015}{1,03} \right)$$

In the case of a physical vehicle test, the following formula applies:

$$F_{2n,H} = F_*^{2w,H} \cdot \left(\frac{1}{1,03} \right)$$

Where the factor

$$F_{2w,L}$$

is the road load coefficient F_2 determined for the WLTP test of vehicle H from which the effect of all aerodynamic optional equipment has been removed.

2.3.8.1.2. Determination of the NEDC road load coefficients for vehicle L

(a)   The road load coefficient $F_{0,n}$ for vehicle L shall be determined as follows:

(1)   Effect of different inertia:

$$F_1^{0n,L} = F_{0w,L} \cdot \left(\frac{RM_{w,L}}{TM_{w,L}} \right)$$

Where the factors in the formula are as defined in point 2.3.1, with the exception of $F_{0w,L}$ which is the road load coefficient F_0 determined for the WLTP test of vehicle L, and $TM_{w,L}$ which is the test mass used for the WLTP test of vehicle L.

(2)   Effect of different tyre pressure:

$$F_2^{0n,L} = F_1^{0n,L} \cdot TP_L$$

Where the factors in the formula are as defined in point 2.3.5.

(3)   Effect of the inertia of rotating parts:

$$F_3^{0n,L} = F_2^{0n,L} \cdot \left(\frac{1,015}{1,03} \right)$$

In the case of a physical vehicle test, the following formula applies:

$$F_3^{0n,L} = F_2^{0n,L} \cdot \left(\frac{1}{1,03} \right)$$

(4)   Effect of different tyre tread depth:

$$F_4^{0n,L} = F_3^{0n,L} - TTD_L$$

Where the factors in the formula are as defined in point 2.3.6.

(5)   Effect of preconditioning:

$$F_{0n,L} = F_4^{0n,L} - 6$$

In the case of a physical vehicle test, the correction for the effect of preconditioning shall not be applied.

(b)   The road load coefficient F_{1n} for vehicle L shall be determined as follows:

Effect of the inertia of rotating parts

$$F_{1n,L} = F_{1w,L} \cdot \left(\frac{1,015}{1,03} \right)$$

In the case of a physical vehicle test, the following formula applies:

$$F_{1n,L} = F_{1w,L} \cdot \left(\frac{1}{1,03} \right)$$

Where the factor $F_{1w,L}$ is the road load coefficient F_1 determined for the WLTP test of vehicle L.

(c)   The road load coefficient F_{2n} for vehicle L shall be determined as follows:

Effect of the inertia of rotating parts

$$F_{2n,L} = F_*^{2w,L} \cdot \left(\frac{1,015}{1,03} \right)$$

In the case of a physical vehicle test, the following formula applies:

$$F_{2n,L} = F_*^{2w,L} \cdot \left(\frac{1}{1,03} \right)$$

Where the factor $F_{2w,L}$ is the road load coefficient F_2 determined for the WLTP test of vehicle L from which the effect of all aerodynamic optional equipment has been removed.

2.3.8.2. Determination of the road loads where, for the purpose of the WLTP test, the road loads have been determined in accordance with point 5 of Sub-Annex 4 of Annex XXI to Regulation (EU) 2017/1151.

(a) Where the road load of a vehicle has been calculated in accordance with point 5.1 of Sub-Annex 4 to Annex XXI to Regulation (EU) 2017/1151, the NEDC road load to be used as input for the correlation tool simulations shall be derived as follows:

Vehicle H:

$$F_{0n,H} = T_{0n,H} + (F_{0w,M} - A_{w,M})$$
$$F_{1n,H} = F_{1w,M} - B_{w,M}$$
$$F_{2n,H} = T_{2n,H} + (F_{2w,M} - C_{w,M})$$

Vehicle L:

$$F_{0n,L} = T_{0n,L} + (F_{0w,M} - A_{w,M})$$
$$F_{1n,L} = F_{1w,M} - B_{w,M}$$
$$F_{2n,L} = T_{2n,L} + (F_{2w,M} - C_{w,M})$$

Where:

$F_{0n,i}$, $F_{1n,i}$, $F_{2n,i}$, with i = H,L,	are the NEDC road load coefficients for vehicle H or L;
$T_{0n,i}$, $T_{2n,i}$, with i = H,L	are the NEDC chassis dynamometer coefficients for vehicles H or L determined in accordance with Table 3 of Annex 4a to UN/ECE Regulation No 83;
$A_{W,M}$, $B_{W,M}$, $C_{W,M}$	are the chassis dynamometer coefficients for the vehicle used for the purpose of the preparation of the chassis dynamometer in accordance with points 7 and 8 of Sub-Annex 4 to Annex XXI to Regulation (EU) 2017/1151.

(b) Where default road loads have been calculated in accordance with point 5.2 of Sub-Annex 4 to Annex XXI to Regulation (EU) 2017/1151, the NEDC road loads shall be calculated as follows:

Vehicle H:

$$F_{0n,H} = T_{0n,H} + (F_{0w,H} - A_{w,H})$$
$$F_{1n,H} = F_{1w,H} - B_{w,H}$$
$$F_{2n,H} = T_{2n,H} + (F_{2w,H} - C_{w,H})$$

Vehicle L:

$$F_{0n,L} = T_{0n,L} + (F_{0w,M} - A_{w,M})$$
$$F_{1n,L} = F_{1w,M} - B_{w,M}$$
$$F_{2n,L} = T_{2n,L} + (F_{2w,M} - C_{w,M})$$

Where:

$F_{0n,i}$, $F_{1n,i}$,	are the NEDC road load coefficients for vehicle H or L;

$F_{2n,i}$, with $i =$ H,L, $T_{0n,i}$, $T_{2n,i}$, with $i =$ H,L		are the NEDC chassis dynamometer coefficients for vehicles H or L determined in accordance with Table 3 of Annex 4a to UN/ECE Regulation No 83;
$A_{W,i}$, $B_{W,i}$, $C_{W,i}$, with $i =$ H,L		are the chassis dynamometer coefficients for vehicles H or L determined for the purpose of the preparation of the chassis dynamometer in accordance with points 7 and 8 of Sub-Annex 4 to Annex XXI to Regulation (EU) 2017/1151.

2.4.   **Input data matrix**

The manufacturer shall determine the input data for each vehicle H and vehicle L in accordance with point 2.2 and submit the completed matrix set out in Table 1 to the type-approval authority or, where applicable, the technical service appointed to perform the test, with the exception of entries 31, 32 and 33 (the NEDC road loads) which shall be calculated by the type-approval authority or the technical service in accordance with the formulae specified in point 2.3.8.

The type-approval authority or technical service shall independently verify and confirm the correctness of the input data provided by the manufacturer. In case of doubt, the type-approval authority or technical service shall determine the relevant input data independently of the information provided by the manufacturer or, where appropriate, act in accordance with point 3.2.7 and 3.2.8.

TABLE 1

Matrix of input data for the correlation tool

No	Input parameters for the correlation tool	Unit	Source	Remarks
1	Fuel type	—	Point 3.2.2.1 of Appendix 3 to Annex I to Regulation (EU) 2017/1151	Diesel/Petrol/ LPG/NG or Biomethane/ Ethanol(E85)/ Biodiesel
2	Fuel lower heating value	kJ/kg	Declaration by manufacturer and/or technical service	
3	Fuel carbon content	%	Idem	% of carbon in the fuel by weight, e.g. 85,5 %

a	Either normal engine idling speed, high engine idling speed and maximum net torque or T1 maps speed torque and power are necessary (for gearshift)
b	Either tyre dimensions or velocity speed ratio is necessary (for gearshift)

4	Engine type		Point 3.2.1.1 of Appendix 3 to Annex I to Regulation (EU) 2017/1151	Positive ignition or compression ignition
5	Engine capacity	cc	Point 3.2.1.3 of Appendix 3 to Annex I to Regulation (EU) 2017/1151	
6	Engine stroke	mm	Point 3.2.1.2.2 Appendix 3 to Annex I to Regulation (EU) 2017/1151	
7	Rated engine power	kW…min^{-1}	Point 3.2.1.8 of Appendix 3 to Annex I to Regulation (EU) 2017/1151	
8	Engine speed at rated engine power	min^{-1}	Point 3.2.1.8 in Appendix 3 to Annex I to Regulation (EU) 2017/1151	Engine speed at maximum net power
9	High engine idling speed[a]	min^{-1}	Point 3.2.1.6.1 Appendix 3 to Annex I to Regulation (EU) 2017/1151	
10	Maximum net torque[a]	Nm at… min^{-1}	Point 3.2.1.10 Appendix 3 to Annex I to Regulation (EU) 2017/1151	
11	T1 map speed[a]	rpm	Sub-Annex 2 to Annex XXI to Regulation (EU) 2017/1151	Array
12	T1 map torque[a]	Nm	Sub-Annex 2 to Annex XXI to Regulation (EU) 2017/1151	Array

[a]   Either normal engine idling speed, high engine idling speed and maximum net torque or T1 maps speed torque and power are necessary (for gearshift)

[b]   Either tyre dimensions or velocity speed ratio is necessary (for gearshift)

13	T1 map power[a]	kW	Sub-Annex 2 to Annex XXI to Regulation (EU) 2017/1151	Array
14	Engine idle speed	rpm	Sub-Annex 2 to Annex XXI to Regulation (EU) 2017/1151	Idle speed in warm condition
15	Engine idle fuel consumption	g/s	Manufacturer declaration	Idle fuel consumption in warm condition
16	Final drive ratios	—	Point 4.6 in Appendix 3 to Annex I to Regulation (EU) 2017/1151	Final drive ratio
17	Tyre code[b]	—	Point 6 of Appendix 3 to Annex I to Regulation (EU) 2017/1151	Tyre code (e.g. P195/55R1685H) of the tyres used in the WLTP test
18	Gearbox type	—	Point 4.5 of Appendix 3 to Annex I to Regulation (EU) 2017/1151	automatic/ manual/CVT
19	Torque converter	—	Manufacturer declaration	0 = No, 1 = Yes; Does the vehicle use torque converter?
20	Fuel saving gear for automatic transmission	—	Manufacturer declaration	0 = No, 1 = Yes Setting this value to 1 will allow the correlation tool to use a higher gear at constant speed driving than in the case of transient conditions
21	Drive mode	—	Point 2.3.1 of Sub-Annex 5 to Annex XXI to	Two-wheel drive, four-wheel drive.

a   Either normal engine idling speed, high engine idling speed and maximum net torque or T1 maps speed torque and power are necessary (for gearshift)

b   Either tyre dimensions or velocity speed ratio is necessary (for gearshift)

			Regulation (EU) 2017/1151	
22	Start-stop activation time	sec	Manufacturer declaration	Start-stop activation time elapsed from test start
23	Nominal voltage of the alternator	V	Point 3.4.4.5 of Appendix 3 to Annex I to Regulation (EU) 2017/1151	
24	Battery capacity	Ah	Point 3.4.4.5 of Appendix 3 to Annex I to Regulation (EU) 2017/1151	
25	Starting ambient temperature WLTP	°C		Default value = 23 °C WLTP test measurement
26	Alternator maximum power	kW	Manufacturer declaration	
27	Efficiency of the alternator	—	Manufacturer declaration	Default value = 0,67
28	Gearbox ratios	—	Point 4.6 of Appendix 3 to Annex I to Regulation (EU) 2017/1151	Array: ratio gear 1, ratio gear 2, etc.
29	Ratio of vehicle speed to engine speed[b]	(km/h)/rpm	Manufacturer declaration	Array: [constant velocity speed ratio gear 1, constant velocity speed ratio gear 2, ...]; Alternative to gear box ratios
30	Vehicle inertia NEDC	kg	Point 2.6 of Appendix 3 to Annex I to Regulation (EU) 2017/1151	To be derived in accordance with point 2.3.1 of this Annex.
31	F0 NEDC	N	Point 2.3.8 of this Annex, To	F0 road load coefficient

a	Either normal engine idling speed, high engine idling speed and maximum net torque or T1 maps speed torque and power are necessary (for gearshift)
b	Either tyre dimensions or velocity speed ratio is necessary (for gearshift)

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			be completed by the type-approval authority or Technical Service	
32	F1 NEDC	N/(km/h)	Idem	F1 road load coefficient
33	F2 NEDC	$N/(km/h)^2$	Idem	F2 road load coefficient
34	Test mass WLTP	kg	Point 2.4.6 of the Appendix to the information document in Appendix 3 to Annex I to Regulation (EU) 2017/1151	no correction for rotating parts
35	F0 WLTP	N	Point 2.4.8 of the Appendix to the information document in Appendix 3 to Annex I to Regulation (EU) 2017/1151	F0 road load coefficient
36	F1 WLTP	N/(km/h)	Idem	F1 road load coefficient
37	F2 WLTP	$N/(km/h)^2$	Idem	F2 road load coefficient
38	WLTP CO_2 value phase 1	gCO_2/km	Point 2.1.1 of test report of Annex I, Appendix 8a of Regulation (EU) 2017/1151	Phase low, bag values not corrected for RCB, not rounded WLTP test measurement
39	WLTP CO_2 value phase 2	gCO_2/km	Idem	Phase medium, bag values not corrected for RCB, not rounded WLTP test measurement
40	WLTP CO_2 value phase 3	gCO_2/km	Idem	Phase high, bag values not corrected

a   Either normal engine idling speed, high engine idling speed and maximum net torque or T1 maps speed torque and power are necessary (for gearshift)

b   Either tyre dimensions or velocity speed ratio is necessary (for gearshift)

				for RCB, not rounded WLTP test measurement
41	WLTP CO_2 value phase 4	gCO_2/km	Idem	Phase extra high, bag values not corrected for RCB, not rounded WLTP test measurement
42	Turbo- or Supercharger	—	Manufacturer declaration	0 = No | 1 = Yes — Is the engine equipped with any kind of charging system?
43	Start-stop	—	Manufacturer declaration	0 = No | 1 = Yes — Does the vehicle have start-stop system?
44	Brake energy Recuperation	—	Manufacturer declaration	0 = No | 1 = Yes — Does the vehicle have energy recuperation technologies?
45	Variable valve actuation	—	Manufacturer declaration	0 = No | 1 = Yes — Does the engine feature variable valve actuation?
46	Thermal management	—	Manufacturer declaration	0 = No | 1 = Yes — Does the vehicle have technologies that actively manage temperature at the gear box?
47	Direct injection/ Port Fuel Injection	—	Manufacturer declaration	0 = PFI | 1 = DI
48	Lean burn	—	Manufacturer declaration	0 = No | 1 = Yes — Does the engine use lean burn?

a   Either normal engine idling speed, high engine idling speed and maximum net torque or T1 maps speed torque and power are necessary (for gearshift)

b   Either tyre dimensions or velocity speed ratio is necessary (for gearshift)

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49	Cylinder deactivation	—	Manufacturer declaration	0 = No | 1 = Yes — Does the engine use a cylinder deactivation system?
50	Exhaust gas recirculation	—	Manufacturer declaration	0 = No | 1 = Yes — Does the vehicle have an external EGR system?
51	Particulate filter	—	Manufacturer declaration	0 = No | 1 = Yes — Does the vehicle have a particulate filter?
52	Selective Catalytic Reduction	—	Manufacturer declaration	0 = No | 1 = Yes — Does the vehicle have an SCR system?
53	NOx storage catalyst	—	Manufacturer declaration	0 = No | 1 = Yes — Does the vehicle have a NOx storage catalyst?
54	WLTP Time	sec	WLTP test measurement (identified in accordance to Point 2.2 of this Annex)	Array: OBD and Chassis Dynamometer data, 1hz
55	WLTP Velocity (theoretical)	km/h	As defined in sub-Annex 1 to Annex XXI to Regulation (EU) 2017/1151	Array: 1hz, resolution 0,1 km/h. If not provided the speed profile defined in Point 6 of sub-Annex 1 to Annex XXI to Regulation (EU) 2017/1151 and in particular to Tables A1/7-A1/9, A1/11, and A1/12 applies

a   Either normal engine idling speed, high engine idling speed and maximum net torque or T1 maps speed torque and power are necessary (for gearshift)

b   Either tyre dimensions or velocity speed ratio is necessary (for gearshift)

56	WLTP Velocity (actual)	km/h	WLTP test measurement (identified in accordance to Point 2.2 of this Annex)	Array: OBD and Chassis Dynamometer data, 1hz, resolution 0,1 km/h
57	WLTP Gear (theoretical)	—	As defined in sub-Annex 2 to Annex XXI to Regulation (EU) 2017/1151	Array: 1hz. If not provided, the calculation by the correlation tool applies
58	WLTP Engine Speed	rpm	WLTP test measurement (identified in accordance to Point 2.2 of this Annex)	Array: 1hz, 10 RPM resolution from OBD
59	WLTP Engine Coolant Temperature	°C	Idem	Array: OBD Data, 1hz, 0,5 °C resolution
60	WLTP Alternator Current	A	As defined, for the low-voltage battery current, in Appendix 2 to Sub-Annex 6 to Annex XXI to Regulation (EU) 2017/1151	Array: 1hz, 0,1 A resolution, external measurement device synchronised with the chassis dynamometer
61	WLTP Low-Voltage Battery Current	A	As defined in Appendix 2 to Sub-Annex 6 to Annex XXI to Regulation (EU) 2017/1151	Array: 1hz, 0,1 A resolution, external measurement device synchronised with the chassis dynamometer
62	WLTP calculated load	—	As defined in Annex 11 of UN/ECE Regulation No 83	Array: OBD data, 1hz at least (higher frequencies possible, 1 % resolution) WLTP test measurement

a   Either normal engine idling speed, high engine idling speed and maximum net torque or T1 maps speed torque and power are necessary (for gearshift)

b   Either tyre dimensions or velocity speed ratio is necessary (for gearshift)

63	WLTP preconditioning time	sec	Preconditioning test measurement, point 1.2.6 of Annex XXI, Sub-Annex 6 of Regulation (EU) 2017/1151	Array: OBD and Chassis Dynamometer data, 1hz
64	WLTP preconditioning velocity	km/h	Idem	Array: OBD and Chassis Dynamometer data, 1hz, resolution 0,1 km/h
65	WLTP preconditioning alternator current	A	To be measured in accordance with the methodology defined for the low-voltage battery current, in point 2.1 of Appendix 2 to Sub-Annex 6 to Annex XXI to Regulation (EU) 2017/1151	Array: 1hz, 0,1 A resolution, external measurement device synchronised with the chassis dynamometer
66	WLTP preconditioning low-voltage battery current	A	As defined in Appendix 2 to Sub-Annex 6 to Annex XXI to Regulation (EU) 2017/1151	Array: 1hz, 0,1 A resolution, external measurement device synchronised with the chassis dynamometer

a	Either normal engine idling speed, high engine idling speed and maximum net torque or T1 maps speed torque and power are necessary (for gearshift)
b	Either tyre dimensions or velocity speed ratio is necessary (for gearshift)

3.   DETERMINATION OF NEDC CO_2 EMISSION AND FUEL CONSUMPTION VALUES FOR VEHICLE H AND L

3.1.   **Determination of NEDC CO_2 reference values, phase-specific values and fuel consumption values for vehicle H and L**

The type-approval authority shall ensure that the NEDC CO_2 reference value for the respective vehicle H and, where applicable, vehicle L of a WLTP interpolation family as well as the phase-specific values and the fuel consumption is determined in accordance with points 3.1.2 and 3.1.3.

In the case the NEDC road loads calculated in accordance with point 2.3.8 for vehicle H and L are the same, the NEDC CO_2 reference value shall be determined for vehicle H only.

3.1.1.   *Correlation tool input and output*

The type-approval authority or designated technical service shall ensure that the input data file for the correlation tool is complete. Following a completed test run on the correlation tool, the person designated in accordance with point 2.1.1 shall digitally sign

(a)   the original correlation output report;

(b)   the summary text file.

The correlation output report referred to in point (a) shall include the input data used, the output data resulting from the execution of the correlation, the manufacturer-declared value and, where available, the result of physical vehicle tests. The summary text file referred to in point (b) shall include the manufacturer-declared value and the CO_2 emission value resulting from the correlation tool and relevant identifiers, such as the code for the interpolation family concerned.

3.1.2.   *NEDC CO_2 reference value for vehicle H*

The correlation tool shall be used to execute the following simulated tests using the relevant input data file referred to in point 3.1.1.:

(a)   a WLTP test of vehicle H;

(b)   an NEDC test of vehicle H.

The NEDC CO_2 reference value for vehicle H shall be determined as follows:

$$CO_{2,H} = (WLTP_{ACGcorr,H} + RCB_{corr,H} - DE_{c,H}) \cdot K_{i,H}$$

Where:

$CO_{2,H}$	is the NEDC CO_2 reference value for vehicle H;
$WLTP_{ACGcorr,H}$	is the average of the WLTP CO_2 values for vehicle H resulting from the tests referred to in point 2.2 corrected for the REESS charge balance (RCB) following the procedure set out in Appendix 2 to Sub-Annex 6 to Annex XXI to Regulation (EU) 2017/1151; Correction for the RCB shall be applied in cases when RCB is negative (corresponding to REESS discharging) and positive (corresponding to REESS charging) and also in the cases when the correction criterion c specified in Table A6. App 2/2 in that Appendix is less than the applicable tolerance according to that Table;
$RCB_{corr,H}$	is the CO_2 correction for RCB of the WLTP test for vehicle H selected in accordance with point 2.2 for the purpose of defining the input data, gCO_2/km, calculated following the procedure set out in Appendix 2 to Sub-Annex 6 to Annex XXI to Regulation (EU) 2017/1151 with RCB negative (corresponding to REESS discharging) and positive (corresponding to REESS charging);
$DE_{c,H}$	is the difference between the WLTP test result referred to in point (a) and the NEDC test result referred to in point (b) for vehicle H;
$K_{i,H}$	is the value determined in accordance with appendix 1 to Sub-Annex 6 to Annex XXI to Regulation (EU) 2017/1151 for vehicle H.

3.1.3.   *NEDC CO_2 reference value for vehicle L*

Where applicable, the following simulations shall be performed using the correlation tool and the relevant input data as recorded in the matrix referred to in point 2.4:

(a)   a WLTP test of vehicle L;

(b)   an NEDC test of vehicle L.

The NEDC CO_2 reference value for vehicle L shall be determined as follows:

$$CO_{2,L} = (WLTP_{ACGcorr,L} + RCB_{corr,L} - DE_{c,L}) \cdot K_{i,L}$$

Where:

$CO_{2,L}$	is the NEDC CO_2 reference value for vehicle L;
$WLTP_{ACGcorr,L}$	is the average of the WLTP CO_2 values resulting from the vehicle L tests referred to in point 2.2 corrected for the REESS charge balance (RCB) following the procedure set out in Appendix 2 to Sub-Annex 6 to Annex XXI to Regulation (EU) 2017/1151; Correction for the RCB shall be applied in cases when RCB is negative (corresponding to REESS discharging) and positive (corresponding to REESS charging) and also in the cases when the correction criterion c specified in Table A6. App 2/2 in that Appendix is less than the applicable tolerance according to that Table;
$RCB_{corr,L}$	is the CO_2 correction for RCB of the WLTP test of vehicle L selected in accordance with point 2.2 for the purpose of defining the input data, gCO_2/km, calculated following the procedure set out in Appendix 2 to Sub-Annex 6 to Annex XXI to Regulation (EU) 2017/1151 with RCB negative (corresponding to REESS discharging) and positive (corresponding to REESS charging);
$DE_{c,L}$	is the difference between the WLTP test result referred to in point (a) and the NEDC test result referred to in point (b) for vehicle L;
$K_{i,L}$	is the value determined in accordance with appendix 1 to Sub-Annex 6 to Annex XXI to Regulation (EU) 2017/1151 for vehicle L.

3.2.   Interpretation of the NEDC CO_2 reference values determined for vehicle H and L

For each WLTP interpolation family, the manufacturer shall declare the NEDC CO_2 mass emissions combined value for vehicle H, and, where applicable, vehicle L, to the approval authority. The type-approval authority shall ensure that the NEDC CO_2 reference values for vehicle H and, where applicable, vehicle L are determined in accordance with point 3.1.2 and 3.1.3, and that the reference values for the respective vehicle is interpreted in accordance with points 3.2.1 to 3.2.5.

3.2.1.   The NEDC CO_2 value for test vehicle H or L to be used for the purpose of the calculations set out in point 4 shall be the manufacturer-declared value, if the NEDC CO_2 reference value does not exceed that value by more than 4 per cent. The reference value may be lower without any limitation.

3.2.2.   If the NEDC CO_2 reference value exceeds the manufacturer-declared value by more than 4 per cent, the reference value may be used for the purpose of the calculations set out in point 4 for test vehicle H or L, or the manufacturer may request that a physical measurement is performed under the responsibility of the type-approval authority in accordance with the procedure referred to in Annex XII to Regulation (EC) No 692/2008, taking into account the precisions specified in point 2 of this Annex.

3.2.3.   If the physical measurement referred to in point 3.2.2, amplified by the Ki-factor, does not exceed the manufacturer-declared value by more than 4 per cent, the declared value shall be used for the purpose of the calculations set out in point 4.

3.2.4.   If the physical measurement, amplified by the Ki-factor, exceeds the manufacturer-declared value by more than 4 per cent, another physical measurement of the same vehicle shall be performed and the results shall be amplified by the Ki-factor. If the average of those two measurements does not exceed the declared value by more than 4 per cent, the declared value shall be used for the purpose of the calculations set out in point 4.

3.2.5.   If the average of the two measurements referred to in point 3.2.4 exceeds the manufacturer-declared value by more than 4 per cent, a third measurement shall be performed and the results shall be amplified by the Ki-factor. The average of the three measurements shall be used for the purpose of the calculations set out in point 4.

3.2.6.   Where the NEDC CO_2 value for vehicle H or L is determined in accordance with point 3.2.1, the type-approval authority or the designated technical service shall use the relevant commands in the correlation tool to send the signed summary text file to a time-stamp-server and the following functional mailbox:

EC-CO2-LDV-IMPLEMENTATION@ec.europa.eu

A time-stamped reply shall be sent in return including a randomly generated integer number in the range 1 to 100 calculated by the correlation tool. Where the number is in the range of 91 to 100 the vehicle shall be selected for one physical measurement in accordance with the procedure referred to in Annex XII to Regulation (EC) No 692/2008, taking into account the precisions specified in point 2 of this Annex. The test results shall be documented in accordance with Annex VIII to Directive 2007/46/EC.

In the case the NEDC CO_2 value for both vehicles H and L is determined in accordance with point 3.2.1, the vehicle configuration selected for physical measurement shall be the vehicle L, if the random number is in the range to 91 to 95, and vehicle H, if the random number is in the range of 96 to 100.

3.2.7.   Notwithstanding point 3.2.6, a type-approval authority shall, where applicable, based on a proposal by a technical service, in those cases where the NEDC CO_2 value is determined in accordance with point 3.2.1, request that a vehicle undergoes one physical measurement where, based on their independent expertise, there are justified reasons to consider that the declared NEDC CO_2 value is too low in relation to a measured NEDC CO_2 value. The test results shall be documented in accordance with Annex VIII to Directive 2007/46/EC.

3.2.8.   Where a physical test is performed in accordance with point 3.2.6 or point 3.2.7, the type-approval authority shall for each WLTP interpolation family record the relative deviation (De) between the measured value and the manufacturer-declared value determined as follows:

$$De = \frac{RTr - DV}{DV}$$

Where:

RTr   is the random test result, amplified by the Ki-factor;
DV   is the manufacturer-declared value.

The De factor shall be recorded in the type-approval certificate and in the certificate of conformity.

Where the type-approval authority finds that the physical test results do not confirm the input data provided by the manufacturer and, in particular, the data referred to in points 20, 22 and 44 of Table 1 in point 2.4, a verification factor shall be set to 1 and be recorded in the type-approval certificate and in the certificate of conformity. Where the input data is confirmed or where the error in the input data is not to the benefit of the manufacturer the verification factor shall be set to 0.

3.3. Calculation of the NEDC phase-specific CO_2 values and fuel consumption values for vehicle H and L

The type-approval authority or, where applicable, the technical service shall determine the NEDC phase-specific values and the fuel consumption values for vehicle H and L in accordance with points 3.3.1 to 3.3.4.

3.3.1. *Calculation of the NEDC phase-specific CO_2 values for vehicle H*

$$\text{NEDC } CO_{2,p,H} = \text{NEDC } CO_{2,p,H,c} \cdot CO_{2,AF,H}$$

Where:

p	is the NEDC phase 'UDC' or 'EUDC';
NEDC $CO_{2,p,H,c}$	is the NEDC CO_2 test result for the phase p referred to in point (b) of paragraph 3.1.2
NEDC $CO_{2,p,H}$	is the NEDC phase-specific value for the vehicle H of the applicable phase p, gCO_2/km
$CO_{2,AF,H}$	is the adjustment factor for the vehicle H calculated by the ratio between the NEDC CO_2 value determined in accordance with point 3.2 and the NEDC test result referred to in point (b) of paragraph 3.1.2

3.3.2. *Calculation of the NEDC phase-specific CO_2 values for vehicle L*

The NEDC phase-specific values shall be calculated as follows:

$$\text{NEDC } CO_{2,p,L} = \text{NEDC } CO_{2,p,L,c} \cdot CO_{2,AF,L}$$

Where:

p	is the NEDC phase 'UDC' or 'EUDC';
NEDC $CO_{2,p,L,c}$	is the NEDC CO_2 test result for the phase p determined in accordance with point (b) of paragraph 3.1.3;
NEDC $CO_{2,p,L}$	is the NEDC phase-specific value for the vehicle L of the applicable phase p, gCO_2/km;
$CO_{2,AF,L}$	is the adjustment factor for the vehicle L calculated by the ratio between the NEDC CO_2 value determined in accordance with point 3.2 and the NEDC test result referred to in point (b) of paragraph 3.1.3.

3.3.3. *Calculation of the NEDC fuel consumption for vehicle H*

3.3.3.1. Calculation of the NEDC fuel consumption (combined)

The NEDC fuel consumption (combined) for vehicle H shall be calculated as follows:

$$\text{NEDC } FC_H = \text{NEDC } FC_{H,c} \cdot CO_{2,AF,H}$$

Where:

NEDC $FC_{H,c}$	is the NEDC fuel consumption (combined) test result determined in accordance with Annex XII to Regulation (EC) No 692/2008 using the CO_2 emissions determined in accordance with point (b) of paragraph 3.1.2 or a physical measurement result as referred to in point 3.2.2; the emissions of other pollutants relevant to the fuel consumption calculation (hydrocarbons, carbon monoxide) shall be considered equal to 0 (zero) g/km;
NEDC FC_H	is the NEDC fuel consumption (combined) for the vehicle H, l/100km;
$CO_{2,AF,H}$	is the adjustment factor for the vehicle H calculated by the ratio between the NEDC CO_2 value determined in accordance with point 3.2 and the NEDC test result referred to in point (b) of paragraph 3.1.2.

3.3.3.2.   Calculation of the NEDC phase-specific fuel consumption for vehicle H

The NEDC phase-specific fuel consumption for vehicle H shall be calculated as follows:

$$\text{NEDC } FC_{p,H} = \text{NEDC } FC_{p,H,c} \cdot CO_{2,AF,H}$$

Where:

p	is the NEDC phase 'UDC' or 'EUDC';
NEDC $FC_{p,H,c}$	is the NEDC fuel consumption for the phase p determined in accordance with Annex XII to Regulation (EC) No 692/2008 using the CO_2 emissions determined in accordance with point (b) of paragraph 3.1.2 or a physical measurement result as referred to in point 3.2.2; the emissions of other pollutants relevant to the fuel consumption calculation (hydrocarbons, carbon monoxide) shall be considered equal to 0 (zero) g/km;
NEDC $FC_{p,H}$	is the NEDC phase-specific fuel consumption for the vehicle H of the applicable phase p, l/100km;
$CO_{2,AF,H}$	is the adjustment factor for the vehicle H calculated by the ratio between the NEDC CO_2 value determined in accordance with point 3.2 and the NEDC test result referred to in point (b) of paragraph 3.1.2.

3.3.4.   *Calculation of the NEDC fuel consumption for vehicle L*

3.3.4.1.   Calculation of the NEDC fuel consumption (combined) for vehicle L

The NEDC combined fuel consumption for vehicle L shall be calculated as follows:

$$\text{NEDC } FC_L = \text{NEDC } FC_{L,c} \cdot CO_{2,AF,L}$$

Where:

NEDC $FC_{L,c}$	is the NEDC fuel consumption (combined) test result determined in accordance with Annex XII to Regulation (EC) No 692/2008 using the CO_2 emissions determined in accordance with point (b) of paragraph 3.1.3 or a physical measurement result as referred to in point 3.2.2; the emissions of other pollutants relevant to the fuel consumption calculation (hydrocarbons, carbon monoxide) shall be considered equal to 0 (zero) g/km;
NEDC FC_L	is the NEDC fuel consumption (combined) for the vehicle L, l/100km;
$CO_{2,AF,L}$	is the adjustment factor for the vehicle L calculated by the ratio between the NEDC CO_2 value determined in accordance with point 3.2 and the NEDC test result referred to in point (b) of paragraph 3.1.3;

3.3.4.2.   Calculation of the NEDC phase-specific fuel consumption for vehicle L

The NEDC phase-specific fuel consumption for vehicle L shall be calculated as follows:

$$\text{NEDC FC}_{p,L} = \text{NEDC FC}_{p,L,c} \cdot \text{CO}_{2,AF,L}$$

Where:

p	is the NEDC phase 'UDC' or 'EUDC';
NEDC FC$_{p,L,c}$	is the NEDC fuel consumption test result for the phase p determined in accordance with Annex XII to Regulation (EC) No 692/2008 using the CO_2 emissions determined in accordance with point (b) of paragraph 3.1.2 or a physical measurement result as referred to in point 3.2.2; the emissions of other pollutants relevant to the fuel consumption calculation (hydrocarbons, carbon monoxide) shall be considered equal to 0 (zero) g/km;
NEDC FC$_{p,L}$	is the NEDC phase-specific fuel consumption for the vehicle L of the applicable phase p, l/100km;
$CO_{2,AF,L}$	is the adjustment factor for the vehicle L calculated by the ratio between the NEDC CO_2 value determined in accordance with point 3.2 and the NEDC test result referred to in point (b) of paragraph 3.1.3.

4.   CALCULATION OF THE NEDC CO_2 VALUES AND FUEL CONSUMPTION VALUES TO BE ATTRIBUTED TO INDIVIDUAL M1 VEHICLES

The manufacturer shall calculate the (phase-specific and combined) NEDC CO_2 values and the fuel consumption values to be attributed to individual passenger cars in accordance with points 4.1 and 4.2 and record those values in the certificates of conformity.

The provisions on rounding set out in point 1.3 of Sub-Annex 7 to Annex XXI to Regulation (EU) 2017/1151 shall apply.

4.1.   **Determination of the NEDC CO_2 values in the case of a WLTP interpolation family based on vehicle H**

Where the CO_2 emissions of the WLTP interpolation family are determined by reference to vehicle H only in accordance with point 1.2.3.1 of Sub-Annex 6 to Annex XXI to Regulation (EU) 2017/1151, the NEDC CO_2 value to be recorded in the certificates of conformity of the vehicles belonging to that family shall be the NEDC CO_2 emissions determined in accordance with point 3.2 of this Annex and recorded in the type-approval certificate of the vehicle H in question.

4.2.   **Determination of the NEDC CO_2 value in the case of a WLTP interpolation family based on vehicle L and vehicle H**

4.2.1.   *Road load calculation of an individual vehicle*

4.2.1.1.   Mass of the relevant vehicle

The NEDC reference mass of the individual vehicle (RM$_{n,ind}$) shall be determined as follows:

$$RM_{n,ind} = (MRO_{ind} - 75 + 100)\,[\text{kg}]$$

Where: MRO$_{ind}$ is the mass in running order as defined in Article 3(d) of Regulation (EC) No 443/2009 of the individual vehicle.

The mass to be used for the calculation of the NEDC CO_2 values of the individual vehicle shall be the inertia value set out in Table 3 of Annex 4a to UN/ECE Regulation No 83 which is equivalent to the reference mass determined in accordance with this point and referred to as. TM$_{n,ind.}$

4.2.1.2.   Rolling resistance of the individual vehicle

The tyre rolling resistance values determined in accordance with point 3.2.3.2.2.2 of sub-Annex 7 to Annex XXI to Regulation (EU) 2017/1151 shall be used for the purpose of the interpolation of the NEDC CO_2 value of the individual vehicle.

4.2.1.3.   Aerodynamic drag of an individual vehicle

The aerodynamic drag of the individual vehicle shall be calculated by considering the difference in aerodynamic drag between an individual vehicle and vehicle L, due to a difference in body shape (m^2):

$$\Delta\left[C_d \cdot A_f\right]_{ind-L,n}$$

Where:

C_d is the aerodynamic drag coefficient;
A_f is the frontal area of the vehicle, m^2.

The type-approval authority or, where applicable, the technical service shall verify if the wind tunnel facility referred to in 3.2.3.2.2.3. in Sub-Annex 7 to Annex XXI to Regulation (EU) 2017/1151 is qualified to accurately determine the $\Delta(C_d \times A_f)$ for body shapes that differ between vehicle L and H. If the wind tunnel facility is not qualified, the

$$\Delta\left[C_d \cdot A_f\right]_{H-L,n}$$

for vehicle H shall apply for the individual vehicle.

If vehicles L and H have the same body shape, the value of

$$\Delta\left[C_d \cdot A_f\right]_{ind-L,n}$$

for the interpolation method shall be set to zero.

4.2.1.4.   Calculation of the road load for an individual vehicle in a WLTP interpolation family

The road load coefficients $F_{0,n}$, $F_{1,n}$ and $F_{2,n}$ for test vehicles H and L determined in accordance with point 2.3.8 are referred to as $F_{0n,H}$, $F_{1n,H}$ and $F_{2n,H}$ and $F_{0n,L}$, $F_{1n,L}$ and $F_{2n,L}$ respectively.

The road load coefficients $f_{0n,ind}$, $f_{1n,ind}$ and $f_{2n,ind}$ for an individual vehicle shall be calculated in accordance with the following formula:
Formula 1

$$f_{0n,ind} = F_{0n,H} - \Delta F_{0n} \cdot \frac{\left(TM_{n,H} \cdot RR_{n,H} - TM_{n,ind} \cdot RR_{n,ind}\right)}{\left(TM_{n,H} \cdot RR_{n,H} - TM_{n,L} \cdot RR_{n,L}\right)}$$

Or, if

$$\left(TM_{n,H} \cdot RR_{n,H} - TM_{n,L} \cdot RR_{n,L}\right) = 0$$

Formula 2 shall apply:
Formula 2

$$f_{0n,ind} = F_{0n,H} - \Delta F_{0n}$$

$$f_{1n,ind} = F_{1n,H}$$

$$f_{2n,ind} = F_{2n,H} - \Delta F_{2n} \cdot \frac{\left(\Delta[C_d \times A_f]_{LH,n} - \Delta[C_d \times A_f]_{ind,n}\right)}{\left(\Delta[C_d \times A_f]_{LH,n}\right)}$$

or, if

$$\Delta[C_d \times A_f]_{n,LH}$$

= 0, Formula 3 shall apply:

Formula 3

$$f_{2n,ind} = F_{2n,H} - \Delta F_{2n}$$

where:

$$\Delta F_{0,n} = F_{0n,H} - F_{0n,L}$$

$$\Delta F_{2,n} = F_{2n,H} - F_{2n,L}$$

4.2.1.5. Calculation of cycle energy demand

The cycle energy demand of the applicable NEDC $E_{k,n}$ and the energy demand for all applicable cycle phases $E_{k,p,n}$ applicable for individual vehicles in the WLTP interpolation family shall be calculated according to the procedure in paragraph 5 of Sub-Annex 7 to Annex XXI to Regulation (EU) 2017/1151, for the following sets k of road load coefficients and masses:

k = 1   : $F_0 = F_{0n,L}, F_1 = F_{1n,H}, F_2 = F_{2n,L}, m = TM_{n,L}$

(test vehicle L)

k = 2   : $F_0 = F_{0n,H}, F_1 = F_{1n,H}, F_2 = F_{2n,H}, m = TM_{n,H}$

(test vehicle H)

k = 3   : $F_0 = f_{0n,ind}, F_1 = F_{1n,H}, F_2 = f_{2n,ind}, m = TM_{n,ind}$

(an individual vehicle in the WLTP interpolation family)

In case the chassis dynamometer coefficients specified in Table 3 of Annex 4a of UN/ECE Regulation No 83 are applied, the following formulae shall be used:

$$f_{0n,ind} = F_{0n,H} - \Delta F_{0n} \cdot \frac{TM_{n,H} - TM_{n,ind}}{TM_{n,H} - TM_{n,L}}$$

$$f_{1n,ind} = F_{1n,H} - \Delta F_{1n} \cdot \frac{TM_{n,H} - TM_{n,ind}}{TM_{n,H} - TM_{n,L}}$$

$$f_{2n,ind} = F_{2n,H} - \Delta F_{2n} \cdot \frac{TM_{n,H} - TM_{n,ind}}{TM_{n,H} - TM_{n,L}}$$

4.2.1.6. Calculation of the NEDC CO_2 value for an individual vehicle by the CO_2 interpolation method

For each cycle phase p of the NEDC applicable for individual vehicles in the WLTP interpolation family, the contribution to the total mass of CO_2 for an individual vehicle shall be calculated as follows:

$$M_{CO_2-ind,p,n} = M_{CO_2-L,p,n} + \left(\frac{E_{3,p,n} - E_{1,p,n}}{E_{2,p,n} - E_{1,p,n}} \right) \cdot (M_{CO_2-H,p,n} - M_{CO_2-L,p,n})$$

The mass of CO_2 emissions, g/km, attributed to an individual vehicle of the WLTP interpolation family

$$M_{CO_2-ind,n}$$

shall be calculated as follows:

$$M_{CO_2-ind,n} = M_{CO_2-L,n} + \left(\frac{E_{3,n} - E_{1,n}}{E_{2,n} - E_{1,n}} \right) \cdot (M_{CO_2-H,n} - M_{CO_2-L,n})$$

The terms $E_{1,p,n}$, $E_{2,p,n}$, $E_{3,p,n}$, and $E_{1,n}$, $E_{2,n}$, $E_{3,n}$ respectively are defined in paragraph 4.2.1.5.

4.2.1.7. Calculation of the NEDC fuel consumption value for an individual vehicle by the interpolation method

For each cycle phase p of the NEDC applicable for individual vehicles in the WLTP interpolation family, the fuel consumption, l/100km, shall be calculated as follows:

$$FC_{p,n} = FC_{L,p,n} + \left(\frac{E_{3,p,n} - E_{1,p,n}}{E_{2,p,n} - E_{1,p,n}}\right) \cdot (FC_{H,p,n} - FC_{L,p,n})$$

The fuel consumption, l/100km, of the complete cycle for an individual vehicle of the WLTP interpolation family shall be calculated as follows:

$$FC_{ind,n} = FC_{L,n} + \left(\frac{E_{3,n} - E_{1,n}}{E_{2,n} - E_{1,n}}\right) \cdot (FC_{H,n} - FC_{L,n})$$

The terms $E_{1,p,n}$, $E_{2,p,n}$, $E_{3,p,n}$, and $E_{1,n}$, $E_{2,n}$, $E_{3,n}$ respectively are defined in paragraph 4.2.1.5.

5.   RECORDING OF DATA

The type-approval authority or the designated Technical Service shall ensure that the following information is recorded:

(a)   the correlation tool output report referred to in point 3.1.1 including the NEDC CO_2 reference value referred to in points 3.1.2 and 3.1.3 and the manufacturer-declared value, as a test report in accordance with Annex VIII to Directive 2007/46/EC;

(b)   the NEDC CO_2 values resulting from physical measurements referred to in point 3.2 in this Annex, in the type-approval certificate specified in the Appendix to the Addendum to the type-approval certificate set out in Appendix 4 to Annex I to Regulation (EU) 2017/1151;

(c)   the deviation factor (De) and the verification factor determined in accordance with point 3.2.8 of this Annex (if available), in the type-approval certificate as specified in the Appendix to the Addendum to the type-approval certificate set out in Appendix 4 to Annex I to Regulation (EU) 2017/1151 and in entry 49.1 of the certificate of conformity as specified in Annex IX to Directive 2007/46/EC;

(d)   the NEDC phase-specific values and the phase-specific and combined fuel consumption values determined in accordance with point 3.3, as specified in the Appendix to the Addendum to the type-approval certificate set out in Appendix 4 to Annex I to Regulation (EU) 2017/1151;

(e)   the NEDC CO_2 (all phases and combined) and fuel consumption values (all phases and combined) determined in accordance with point 4.2 of this Annex, in entry 49.1 of the certificate of conformity as specified in Annex IX to Directive 2007/46/EC.

(**1**)   https://co2mpas.io/

(**2**)   From 1 August 2017 jrc-co2mpas@ec.europa.eu