

COMMISSION IMPLEMENTING REGULATION (EU) 2017/1152**of 2 June 2017****setting out a methodology for determining the correlation parameters necessary for reflecting the change in the regulatory test procedure with regard to light commercial vehicles and amending Implementing Regulation (EU) No 293/2012****(Text with EEA relevance)**

THE EUROPEAN COMMISSION,

Having regard to the Treaty on the Functioning of the European Union,

Having regard to Regulation (EU) No 510/2011 of the European Parliament and of the Council of 11 May 2011 setting emission performance standards for new light commercial vehicles as part of the Union's integrated approach to reduce CO₂ emissions from light-duty vehicles⁽¹⁾, and in particular the first subparagraph of Article 8(9) and the third subparagraph of Article 13(6) thereof,

Whereas:

- (1) A new regulatory test procedure for measuring CO₂ emissions and fuel consumption from light duty vehicles, the Worldwide Harmonised Light Vehicles Test Procedure (WLTP), set out in Commission Regulation (EU) 2017/1151⁽²⁾, will replace the New European Test Cycle (NEDC), which is currently used pursuant to Commission Regulation (EC) No 692/2008⁽³⁾, with effect starting from 1 September 2017. The WLTP is expected to provide CO₂ emission and fuel consumption values that are more representative of real driving conditions.
- (2) In order to take into account the difference in the level of CO₂ emissions measured under the existing NEDC and the new WLTP procedures, a methodology for correlating those values should be provided to allow the determination of the manufacturers' compliance with their specific CO₂ emission targets pursuant to Regulation (EU) No 510/2011.
- (3) For light commercial vehicles, the WLTP is to be gradually applied in two separate steps, starting with new N1 class I vehicle types from 1 September 2017 and all new N1 class I vehicles from 1 September 2018. The WLTP will be implemented 1 year later for category N1 class II and III, i.e. for new vehicle types from 1 September 2018 and for all new vehicles from 1 September 2019. End-of-series vehicles as defined in point (22) of Article 3 of Directive 2007/46/EC of the European Parliament and of the Council⁽⁴⁾ belonging to the latter category N1 class II and III may however remain on the market until 28 February 2021 at the latest in accordance with Article 27 of Directive 2007/46/EC.
- (4) While it is appropriate to continue verifying compliance with specific emission targets using NEDC based CO₂ emission values during the separate steps of gradual application of the WLTP, it is also desirable to ensure that the change to WLTP based targets takes place at the same time for all light duty vehicles. As a consequence, it is necessary to take into account the end-of-series vehicles that will remain on the market until 2021 and attribute a default WLTP CO₂ emissions value to those vehicles. That default value should be defined so that it does not affect negatively the manufacturer's ability to comply with its specific emission target in 2021.

⁽¹⁾ OJ L 145, 31.5.2011, p. 1.

⁽²⁾ Commission Regulation (EU) 2017/1151 of 1 June 2017 supplementing Regulation (EC) No 715/2007 of the European Parliament and of the Council on type-approval of motor vehicles with respect to emissions from light passenger and commercial vehicles (Euro 5 and Euro 6) and on access to vehicle repair and maintenance information, amending Directive 2007/46/EC of the European Parliament and of the Council, Commission Regulation (EC) No 692/2008 and Commission Regulation (EU) No 1230/2012 and repealing Regulation (EC) No 692/2008 (see page 1 of this Official Journal).

⁽³⁾ Commission Regulation (EC) No 692/2008 of 18 July 2008 implementing and amending Regulation (EC) No 715/2007 of the European Parliament and of the Council on type-approval of motor vehicles with respect to emissions from light passenger and commercial vehicles (Euro 5 and Euro 6) and on access to vehicle repair and maintenance information (OJ L 199, 28.7.2008, p. 1).

⁽⁴⁾ Directive 2007/46/EC of the European Parliament and of the Council of 5 September 2007 establishing a framework for the approval of motor vehicles and their trailers, and of systems, components and separate technical units intended for such vehicles (OJ L 263, 9.10.2007, p. 1).

- (5) Consideration should also be given to the specific situation of manufacturers of incomplete vehicles as defined in Article 3(19) of Directive 2007/46/EC which are type approved in multiple stages. For the purposes of the correlation, it is appropriate to attribute a single correlated NEDC CO₂ emissions value to incomplete vehicles belonging to the same road load matrix family as defined in point 5.2 of Sub-Annex 4 to Annex XXI to Regulation (EU) 2017/1151.
- (6) Moreover, manufacturers should be allowed, in the case of N1 vehicles with a technically permissible maximum laden mass of 3 000 kg or more to have the choice to either derive NEDC road load coefficients from the WLTP tests or to use the tabulated values set out in Table 3 of Annex 4(a) to Regulation UN/ECE No 83 ⁽¹⁾.
- (7) It is desirable to limit the testing burden for both manufacturers and type approval authorities and the possibility to determine the reference NEDC CO₂ emission values by way of simulations should therefore be provided. A specific vehicle simulation tool (the correlation tool) has been developed for that purpose. The input data for the correlation tool should not require additional tests but be derived from the WLTP type approval tests.
- (8) The stringency of the CO₂ reduction requirements following the change to WLTP must, in accordance with the fourth subparagraph of Article 13(6) to Regulation (EU) No 510/2011, remain comparable for manufacturers and vehicles of different utility to that defined in Regulation (EU) No 510/2011 by reference to the CO₂ emission levels determined in accordance with the NEDC procedure. The correlation procedure should therefore take into account those NEDC test conditions which are explicitly required for granting a type approval.
- (9) There may be advanced vehicle technologies or specific technology configurations for which the correlation tool might not be able to deliver NEDC CO₂ values with sufficient accuracy. In those cases, the manufacturer should have the possibility to perform a physical vehicle test instead. In order to ensure a level playing field, the same NEDC test conditions that have been defined for the correlation tool should apply for those tests.
- (10) In order to ensure comparable stringency, it is necessary to make certain adjustments to the calculation of the eco-innovation savings referred to in Article 12 of Regulation (EU) No 510/2011. However, the framework conditions for that modality are considered not to be directly dependent on the applicable test procedure, and, should, as a consequence, be maintained without adjustments, including the cap set for the eco-innovation savings.
- (11) It is important to ensure that procedural tolerances and correlation tool outputs are applied as intended and not as a means to artificially lower the CO₂ emission values used for target compliance purposes. Therefore, a limited number of random physical tests should be performed with a view to verifying that the input data and the NEDC reference values based on the correlation tool output are correctly determined. If it is found, as a result of a random test, that a manufacturer has declared an NEDC CO₂ value for the purpose of the type approval that is lower than the tolerance permitted in the measurement result or if incorrect input data has been provided, it should be possible for the Commission to determine and apply a correction factor to increase the average specific emissions of a manufacturer. This should also act as a disincentive for any abuse or overexploitations of measurement tolerances.
- (12) The monitoring of CO₂ emission values is regulated in Commission Implementing Regulation (EU) No 293/2012 ⁽²⁾. The provisions of that Implementing Regulation need to be adjusted to the new test procedure. It is also appropriate to align the monitoring provisions for light commercial vehicles with the monitoring provisions for passenger cars set out in Commission Regulation (EU) No 1014/2010 ⁽³⁾. With the WLTP, a specific CO₂ emission value will be calculated and recorded in the certificate of conformity of each individual vehicle and those values should be monitored in addition to already existing data parameters. Therefore, Implementing Regulation (EU) No 293/2012 should be amended accordingly.

⁽¹⁾ Regulation No 83 of the Economic Commission for Europe of the United Nations (UNECE) — Uniform provisions concerning the approval of vehicles with regard to the emission of pollutants according to engine fuel requirements (OJ L 172, 3.7.2015, p. 1).

⁽²⁾ Commission Implementing Regulation (EU) No 293/2012 of 3 April 2012 on monitoring and reporting of data on the registration of new light commercial vehicles pursuant to Regulation (EU) No 510/2011 of the European Parliament and the Council (OJ L 98, 4.4.2012, p. 1).

⁽³⁾ Commission Regulation (EU) No 1014/2010 of 10 November 2010 on monitoring and reporting of data on the registration of new passenger cars pursuant to Regulation (EC) No 443/2009 of the European Parliament and the Council (OJ L 293, 11.11.2010, p. 15).

- (13) In view of the required extensive adaptations of vehicle registration and CO₂ monitoring systems, it is appropriate to provide Member States with the possibility to gradually introduce the new monitoring parameters in 2017 and require the complete new dataset from 2018 only. The 2017 data to be reported should include as a minimum the data required for target compliance purposes and for preventing abuse of the correlation procedure.
- (14) The measures provided for in this Regulation are in accordance with the opinion of the Climate Change Committee,

HAS ADOPTED THIS REGULATION:

Article 1

Subject matter

This Regulation provides for:

- (a) a methodology for the correlation of the CO₂ emissions measured in accordance with Annex XXI to Regulation (EU) 2017/1151 with those determined in accordance with Annex XII to Regulation (EC) No 692/2008;
- (b) a procedure for applying the methodology referred to in point (a) for the purpose of determining each manufacturer's average specific emissions of CO₂;
- (c) the amendments to Implementing Regulation (EU) No 293/2012 required for the purpose of adapting the monitoring of CO₂ emissions data to reflect the change in emission values.

Article 2

Definitions

For the purposes of this Regulation, the following definitions shall apply:

- (1) 'NEDC CO₂ values' means the CO₂ emissions determined in accordance with Annex I and entered into the certificates of conformity;
- (2) 'Measured NEDC CO₂ values' means the CO₂ emissions (phases and combined) determined in accordance with Annex XII to Regulation (EC) No 692/2008 by way of physical vehicle tests;
- (3) 'WLTP CO₂ values' means the CO₂ emissions (combined) determined in accordance with the test procedure set out in Annex XXI to Regulation (EU) 2017/1151;
- (4) 'WLTP vehicle family' means a vehicle family as determined in accordance with point 5.0 of Annex XXI to Regulation (EU) 2017/1151;
- (5) 'Correlation tool' means the simulation model referred to in point 2 of Annex I.

Article 3

Determination of average specific emissions of CO₂ for target compliance purposes in the period 2017 to 2020

1. For the calendar years 2017 to 2020 inclusive, the average specific emissions of a manufacturer shall be determined using the following CO₂ mass emissions (combined) values:

- (a) with regard to N1 light commercial vehicles type approved in accordance with Annex XXI to Regulation (EU) 2017/1151, the NEDC CO₂ values;
- (b) with regard to existing types of N1 class I vehicles that have been type approved in accordance with Annex XII to Regulation (EC) No 692/2008, the measured NEDC CO₂ values until 31 August 2018 and the NEDC CO₂ values from 1 September 2018 to 31 December 2020;

(c) with regard to existing types of N1 class II and III vehicles that have been type approved in accordance with Annex XII to Regulation (EC) No 692/2008, the measured NEDC CO₂ values until 31 August 2019 and the NEDC CO₂ values from 1 September 2019 to 31 December 2020;

(d) with regard to end-of-series vehicles referred to in Article 27 of Directive 2007/46/EC, the measured NEDC CO₂ values.

2. Manufacturers responsible for more than 1 000 but fewer than 22 000 new light commercial vehicles registered in the Union in each of the calendar years 2017 to 2020 inclusive may use either the NEDC CO₂ values or the measured NEDC CO₂ values.

Article 4

Determination of average specific emissions based on WLTP CO₂ values

1. The WLTP CO₂ emissions (combined) or, where applicable, (weighted combined) specified in entry 49.4 of the certificate of conformity shall be monitored for all new registered vehicles starting from 1 January 2018.

2. With regard to end-of-series vehicles that have not been type approved in accordance with Commission Regulation (EU) 2017/1151 but are registered in 2020 or in 2021, the following WLTP CO₂ values shall be attributed to each registered vehicle for the purpose of calculating the average specific emissions of CO₂ pursuant to Article 8(4)(a) of Regulation (EU) No 510/2011:

(a) for complete N1 vehicles, the average specific WLTP CO₂ emissions value determined for the manufacturer in the respective calendar year;

(b) for completed N1 vehicles, the average specific WLTP CO₂ emissions value of new completed vehicles that were registered in the respective calendar year, where the manufacturer is responsible for the base vehicles used for those completed vehicles.

3. For each manufacturer, the average specific emissions calculated using WLTP CO₂ values shall be determined starting from 1 January 2019. With effect from 1 January 2021, those average specific emissions shall be used to determine the manufacturer's compliance with its specific emission target.

Article 5

Application of Article 12 of Regulation (EU) No 510/2011 – eco-innovations

1. With effect from 1 January 2021, only CO₂ savings due to eco-innovations, within the meaning of Article 12 of Regulation (EU) No 510/2011, that are not covered by the test procedure set out in Annex XXI to Regulation (EU) 2017/1151, shall be taken into account for the calculation of the average specific emissions of a manufacturer.

2. A manufacturer's total eco-innovation savings in the calendar years 2021, 2022 and 2023 shall be adjusted as follows:

(a) in 2021: $EI\ savings_{adjusted\ 2021} = WLTP_{EI\ savings\ 2021} \cdot 1,9$;

(b) in 2022: $EI\ savings_{adjusted\ 2022} = WLTP_{EI\ savings\ 2022} \cdot 1,7$;

(c) in 2023: $EI\ savings_{adjusted\ 2023} = WLTP_{EI\ savings\ 2023} \cdot 1,5$.

Where,

$EI\ savings_{adjusted\ 20xx}$ are the eco-innovation savings in the relevant year to be taken into account for the calculation of the average specific emissions;

$WLTP_{EI\ savings\ 20xx}$ are the eco-innovation savings in the relevant year determined in relation to the WLTP and recorded in the certificate of conformity.

From calendar year 2024 eco-innovation savings shall be taken into account for the calculation of the specific average emissions without adjustment.

Article 6

Determination and correction of NEDC CO₂ values for the calculation of the specific average emissions

1. Starting from the calendar year 2017 until 2020 inclusive, the average specific CO₂ emissions of a manufacturer shall be calculated using the NEDC CO₂ values determined in accordance with point 3.2(b) of Annex I in the case of incomplete vehicles, or, in the case of complete or, where applicable, completed vehicles, in accordance with the procedure laid down in Section 4 of Annex I, unless Article 3(1)(b) or (c), or Article 3(2) applies.

2. Where for a WLTP vehicle family the deviation factor De_i , determined in accordance with point 3.2.8 of Annex I, exceeds the value 0,04, or in the presence of a verification factor '1' as determined in that point, the average specific NEDC CO₂ emissions of the manufacturer responsible for that vehicle family shall be multiplied by the following correction factor:

$$\text{correction factor} = 1 + \frac{\sum_{i=1}^N De_i \cdot r_i}{\sum_{i=1}^N \delta_{3,i} \cdot r_i}$$

Where,

De_i is the value determined in accordance with point 3.2.8 of Annex I;

r_i is the number of annual registrations of vehicles belonging to the respective WLTP vehicle family i concerned;

$\delta_{3,i}$ is equal to 0 if De_i is missing and equal to 1 otherwise;

N is the number of WLTP vehicle families for which a manufacturer is responsible.

Article 7

Amendments to Regulation (EU) No 293/2012

Regulation (EU) No 293/2012 is amended as follows:

(1) in Article 4, the following paragraph 10 is added:

'10. With regard to end-of-series vehicles registered in 2020 or in 2021, the WLTP CO₂ values to be attributed to those vehicles for the purpose of the calculation of the average specific emissions shall be those determined in accordance with Article 4(2) of Commission Implementing Regulation (EU) 2017/1152 (*).

(*) Commission Implementing Regulation (EU) 2017/1152 of 2 June 2017 setting out a methodology for determining the correlation parameters necessary for reflecting the change in the regulatory test procedure with regard to light commercial vehicles and amending Commission Implementing Regulation (EU) No 293/2012 (OJ L 175, 7.7.2017, p. 664).;

(2) Article 6 is replaced by the following:

'Article 6

Preparation of data by Member States

When completing the detailed monitoring data, Member States shall include:

(a) for each vehicle equipped with innovative technologies, the specific emissions of CO₂ without taking into account the CO₂ emission reduction through innovative technologies approved in accordance with Article 12 of Regulation (EC) No 510/2011;

- (b) for each vehicle, the deviation factor and the verification factor determined in accordance with point 3.2.8 of Annex I to Implementing Regulation (EU) 2017/1152.

Notwithstanding the detailed data referred to in Part A of Annex II to Regulation (EU) No 510/2011, a Member State shall, with regard to the data monitored until 31 December 2017, in addition to the already required parameters in that Part, report only the deviation factor and the verification factor referred to in point (b) of this Article. From 1 January 2018 all detailed data specified in Part A of Annex II to Regulation (EU) No 510/2011 shall be monitored and reported in the formats set out in Part C of Annex II to Regulation (EU) no 510/2011.;

- (3) Article 7 is deleted;

- (4) Article 10 is amended as follows:

(a) in paragraph 1, the last subparagraph is deleted;

(b) paragraphs 3 and 4 are deleted;

- (5) Article 10b is replaced by the following:

'Article 10b

Preparation of the provisional dataset

1. The provisional dataset to be notified to a manufacturer in accordance with the second subparagraph of Article 8(4) of Regulation (EU) No 510/2011 shall include the records which, on the basis of the manufacturer's name and the vehicle identification number, can be attributed to that manufacturer.

The central register referred to in the first subparagraph of Article 8(4) of Regulation (EU) No 510/2011 shall not include any data on vehicle identification numbers.

2. The processing of the vehicle identification numbers shall not include the processing of any personal data that could be linked to those numbers or any other data that could permit the linking of vehicle identification numbers with personal data.'

- (6) Annex I is replaced by the text in Annex II to this Regulation.

Article 8

Entry into force

This Regulation shall enter into force on the twentieth day following that of its publication in the *Official Journal of the European Union*.

Points 4 and 5 of Article 8 shall apply from 1 January 2018.

This Regulation shall be binding in its entirety and directly applicable in all Member States.

Done at Brussels, 2 June 2017.

For the Commission
The President
Jean-Claude JUNCKER

ANNEX I

1. INTRODUCTION

This Annex sets out the methodology for determining the NEDC CO₂ value of individual N1 vehicles.

2. DETERMINATION OF THE NEDC CO₂ VALUE FOR THE WLTP INTERPOLATION FAMILY2.1. **Correlation tool**

The type approval authority shall ensure that the NEDC CO₂ 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 on 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 ⁽²⁾:

co2mpas@jrc.ec.europa.eu

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. *Designation of correlation tool users*

Member States shall inform the Commission of the respective contact points responsible for executing the correlation tool runs at the approval authority and, where applicable, at the technical services. Only one contact point per authority or service shall be appointed. The information provided to the Commission shall include the following (the name of the organisation, the name of the person responsible, the postal address, the email address and the telephone number). This information shall be sent to the following functional mailbox ⁽³⁾:

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

Electronic signing keys for the purpose of the execution of the correlation tool shall be provided only at the request of the contact point ⁽⁴⁾. The Commission shall publish guidance on the procedure to follow for such requests.

⁽¹⁾ <https://co2mpas.io/>

⁽²⁾ From 1 August 2017 JRC-CO2MPAS@ec.europa.eu. Any up-dates of the mailbox address will be made available on the website

⁽³⁾ Any up-dates of the mailbox address will be made available on the website.

⁽⁴⁾ To be provided by the European Commission Joint Research Centre.

2.1.3. *Annual up-date 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 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 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 2 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 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 4.2.1.2 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 two type approval tests are performed, the test results with the highest combined CO₂ emissions shall be used;
- (b) In the case three type approval tests are performed, the test results with the median combined CO₂ 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 2.3.8 of this Annex.

The physical vehicle measurements referred to in Section 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*

- 2.3.1.1. NEDC reference mass of vehicle H, and where applicable of vehicle L, and of the representative vehicle of a road load matrix family in the case of completed vehicles

The NEDC reference mass of vehicles H and L of the WLTP interpolation family and vehicle R of the WLTP road load matrix family shall be determined as follows:

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

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

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

Where,

MRO is the mass in running order as defined in Article 3(g) of Regulation (EU) No 510/2011 for vehicle H, L and R respectively.

The reference mass to be used as input for the simulations and, where applicable, for a physical vehicle test, 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 shall be referred to as $TM_{n,L}$, $TM_{n,H}$ and $TM_{n,R}$.

- 2.3.1.2. NEDC reference mass of the representative vehicle of a road load matrix family in the case of incomplete vehicles to be submitted to multi-stage type approval

In the case of incomplete N1 vehicles, the NEDC reference mass ($RM_{n,MSV}$) of the representative vehicle in the road load matrix family shall be determined as follows:

$$RM_{n,MSV} = (MRO_{n,MSV} - 75 + 100) + DAM$$

Where,

MRO is as defined in point 2.3.1.1, and

DAM is as defined in Section 5 of Annex XII to Regulation (EC) No 692/2008.

The reference mass to be used as input to the simulations and, where applicable, for a physical vehicle test, 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 shall be referred to as $TM_{n,R}$.

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 Section 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 % 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 point 6.6.3 of Appendix 3 to Annex I to Regulation (EU) 2017/1151 the lowest recommended tyre pressure for the vehicle test mass shall be used during the coast down for the road load determination, 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 vehicle H, and where applicable, for vehicles L and R in accordance with the following formulae:

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

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

$$\text{For vehicle R: } P_{\text{avg,R}} = \left(\frac{P_{\text{max,R}} + P_{\text{min,R}}}{2} \right)$$

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 vehicles H, L and R:

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

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

$$\text{For vehicle R: } TP_R = \left(\frac{P_{\text{avg,R}}}{P_{\text{min,R}}} \right)^{-0,4}$$

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 the minimum tyre tread depth is 80 % 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 50 % of the nominal value. That 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 vehicles H, L and R:

$$\text{For vehicle H: } TTD_H = \left(2 \cdot \frac{0,1 \cdot RM_{n,H} \cdot 9,81}{1\,000} \right)$$

$$\text{For vehicle L: } TTD_L = \left(2 \cdot \frac{0,1 \cdot RM_{n,L} \cdot 9,81}{1\,000} \right)$$

$$\text{For vehicle R: } TTD_R = \left(2 \cdot \frac{0,1 \cdot RM_{n,R} \cdot 9,81}{1\,000} \right)$$

Where,

$RM_{n,H}$, $RM_{n,L}$ or $RM_{n,R}$ are the reference masses of vehicle H, L and R determined in accordance with point 2.3.1.1.

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 shall be considered, while for the purpose of the NEDC tests only two rotating wheels shall 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 shall 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 shall be transferred to forces and vice versa by neglecting the effect of rotational mass (only the 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 WLTP road loads being determined in accordance with points 4 and 6 of Sub-Annex 4 to Annex XXI to Regulation (EU) 2017/1151 for complete N1 vehicles

The NEDC road load coefficients for complete N1 vehicles shall be calculated in accordance with the formulae specified in point 2.3.8.1.1 of this Annex (for vehicle H) and in point 2.3.8.1.2 (for vehicle L).

Unless otherwise specified the formulae shall apply both in the case of simulations and in the case of physical vehicle tests.

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:

$$F_{0n,H}^1 = F_{0w,H} \cdot \left(\frac{RM_{n,H}}{TM_{w,H}} \right)$$

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:

$$F_{0n,H}^2 = F_{0n,H}^1 \cdot TP_H$$

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

(3) Effect of the inertia of rotating parts:

$$F_{0n,H}^3 = F_{0n,H}^2 \cdot \left(\frac{1,015}{1,03} \right)$$

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

$$F_{0n,H}^3 = F_{0n,H}^2 \cdot \left(\frac{1}{1,03} \right)$$

(4) Effect of different tyre tread depth:

$$F_{0n,H}^4 = F_{0n,H}^3 - TTD_H$$

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

(5) Effect of preconditioning:

$$F_{0n,H} = F_{0n,H}^4 - 6$$

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 $F_{2w,H}^*$ 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:

$$F_{0n,L}^1 = F_{0w,L} \cdot \left(\frac{RM_{n,L}}{TM_{w,L}} \right)$$

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:

$$F_{0n,L}^2 = F_{0n,L}^1 \cdot TP_L$$

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

(3) Effect of the inertia of rotating parts:

$$F_{0n,L}^3 = F_{0n,L}^2 \cdot \left(\frac{1,015}{1,03} \right)$$

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

$$F_{0n,L}^3 = F_{0n,L}^2 \cdot \left(\frac{1}{1,03} \right)$$

(4) Effect of different tyre tread depth:

$$F_{0n,L}^4 = F_{0n,L}^3 - TTD_L$$

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

(5) Effect of preconditioning:

$$F_{0n,L} = F_{0n,L}^4 - 6$$

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 factors in the formula are as defined in point 2.3.7, with the exception of $F_{1w,L}$ which 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 factors in the formula are as defined in point 2.3.7, with the exception of $F_{2w,L}^* \cdot \left(\frac{1}{1,03} \right)$ which 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 NEDC road loads where, for the purpose of the WLTP test, the road loads have been determined in accordance with point 5.1 of Sub-Annex 4 to Annex XXI to Regulation (EU) 2017/1151 for complete and incomplete N1 vehicles

- 2.3.8.2.1. Road load matrix family in accordance with point 5.1 of Sub-Annex 4 to Annex XXI to Regulation (EU) 2017/1151 – complete N1 vehicles

Where the road load of a complete 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 determined as follows:

- (a) NEDC tabulated road load values in accordance with Table 3 of Annex 4a to Regulation UN/ECE No 83

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:

$$F_{0n,L} = T_{0n,L} + (F_{0w,L} - A_{w,L})$$

$$F_{1n,L} = F_{1w,L} - B_{w,L}$$

$$F_{2n,L} = T_{2n,L} + (F_{2w,L} - C_{w,L})$$

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;

$A_{W,H/L}$, $B_{W,H/L}$, $C_{W,H/L}$ 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.

In the case of a physical vehicle testing, the test shall be performed with the NEDC chassis dynamometer coefficients for vehicle L and H determined in accordance with Table 3 of Annex 4a to UN/ECE Regulation No 83.

(b) NEDC road loads derived from the representative vehicle

In the case of vehicles designed for a technically permissible maximum laden mass equal to or exceeding 3 000 kg, the NEDC road loads may, at the request of the manufacturer and as an alternative to point (a), be determined in accordance with the following:

(1) Determination of the road load coefficients of the representative vehicle of the road load matrix family

(i) Effect of different inertia:

$$F_{0n,R}^1 = F_{0w,R} \cdot \left(\frac{RM_{n,R}}{TM_{w,R}} \right)$$

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

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

(ii) Effect of different tyre pressure:

$$F_{0n,R}^2 = F_{0n,R}^1 \cdot TP_R$$

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

(iii) Effect of the inertia of rotating parts:

$$F_{0n,R}^3 = F_{0n,R}^2 \cdot \left(\frac{1,015}{1,03} \right)$$

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

$$F_{0n,R}^3 = F_{0n,R}^2 \cdot \left(\frac{1}{1,03} \right)$$

(iv) Effect of different tyre tread depth:

$$F_{0n,R}^4 = F_{0n,R}^3 - TTD_R$$

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

(v) Effect of preconditioning:

$$F_{0n,R} = F_{0n,R}^4 - 6$$

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

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

Effect of the inertia of rotating parts:

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

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

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

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

Effect of the inertia of rotating parts:

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

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

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

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

(2) Determination of the NEDC road load coefficients for vehicle H

For the calculation of the NEDC road loads of vehicle H the following formulae shall be used:

(i) The $F_{0n,H}$ for vehicle H shall be determined as follows:

$$F_{0n,H} = \begin{matrix} \text{Max} \left(\left(0,05 \cdot F_{0n,R} + 0,95 \cdot \left(F_{0n,R} \cdot \frac{RM_{n,H}}{RM_{n,R}} + \left(\frac{RR_H - RR_r}{1\,000} \right) \cdot 9,81 \cdot RM_{n,H} \right) \right); \right. \\ \left. \left(0,2 \cdot F_{0n,R} + 0,8 \cdot \left(F_{0n,R} \cdot \frac{RM_{n,H}}{RM_{n,R}} + \left(\frac{RR_H - RR_r}{1\,000} \right) \cdot 9,81 \cdot RM_{n,H} \right) \right) \right) \end{matrix}$$

Where,

$F_{0n,R}$ is the constant road load coefficient of the vehicle R in N;

$RM_{n,H}$ is the reference mass of vehicle H,

$RM_{n,R}$ is the reference mass of vehicle R;

RR_H is the tyre rolling resistance of vehicle H in kg/tonne;

RR_R is the tyre rolling resistance of vehicle R in kg/tonne;

(ii) The $F_{2n,H}$ for vehicle H shall be determined as follows:

$$F_{2n,H} = \text{Max} \left(\left(0,05 \cdot F_{2n,R} + 0,95 \cdot F_{2n,R} \cdot \frac{A_{f,H}}{A_{f,R}} \right); \left(0,2 \cdot F_{2n,R} + 0,8 \cdot F_{2n,R} \cdot \frac{A_{f,H}}{A_{f,R}} \right) \right)$$

Where,

$F_{2n,R}$ is the second order road load coefficient of vehicle R in $N/(km/h)^2$;

$A_{f,H}$ is the frontal area of vehicle H in m^2 ;

$A_{f,R}$ is the frontal area of vehicle R in m^2 .

The $F_{1n,H}$ for vehicle H shall be set to 0.

(3) Determination of the NEDC road load coefficient for vehicle L

For the calculation of NEDC road loads of vehicle L the following formulae shall be used.

(i) The $F_{0n,L}$ for vehicle L shall be determined as follows:

$$F_{0n,L} = \text{Max} \left(\left(0,05 \cdot F_{0n,R} + 0,95 \cdot \left(F_{0n,R} \cdot \frac{RM_{n,L}}{RM_{n,R}} + \frac{RR_L - RR_R}{1\,000} \cdot 9,81 \cdot RM_{n,L} \right) \right); \left(0,2 \cdot F_{0n,R} + 0,8 \cdot \left(F_{0n,R} \cdot \frac{RM_{n,L}}{RM_{n,R}} + \frac{RR_L - RR_R}{1\,000} \cdot 9,81 \cdot RM_{n,L} \right) \right) \right)$$

Where,

$F_{0n,R}$ is the constant road load coefficient of the vehicle R in N;

$RM_{n,L}$ is the reference mass of vehicle L;

$RM_{n,R}$ is the reference mass of vehicle R;

RR_L is the tyre rolling resistance of vehicle L in kg/tonne;

RR_R is the tyre rolling resistance of vehicle R in kg/tonne;

(ii) The $F_{2n,L}$ for vehicle L shall be determined as follows:

$$F_{2n,L} = \text{Max} \left(\left(0,05 \cdot F_{2n,R} + 0,95 \cdot F_{2n,R} \cdot \frac{A_{f,L}}{A_{f,R}} \right); \left(0,2 \cdot F_{2n,R} + 0,8 \cdot F_{2n,R} \cdot \frac{A_{f,L}}{A_{f,R}} \right) \right)$$

Where,

$F_{2n,R}$ is the second order road load coefficient of vehicle R in $N/(km/h)^2$;

$A_{f,L}$ is the frontal area of vehicle L in m^2 ;

$A_{f,R}$ is the frontal area of vehicle R in m^2 .

(iii) The $F_{1n,L}$ for vehicle L shall be set to 0.

2.3.8.2.2. Road load determination for incomplete N1 vehicles in accordance with point 5.2 of Annex XII to Regulation (EU) 2017/1151.

In the case of an incomplete N1 vehicle where the road loads of the representative vehicle has been determined in accordance with point 5.2 of Annex XII and 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 determined as follows:

$$F_{0n,R} = T_{0n,R} + (F_{0w,R} - A_{w,R})$$

$$F_{1n,R} = F_{1w,R} - B_{w,L}$$

$$F_{2n,R} = T_{2n,R} + (F_{2w,R} - C_{w,R})$$

Where,

$F_{0n,R}$, $F_{1n,R}$, $F_{2n,R}$ are the NEDC road load coefficients for the representative vehicle;

$T_{0n,R}$, $T_{2n,R}$ are the NEDC chassis dynamometer coefficients for the representative vehicle determined in accordance with Table 3 of Annex 4a to UN/ECE Regulation No 83;

$A_{w,R}$, $B_{w,R}$, $C_{w,R}$ are the chassis dynamometer coefficients for the vehicle used for 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.

In the case of a physical vehicle testing, the test shall be performed with the NEDC chassis dynamometer coefficients for vehicle R determined in accordance with Table 3 of Annex 4a to UN/ECE Regulation No 83.

2.3.8.3. Default road loads in accordance with point 5.2 of Sub-Annex 4 to Annex XXI to Regulation (EU) 2017/1151

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 in accordance with point 2.3.8.2.1(a) of this Annex.

In the case of physical vehicle testing, the test shall be performed with 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.

2.4. Input data matrix

The manufacturer shall determine the input data for each vehicle H and 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 points 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	%	Declaration by manufacturer and/or technical service	% of carbon in the fuel by weight. E.g. 85,5 %
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 (*)	min ⁻¹	Point 3.2.1.6.1 Appendix 3 to Annex I to Regulation (EU) 2017/1151	
10	Maximum net torque (*)	Nm at... min ⁻¹	Point 3.2.1.10 Appendix 3 to Annex I to Regulation (EU) 2017/1151	

No	Input parameters for the correlation tool	Unit	Source	Remarks
11	T1 map speed (*)	rpm	Sub-Annex 2 to Annex XXI to Regulation (EU) 2017/1151	Array
12	T1 map torque (*)	Nm	Sub-Annex 2 to Annex XXI to Regulation (EU) 2017/1151	Array
13	T1 map power (*)	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 (**)	—	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 Regulation (EU) 2017/1151	Two-wheel drive, four-wheel drive.
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	

No	Input parameters for the correlation tool	Unit	Source	Remarks
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 (**)	(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	Table 3 of Annex 4a to UN/ECE Regulation No 83 (to be completed by the type approval authority or Technical Service)	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 be completed by the type approval authority or Technical Service)	F0 road load coefficient
32	F1 NEDC	N/(km/h) ²	Idem	F1 road load coefficient
33	F2 NEDC	N/(km/h) ²	Idem	F2 road load coefficient
34	Inertia setting WLTP	kg	Point 2.5.3 of sub-Annex 4 to Annex XXI to Regulation (EU) 2017/1151	Chassis dynamometer inertia applied during WLTP test
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) ²	Idem	F1 road load coefficient

No	Input parameters for the correlation tool	Unit	Source	Remarks
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 to 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 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 super-charger	—	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

No	Input parameters for the correlation tool	Unit	Source	Remarks
48	Lean burn	—	Manufacturer declaration	0 = No 1 = Yes — Does the engine use lean burn?
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, 1 hz
55	WLTP Velocity (theoretical)	km/h	As defined in sub-Annex 1 to Annex XXI to Regulation (EU) 2017/1151	Array: 1 hz, 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 Tables A1/7-A1/9, A1/11, and A1/12 applies
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, 1 hz, resolution 0,1 km/h
57	WLTP Gear (theoretical)	—	As defined in sub-Annex 2 to Annex XXI to Regulation (EU) 2017/1151	Array: 1 hz. 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: 1 hz, 10 RPM resolution from OBD

No	Input parameters for the correlation tool	Unit	Source	Remarks
59	WLTP Engine Coolant Temperature	°C	Idem	Array: OBD Data, 1 hz, 1 °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: 1 hz, 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: 1 hz, 0,1 A resolution, external measurement device synchronised with the chassis dynamometer
62	WLTP calculated load	—	As defined in Annex 11 to UN/ECE Regulation No 83	Array: OBD data, 1 hz at least (higher frequencies possible, 1 % resolution) WLTP test measurement
63	Declared combined NEDC CO ₂ emissions	gCO ₂ /km	For the purpose of point 3.2 of this Annex	Declared value for NEDC test. In case of vehicles with periodically regenerative systems the value shall be Ki corrected.
64	NEDC velocity (theoretical)	km/h	As defined in point 6 of Annex 4 to UN/ECE Regulation No 83	Array: 1 hz, resolution 0,1 km/h. If not provided the speed profile defined in point 6 of Annex 4 to UN/ECE Regulation No 83 applies
65	NEDC gear (theoretical)	—	As defined in point 6 of Annex 4 to UN/ECE Regulation No 83	Array: 1 hz. If not provided the speed profile defined in point 6 of Annex 4 to UN/ECE Regulation No 83 applies
66	Vehicle family identification number		Point 5.0 of Annex XXI to Regulation (EU) 2017/1151	
67	K _r Regenerative Factor	—	Appendix 1 to Sub-Annex 6 to Annex XXI to Regulation (EU) 2017/1151	For vehicles without periodically regenerating systems this value is equal to 1. For vehicles with periodically regenerating systems this value, if not provided, is set to 1,05.

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

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

3. DETERMINATION OF NEDC CO₂ EMISSION AND FUEL CONSUMPTION VALUES FOR VEHICLE H AND L

3.1. **Determination of NEDC CO₂ reference values, phase-specific values and fuel consumption values for vehicle H and L**

The type approval authority shall ensure that the NEDC CO₂ reference value for 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.

If the difference between vehicle H and vehicle L is due only to a difference in optional equipment (i.e. the MRO, bodyshape and road load coefficients are the same), the NEDC CO₂ reference value shall be determined for vehicle H only.

3.1.1. *Correlation tool input and output*

3.1.1.1. Original correlation output report

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, an original correlation output report shall be issued and attributed with a hash code. The report shall include the following sub-files:

(a) the input data as specified in point 2.4;

(b) the output data resulting from the execution of the simulation;

(c) the summary file, including

(i) the vehicle family identification number;

(ii) the delta between the manufacturer declared CO₂ value and the value resulting from the correlation tool (CO₂ combined);

(iii) non-confidential technical data (i.e. fuel type, engine capacity, gear-box type, turbo).

3.1.1.2. Complete correlation file

Where the original correlation output report has been attributed with a hash code and issued in accordance with point 3.1.1.1, the type approval authority, or where applicable the designated technical service shall use the relevant commands in the correlation tool to send the summary file to a time stamp-server from which a time stamped reply is returned to the sender (with the relevant services of the Commission in copy), including a randomly generated integer number between 1 and 99.

A complete correlation file shall be created, including the time-stamped reply and the original correlation output report referred to in point 3.1.1.1. A hash code shall be attributed to the complete correlation file. The file shall be maintained by the type approval authority as a test report in accordance with Annex VIII to Directive 2007/46/EC.

3.1.2. *NEDC CO₂ reference value for vehicle H*

The correlation tool shall be used to execute the simulated NEDC test of vehicle H using the relevant input data matrix referred to in point 2.4.

The NEDC CO₂ reference value for vehicle H shall be determined as follows:

$$CO_{2,H} = NEDC CO_{2,C,H} \cdot K_{i,H}$$

Where,

$CO_{2,H}$ is the NEDC CO_2 reference value for vehicle H;

$NEDC\ CO_{2,C,H}$ is the correlation tool simulated combined NEDC CO_2 result (without K_i correction) 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.

In addition to the NEDC reference CO_2 value, the correlation tool shall also provide the phase-specific values for vehicle H.

3.1.3. *NEDC CO_2 reference value for vehicle L*

Where applicable, the simulated NEDC test of vehicle L shall be performed using the correlation tool and the relevant input data as recorded in the matrix referred to in point 2.4.

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

$$CO_{2,L} = NEDC\ CO_{2,C,L} \cdot K_{i,L}$$

Where,

$CO_{2,L}$ is the NEDC CO_2 reference value for vehicle L;

$NEDC\ CO_{2,C,L}$ is the correlation tool simulated combined NEDC CO_2 result (without K_i correction) 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.

In addition to the NEDC reference CO_2 value, the correlation tool shall also provide the phase-specific values for vehicle L.

3.1.4. *The NEDC CO_2 reference value for incomplete N1 vehicles*

In the case of incomplete N1 vehicles, the simulated NEDC test of the representative vehicle (vehicle R_{MSV}) shall be performed using the correlation tool and the relevant input data as recorded in the matrix referred to in point 2.4.

The NEDC CO_2 reference value for vehicle R_{MSV} shall be determined as follows:

$$CO_{2,RMSV} = NEDC\ CO_{2,C,RMSV} \cdot K_{i,RMSV}$$

Where,

$CO_{2,RMSV}$ is the NEDC CO_2 reference value for vehicle R_{MSV} ;

$NEDC\ CO_{2,C,RMSV}$ is the correlation tool simulated combined NEDC CO_2 result for vehicle R_{MSV} ;

$K_{i,RMSV}$ is the value determined in accordance with Appendix 1 to Sub-Annex 6 to Annex XXI to Regulation (EU) 2017/1151 for vehicle R_{MSV} .

3.2. Interpretation of the NEDC CO₂ reference values determined for vehicle H, L or R_{MSV}

For each WLTP interpolation family and, where applicable, for each road load matrix family, the manufacturer shall declare the NEDC CO₂ mass emissions combined value for vehicle H, and, where applicable, vehicle L or R_{MSV}, to the approval authority. The type approval authority shall ensure that the NEDC CO₂ reference values for vehicle H and, where applicable, vehicle L or R_{MSV}, are determined in accordance with point 3.1.2, 3.1.3 or 3.1.4, and that the reference values for the respective vehicle are interpreted in accordance with points 3.2.1 to 3.2.5. The NEDC CO₂ value determined in accordance with those points shall be used as follows:

- (a) In the case of vehicles H and L, for the calculations set out in section 4;
 - (b) In the case of vehicle R_{MSV}, the value shall be recorded in the type approval certificate and certificate of conformity of the incomplete vehicles falling within the relevant road load matrix family.
- 3.2.1. The NEDC CO₂ value for vehicles H, L or R_{MSV} shall be the manufacturer's declared value, if the NEDC CO₂ reference value does not exceed that value by more than 4 %. The reference value may be lower without any limitation.
- 3.2.2. If the NEDC CO₂ reference value exceeds the manufacturer's declared value by more than 4 %, the reference value may be used for the purposes indicated in points (a) and (b), 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 set out in section 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's declared value by more than 4 %, the declared value shall be used for the purposes indicated in points (a) and (b).
- 3.2.4. If the physical measurement, amplified by the Ki-factor, exceeds the manufacturer's declared value by more than 4 %, 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 manufacturer's declared value by more than 4 %, the declared value shall be used for the purposes indicated in points (a) and (b).
- 3.2.5. If the average of the two measurements referred to in point 3.2.4 exceeds the manufacturer's declared value by more than 4 %, 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 purposes indicated in points (a) and (b).
- 3.2.6. Where the randomly generated number referred to in point 3.1.1.2 is in the range of 90 to 99 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 set out in section 2 of this Annex. The test results shall be documented in accordance with Annex VIII to Directive 2007/46/EC.

Where the NEDC CO₂ value for both vehicles H and L, or R_{MSV} is determined in accordance with point 3.2.1, the vehicle configuration selected for physical measurement shall be the following:

- (a) vehicle L, if the random number is in the range of 90 to 94;
- (b) vehicle H, if the random number is in the range of 95 to 99;
- (c) vehicle R_{MSV}, if the random number is in the range of 90 to 99.

Where the NEDC CO₂ value is determined in accordance with point 3.2.1 for only one of the vehicles H and L in the interpolation family, that vehicle shall be selected for one physical measurement if the random number is in the range of 90 to 99.

If the NEDC CO₂ values are not determined in accordance with point 3.2.1, but vehicle H, L or R_{MSV} are physically tested, the random number shall be disregarded.

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 CO₂ 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 CO₂ value is too low in relation to a measured NEDC CO₂ 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, or where applicable for each road load matrix family, record the relative deviation (De) between the measured value and the manufacturer's 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's declared value.

The De factor shall be calculated with three decimals and 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, the 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 CO₂ values and fuel consumption values for vehicles H, L and R_{MSV}**

The type approval authority or, where applicable, the technical service shall determine the NEDC phase-specific values and the fuel consumption values for vehicles H and L or R_{MSV} in accordance with points 3.3.1, 3.3.2 and 3.3.3.

3.3.1. *Calculation of the NEDC phase-specific CO₂ values for vehicle H*

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

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

Where:

p is the NEDC phase 'UDC' or 'EUDC';

NEDC CO_{2,p,H,c} is the correlation tool simulated NEDC CO₂ test result for the phase p referred to in point 3.1.2 or a physical measurement result as referred to in point 3.2.2 for vehicle H.

$NEDC\ CO_{2,p,H}$ is the NEDC phase-specific value for vehicle H of the applicable phase p, gCO₂/km

$CO_{2,AF,H}$ is the adjustment factor for vehicle H calculated by the ratio between the NEDC CO₂ value determined in accordance with point 3.2 and the correlation tool simulated NEDC test result referred to in point 3.1.2.

3.3.2. Calculation of the NEDC phase-specific CO₂ values for vehicle L

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

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

Where:

p is the NEDC phase 'UDC' or 'EUDC';

$NEDC\ CO_{2,p,L,c}$ is the correlation tool simulated NEDC CO₂ test result for the phase p determined in accordance with point 3.1.3 or a physical measurement result referred to in point 3.2.2 for vehicle L;

$NEDC\ CO_{2,p,L}$ is the NEDC phase-specific value for vehicle L of the applicable phase p, gCO₂/km;

$CO_{2,AF,L}$ is the adjustment factor for vehicle L calculated by the ratio between the NEDC CO₂ value determined in accordance with point 3.2 and the correlation tool simulated NEDC test result referred to in point 3.1.3.

3.3.3. Calculation of the NEDC phase-specific CO₂ values for vehicle R_{MSV}

The NEDC phase-specific values for vehicle R_{MSV} shall be calculated as follows:

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

Where:

p is the NEDC phase 'UDC' or 'EUDC';

$NEDC\ CO_{2,p,R,c}$ is the correlation tool simulated NEDC CO₂ test result for the phase p determined in accordance with point 3.1.3 or a physical measurement result referred to in point 3.2.2 for vehicle R_{MSV};

$NEDC\ CO_{2,p,R}$ is the NEDC phase-specific value for vehicle R_{MSV} of the applicable phase p, gCO₂/km;

$CO_{2,AF,R}$ is the adjustment factor for vehicle R_{MSV} calculated by the ratio between the NEDC CO₂ value determined in accordance with point 3.2 and the correlation tool simulated NEDC test result referred to in point 3.1.3.

3.3.4. Calculation of the NEDC fuel consumption for vehicles H, L and R_{MSV}

3.3.4.1. Calculation of the NEDC fuel consumption (combined)

The NEDC fuel consumption (combined) for vehicle H, and where applicable, vehicle L or R_{MSV} shall be calculated using the combined NEDC CO₂ emissions determined in accordance with point 3.2 and following the requirements and formulae specified in Annex XII to Regulation (EC) No 692/2008. The emissions of other pollutants relevant to the fuel consumption calculation (hydrocarbons, carbon monoxide) shall be considered equal to 0 (zero) g/km.

3.3.4.2. Calculation of the NEDC phase-specific fuel consumption

The NEDC phase-specific fuel consumption for vehicle H and where applicable, vehicle L or R_{MSV} shall be calculated using the phase-specific NEDC CO₂ emissions determined in accordance with point 3.3 and following the requirements and formulae specified in Annex XII to Regulation (EC) No 692/2008. The emissions of other pollutants relevant to the fuel consumption calculation (hydrocarbons, carbon monoxide) shall be considered equal to 0 (zero) g/km.

4. CALCULATION OF THE NEDC CO₂ VALUES AND FUEL CONSUMPTION VALUES TO BE ATTRIBUTED TO INDIVIDUAL COMPLETE N1 VEHICLES

The manufacturer shall calculate the (phase-specific and combined) NEDC CO₂ values and the fuel consumption values to be attributed to individual light commercial vehicles in accordance with points 4.1, 4.2 and 4.3 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 CO₂ and fuel consumption values in the case of a WLTP interpolation family based on vehicle H**

Where the CO₂ 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, or in the case of an incomplete vehicle, the NEDC CO₂ value to be recorded in the certificates of conformity of the vehicles belonging to that family or of the base vehicle shall be the NEDC CO₂ emissions determined in accordance with point 3.2 of this Annex and recorded in the type approval certificate of the vehicle H. The NEDC fuel consumption shall be values determined in accordance with point 3.3.4 of this Annex and recorded in the type approval certificate of the vehicle H.

4.2. **Determination of the NEDC CO₂ value and fuel consumption 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(g) of Regulation (EU) No 510/2011 of the individual vehicle.

The mass to be used for the calculation of the NEDC CO₂ 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 interpolation of the NEDC CO₂ 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 (m²):

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

Where:

C_d is the aerodynamic drag coefficient;

A_f is the frontal area of the vehicle, m².

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 vehicle H. If the wind tunnel facility is not qualified, the $\Delta [C_d \times A_f]_{H-L,n}$ for vehicle H shall apply for the individual vehicle.

If vehicles L and H have the same body shape, the value of $\Delta [C_d \times A_f]$ 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 one of the following formulae:

Formula 1

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

Where:

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

Or, if $(TM_{n,H} \cdot RR_{n,H} - TM_{n,L} \cdot RR_{n,L}) = 0$ Formula 2 shall apply:

Formula 2

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

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

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

Where:

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

or, if $\Delta[C_d \times A_f]_{n,LH} = 0$, Formula 3 shall apply:

Formula 3

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

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 cycle phases $E_{k,p,n}$ applicable for individual vehicles in the WLTP interpolation family shall be calculated according to the procedure set out in Section 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 to 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. NEDC road load derived from the representative vehicle of a road load matrix family

Where the NEDC road load of the representative vehicle has been calculated from a WLTP representative vehicle in accordance with point 2.3.8.2.1(b), the NEDC road load of an individual vehicle shall be calculated using the following formulae:

(a) The $f_{0n,ind}$ for the individual vehicle shall be determined as follows:

$$F_{0n,ind} = \text{Max} \left(\left(0,05 \cdot F_{0n,R} + 0,95 \cdot \left(F_{0n,R} \cdot \frac{RM_{n,ind}}{RM_{n,R}} + \frac{RR_{ind} - RR_r}{1\,000} \cdot 9,81 \cdot RM_{n,ind} \right) \right); \right. \\ \left. \left(0,2 \cdot F_{0n,R} + 0,8 \cdot \left(F_{0n,R} \cdot \frac{RM_{n,ind}}{RM_{n,R}} + \frac{RR_{ind} - RR_r}{1\,000} \cdot 9,81 \cdot RM_{n,ind} \right) \right) \right)$$

Where,

$F_{0n,R}$ is the constant road load coefficient of the vehicle R in N;

$RM_{n,ind}$ is the reference mass of the individual vehicle;

$RM_{n,R}$ is the reference mass of vehicle R;

RR_{ind} is the tyre rolling resistance of individual vehicle in kg/tonne;

RR_R is the tyre rolling resistance of vehicle R in kg/tonne.

(b) The $f_{2n,ind}$ for the individual vehicle shall be determined as follows:

$$F_{2n,ind} = \text{Max} \left(\left(0,05 \cdot F_{2n,R} + 0,95 \cdot F_{2n,R} \cdot \frac{A_{f,ind}}{A_{f,R}} \right); \left(0,2 \cdot F_{2n,R} + 0,8 \cdot F_{2n,R} \cdot \frac{A_{f,ind}}{A_{f,R}} \right) \right)$$

Where,

$F_{2n,R}$ is the second order road load coefficient of the vehicle R in N/(km/h)²;

$A_{f,ind}$ is the frontal area of the individual vehicle in m²;

$A_{f,R}$ is the frontal area of the vehicle R in m².

(c) The $f_{1n,ind}$ for the individual vehicle shall be set to 0.

4.2.1.7. Calculation of the NEDC CO₂ value for an individual vehicle by the CO₂ 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 CO₂ 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 CO₂ 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 $E_{1,n}$, $E_{2,n}$, $E_{3,n}$ are defined in point 4.2.1.5.

4.2.1.8. 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/100 km, 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/100 km, 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 $E_{1,n}$, $E_{2,n}$, $E_{3,n}$ are defined in point 4.2.1.5.

4.3. The NEDC CO₂ value and fuel consumption in the case of individual incomplete N1 vehicles

The NEDC CO₂ value and fuel consumption value determined in accordance with point 3.2 and the phase specific values in accordance with point 3.3 for the representative vehicle R_{MSV} shall be attributed to incomplete vehicles belonging to road load matrix family of the representative vehicle.

5. RECORDING OF DATA

The type approval authority or the designated technical service shall ensure that the following information is recorded:

- (a) the complete correlation file referred to in point 3.1.1, as a test report in accordance with Annex VIII to Directive 2007/46/EC;
 - (b) the NEDC CO₂ values resulting from physical measurements referred to in point 3.2 of this Annex, 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;
 - (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 CO₂ values and the phase specific and combined fuel consumption values determined in accordance with point 3.3 of this Annex, 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;
 - (e) the NEDC CO₂ (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.
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ANNEX II

Annex I to Implementing Regulation (EU) No 293/2012 is amended as follows:

(1) the row for the entry 'Specific emissions of CO₂ (g/km)' is replaced by the following:

'Specific NEDC CO ₂ emissions (g/km)	Section 49.1	Section 3 of Annex VIII'
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(2) the following row is deleted:

'Innovative technology or group of innovative technologies and the CO ₂ emissions reduction due to that technology	Section 49.3	Section 4 of Annex VIII'
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(3) the following seven rows are added:

'Specific WLTP CO ₂ emissions (g/km)	Section 49.4	n/a
Total NEDC CO ₂ emissions savings due to the eco-innovation(s)	Section 49.3.2.1	Section 4 of Annex VIII
Total emissions WLTP CO ₂ savings due to the eco-innovation(s)	Section 49.3.2.2	
Test mass WLTP	Section 47.1.1	n/a
Deviation factor De	Section 49.1	Appendix to the Addendum to the type approval certificate set out in Appendix 4 to Annex I to Regulation (EU) 2017/1151
Verification factor ('1' or '0')	Section 49.1	Appendix to the Addendum to the type approval certificate set out in Appendix 4 to Annex I to Regulation (EU) 2017/1151
Vehicle family identification number		Point 5.0 of Annex XXI to Regulation (EU) 2017/1151'