COMMISSION IMPLEMENTING DECISION (EU) 2020/1806

of 25 November 2020

on the approval of the use of the engine-on coasting function in passenger cars with internal combustion engines and in not off-vehicle charging hybrid electric passenger cars as an innovative technology pursuant to Regulation (EU) 2019/631 of the European Parliament and of the Council and repealing Commission Implementing Decisions 2013/128/EU, 2013/341/EU, 2013/451/EU, 2013/529/EU, 2014/128/EU, 2014/465/EU, 2014/806/EU, (EU) 2015/158, (EU) 2015/206, (EU) 2015/279, (EU) 2015/295, (EU) 2015/1132, (EU) 2015/2280, (EU) 2016/160, (EU) 2016/265, (EU) 2016/588, (EU) 2016/362, (EU) 2016/587, (EU) 2016/1721, (EU) 2016/1926, (EU) 2017/785, (EU) 2017/1402, (EU) 2018/1876, (EU) 2018/2079, (EU) 2019/313, (EU) 2019/314, (EU) 2020/728, (EU) 2020/1102, (EU) 2020/1222

(Text with EEA relevance)

THE EUROPEAN COMMISSION,

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

Having regard to Regulation (EU) 2019/631 of the European Parliament and of the Council of 17 April 2019 setting CO_2 emission performance standards for new passenger cars and for new light commercial vehicles, and repealing Regulations (EC) No 443/2009 and (EU) No 510/2011 ([1]), and in particular Article 11(4) thereof,

Whereas:

(1) On 6 December 2018, the manufacturers Toyota Motor Europe NV/SA, Opel Automobile GmbH – PSA, FCA Italy S.p.A., Automobiles Citroën, Automobiles Peugeot, PSA Automobiles SA, Audi AG, Ford Werke GmbH, Jaguar Land Rover Ltd, Hyundai Motor Europe Technical Center GmbH, Bayerische Motoren Werke AG, Renault, Honda Motor Europe Ltd, Volkswagen AG and the supplier Robert Bosch GmbH submitted a joint application ('the application') for the approval as an innovative technology of the engine-on and engine-off coasting functions for use in internal combustion engine powered passenger and in not off-vehicle charging hybrid electric (NOVC-HEV) passenger cars.

(2) The application has been assessed in accordance with Article 11 of Regulation (EU) 2019/631, Commission Implementing Regulation (EU) No 725/2011 ([2]) and the Technical Guidelines for the preparation of applications for the approval of innovative technologies pursuant to Regulation (EC) No 443/2009 and Regulation (EU) No 510/2011 (July 2018 Revision V_2) ([3]).

(3) The application refers to CO_2 emission savings that may not be demonstrated by measurements performed in accordance with the New European Driving Cycle (NEDC) as set out in Commission Regulation (EC) No 692/2008 ([4]).

(4) The coasting function decouples the combustion engine from the drivetrain and prevents deceleration caused by engine braking. It allows the rolling distance of the vehicle to increase in situations where no propulsion or a slow reduction of the speed is needed. The coasting function should be automatically activated in the predominant driving mode, which is the mode automatically selected when the engine is turned on.

([1]) OJ L 111, 25.4.2019, p. 13.

([2]) Commission Implementing Regulation (EU) No 725/2011 of 25 July 2011 establishing a procedure for the approval and certification of innovative technologies for reducing CO_2 emissions from passenger cars pursuant to Regulation (EC) No 443/2009 of the European Parliament and of the Council (OJ L 194, 26.7.2011, p. 19).

([3]) https://circabc.europa.eu/sd/a/a19b42c8-8e87-4b24-a78b-9b70760f82a9/July%202018%20Technical%20Guidelines.pdf

([4]) 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).

(5) The application concerns two distinct coasting functions: engine-on coasting and engine-off coasting. With engine-on coasting, the combustion engine remains switched-on during the coasting events with a certain fuel consumption required to retain idle speed. With engine-off coasting, the combustion engine is switched-off during the coasting events.

(6) In determining the potential CO_2 savings of the technologies, it is necessary to consider the effect on fuel consumption of the restart of the engine after the coasting event in the case of engine-off coasting, and of the need to bring engine speed up to the desired synchronisation speed for both technologies.

(7) New information concerning the potential of the engine-off coasting function to save CO_2 emissions became available to the Commission during the course of 2019, i.e. well after the submission of the application. Additional data was requested from the applicants and this was made available in February 2020.

(8) As regards the engine-off coasting function, it has not been possible, on the basis of the supporting data provided, to conclusively determine the level of CO_2 savings that may be achieved.

(9) In particular, it has not been sufficiently demonstrated that the CO_2 savings achieved by switching off the engine are not offset by the CO_2 emissions resulting from the energy required to restart the engine and to bring the engine speed up to the desired synchronisation speed.

(10) The engine-on coasting function for use in passenger cars powered by an internal combustion engine has already been approved as an eco-innovation in relation to the NEDC emissions test by Commission Implementing Decisions (EU) 2015/1132 ([5]), (EU) 2017/1402 ([6]) and (EU) 2018/2079 ([7]).

(11) Based on the experience gained from those Decisions, together with the information provided with the present application, it has been satisfactorily and conclusively demonstrated that the engine-on coasting function for use in passenger cars powered by an internal combustion engine meets the criteria referred to in Article 11(2) of Regulation (EU) 2019/631 and the eligibility criteria specified in Article 9(1)(a) of Implementing Regulation (EU) No 725/2011.

(12) For certain NOVC-HEVs for which uncorrected measured fuel consumption and CO_2 emission values may be used in accordance with Annex 8 to Regulation No 101 of the Economic Commission for Europe of the United Nations ([8]), it has been demonstrated that the same conditions apply as for internal combustion engine powered passenger cars. As regards other NOVC-HEVs, those conditions cannot be considered applicable, as it has not been sufficiently substantiated in the application how the CO_2 savings from the use of the engine-on coasting function in such NOVC-HEVs are to be determined.

(13) The testing methodology proposed by the applicants for determining the CO_2 savings from the use of the engine-on coasting function differs from the one approved in Implementing Decision (EU) 2018/2079 in the way the baseline vehicle is to be tested. As the methodology simplifies the testing process, whilst ensuring more conservative results, it is appropriate to approve it for the purpose of determining the CO_2 savings of the technology in question.

(14) Manufacturers should have the possibility to apply to a type-approval authority for the certification of CO_2 savings from the use of the innovative technology where the conditions laid down in this Decision are met. Manufacturers should for that purpose ensure that the application for certification is accompanied by a verification report from an independent and certified body confirming that the innovative technology complies with the conditions laid down in this Decision and that the savings have been determined in accordance with the testing methodology referred to in this Decision.

([5]) Commission Implementing Decision (EU) 2015/1132 of 10 July 2015 on the approval of the Porsche AG coasting function as an innovative technology for reducing CO_2 emissions from passenger cars pursuant to Regulation (EC) No 443/2009 of the European Parliament and of the Council (OJ L 184, 11.7.2015, p. 22).

([6]) Commission Implementing Decision (EU) 2017/1402 of 28 July 2017 on the approval of the BMW AG engine idle coasting function as an innovative technology for reducing CO_2 emissions from passenger cars pursuant to Regulation (EC) No 443/2009 of the European Parliament and of the Council (OJ L 199, 29.7.2017, p. 14).

([7]) Commission Implementing Decision (EU) 2018/2079 of 19 December 2018 on the approval of the engine idle coasting function as an innovative technology for reducing CO_2 emissions from passenger cars pursuant to Regulation (EC) No 443/2009 of the European Parliament and of the Council (OJ L 331, 28.12.2018, p. 225).

([8]) Regulation No 101 of the Economic Commission for Europe of the United Nations (UN/ECE) – Uniform provisions concerning the approval of passenger cars powered by an internal combustion engine only, or powered by a hybrid electric power train with regard to the measurement of the emission of carbon dioxide and fuel consumption and/or the measurement of electric energy consumption and electric range, and of categories M_1 and N_1 vehicles powered by an electric power train only with regard to the measurement of electric energy consumption and electric range (OJ L 138, 26.5.2012, p. 1).

(15) It is the responsibility of the type-approval authority to verify thoroughly that the conditions for certifying the CO_2 savings from the use of an innovative technology as specified in this Decision are met. Where the certification is issued, the responsible type-approval authority should ensure that all elements considered for the certification are recorded in a test report and kept together with the verification report and that this information is made available to the Commission on request.

(16) For the purpose of determining the general eco-innovation code to be used in the relevant type-approval documents in accordance with Annexes I, III, VI and VIII to Commission Implementing Regulation (EU) 2020/683 ([9]), it is necessary to attribute an individual code to the innovative technology.

(17) From 2021, manufacturers' compliance with their specific emissions targets under Regulation (EU) 2019/631 is to be established on the basis of the CO_2 emissions determined in accordance with the Worldwide Harmonised Light Vehicle Test Procedure (WLTP) set out in Commission Regulation (EU) 2017/1151 ([10]). CO_2 savings from the innovative technology certified by reference to this Decision may therefore be taken into account for the calculation of a manufacturer's average specific emissions of CO_2 only for calendar year 2020.

(18) In view of the change to WLTP, it is appropriate to repeal with effect from 1 January 2021 this Decision together with the following Implementing Decisions that refer to the conditions applicable under the NEDC, i.e. Commission Implementing Decisions 2013/128/EU ([11]), 2013/341/EU ([12]), 2013/451/EU ([13]), 2013/529/EU ([14]), 2014/128/EU ([15]), 2014/465/EU ([16]), 2014/806/EU ([17]), (EU) 2015/158 ([18]), (EU) 2015/206 ([19]), (EU) 2015/279 ([20]), (EU) 2015/295 ([21]), (EU) 2015/1132,

([9]) Commission Implementing Regulation (EU) 2020/683 of 15 April 2020 implementing Regulation (EU) 2018/858 of the European Parliament and of the Council with regards to the administrative requirements for the approval and market surveillance of motor vehicles and their trailers, and of systems, components and separate technical units intended for such vehicles (OJ L 163, 26.5.2020, p. 1).

([10]) 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 Commission Regulation (EC) No 692/2008 (OJ L 175, 7.7.2017, p. 1).

([11]) Commission Implementing Decision 2013/128/EU of 13 March 2013 on the approval of the use of light emitting diodes in certain lighting functions of an M1 vehicle as an innovative technology for reducing CO_2 emissions from passenger cars pursuant to Regulation (EC) No 443/2009 of the European Parliament and of the Council (OJ L 70, 14.3.2013, p. 7).

([12]) Commission Implementing Decision 2013/341/EU of 27 June 2013 on the approval of the Valeo Efficient Generation Alternator as an innovative technology for reducing CO_2 emissions from passenger cars pursuant to Regulation (EC) No 443/2009 of the European Parliament and of the Council (OJ L 179, 29.6.2013, p. 98).

([13]) Commission Implementing Decision 2013/451/EU of 10 September 2013 on the approval of the Daimler engine compartment encapsulation system as an innovative technology for reducing CO_2 emissions from new passenger cars pursuant to Regulation (EC) No 443/2009 of the European Parliament and of the Council (OJ L 242, 11.9.2013, p. 12).

([14]) Commission Implementing Decision 2013/529/EU of 25 October 2013 on the approval of the Bosch system for navigation-based preconditioning of the battery state of charge for hybrid vehicles as an innovative technology for reducing CO_2 emissions from passenger cars pursuant to Regulation (EC) No 443/2009 of the European Parliament and of the Council (OJ L 284, 26.10.2013, p. 36),

([15]) Commission Implementing Decision 2014/128/EU of 10 March 2014 on the approval of the light emitting diodes low beam module 'E-Light' as an innovative technology for reducing CO_2 emissions from passenger cars pursuant to Regulation (EC) No 443/2009 of the European Parliament and of the Council (OJ L 70, 11.3.2014, p. 30).

([16]) Commission Implementing Decision 2014/465/EU of 16 July 2014 on the approval of the DENSO efficient alternator as an innovative technology for reducing CO_2 emissions from passenger cars pursuant to Regulation (EC) No 443/2009 of the European Parliament and of the Council and amending Commission Implementing Decision 2013/341/EU (OJ L 210, 17.7.2014, p. 17).

([17]) Commission Implementing Decision 2014/806/EU of 18 November 2014 on the approval of the battery charging Webasto solar roof as an innovative technology for reducing CO_2 emissions from passenger cars pursuant to Regulation (EC) No 443/2009 of the European Parliament and of the Council (OJ L 332, 19.11.2014, p. 34).

([18]) Commission Implementing Decision (EU) 2015/158 of 30 January 2015 on the approval of two Robert Bosch GmbH high efficient alternators as the innovative technologies for reducing CO_2 emissions from passenger cars pursuant to Regulation (EC) No 443/2009 of the European Parliament and of the Council (OJ L 26, 31.1.2015, p. 31).

([19]) Commission Implementing Decision (EU) 2015/206 of 9 February 2015 on the approval of the Daimler AG efficient exterior lighting using light emitting diodes as an innovative technology for reducing CO_2 emissions from passenger cars pursuant to Regulation (EC) No 443/2009 of the European Parliament and of the Council (OJ L 33, 10.2.2015, p. 52).

([20]) Commission Implementing Decision (EU) 2015/279 of 19 February 2015 on the approval of the battery charging Asola solar roof as an innovative technology for reducing CO_2 emissions from passenger cars pursuant to Regulation (EC) No 443/2009 of the European Parliament and of the Council (OJ L 47, 20.2.2015, p. 26).

([21]) Commission Implementing Decision (EU) 2015/295 of 24 February 2015 on the approval of the MELCO GXi efficient alternator as an innovative technology for reducing CO_2 emissions from passenger cars pursuant to Regulation (EC) No 443/2009 of the European Parliament and of the Council (OJ L 53, 25.2.2015, p. 11).

(EU) 2015/2280 ([22]), (EU) 2016/160 ([23]), (EU) 2016/265 ([24]), (EU) 2016/588 ([25]), (EU) 2016/362 ([26]), (EU) 2016/587 ([27]), (EU) 2016/1721 ([28]), (EU) 2016/1926 ([29]), (EU) 2017/785 ([30]), (EU) 2017/1402, (EU) 2018/1876 ([31]), (EU) 2018/2079, (EU) 2019/313 ([32]), (EU) 2019/314 ([33]), (EU) 2020/728 ([34]), (EU) 2020/1102 ([35]), (EU) 2020/1222 ([36]).

(19) Taking into account that the time of applicability of this Decision is limited, it is appropriate to ensure that it enters into force as soon as possible and not later than seven days following its publication in the *Official Journal of the European Union*,

([22]) Commission Implementing Decision (EU) 2015/2280 of 7 December 2015 on the approval of the DENSO efficient alternator as an innovative technology for reducing CO_2 emissions from passenger cars pursuant to Regulation (EC) No 443/2009 of the European Parliament and of the Council (OJ L 322, 8.12.2015, p. 64).

([23]) Commission Implementing Decision (EU) 2016/160 of 5 February 2016 on the approval of the Toyota Motor Europe efficient exterior lighting using light emitting diodes as an innovative technology for reducing CO_2 emissions from passenger cars pursuant to Regulation (EC) No 443/2009 of the European Parliament and of the Council (OJ L 31, 6.2.2016, p. 70).

([24]) Commission Implementing Decision (EU) 2016/265 of 25 February 2016 on the approval of the MELCO Motor Generator as an innovative technology for reducing CO_2 emissions from passenger cars pursuant to Regulation (EC) No 443/2009 of the European Parliament and of the Council (OJ L 50, 26.2.2016, p. 30).

([25]) Commission Implementing Decision (EU) 2016/588 of 14 April 2016 on the approval of the technology used in 12 Volt efficient alternators as an innovative technology for reducing CO_2 emissions from passenger cars pursuant to Regulation (EC) No 443/2009 of the European Parliament and of the Council (OJ L 101, 16.4.2016, p. 25).

([26]) Commission Implementing Decision (EU) 2016/362 of 11 March 2016 on the approval of the MAHLE Behr GmbH & Co. KG enthalpy storage tank as an innovative technology for reducing CO_2 emissions from passenger cars pursuant to Regulation (EC) No 443/2009 of the European Parliament and of the Council (OJ L 67, 12.3.2016, p. 59).

([27]) Commission Implementing Decision (EU) 2016/587 of 14 April 2016 on the approval of the technology used in efficient vehicle exterior lighting using light emitting diodes as an innovative technology for reducing CO_2 emissions from passenger cars pursuant to Regulation (EC) No 443/2009 of the European Parliament and of the Council (OJ L 101, 16.4.2016, p. 17).

([28]) Commission Implementing Decision (EU) 2016/1721 of 26 September 2016 on the approval of the Toyota efficient exterior lighting using light emitting diodes for the use in non-externally chargeable hybrid electrified vehicles as an innovative technology for reducing CO_2 emissions from passenger cars pursuant to Regulation (EC) No 443/2009 of the European Parliament and of the Council (OJ L 259, 27.9.2016, p. 71).

([29]) Commission Implementing Decision (EU) 2016/1926 of 3 November 2016 on the approval of the battery-charging photovoltaic roof as an innovative technology for reducing CO_2 emissions from passenger cars pursuant to Regulation (EC) No 443/2009 of the European Parliament and of the Council (OJ L 297, 4.11.2016, p. 18).

([30]) Commission Implementing Decision (EU) 2017/785 of 5 May 2017 on the approval of efficient 12 V motor-generators for use in conventional combustion engine powered passenger cars as an innovative technology for reducing CO_2 emissions from passenger cars pursuant to Regulation (EC) No 443/2009 of the European Parliament and of the Council (OJ L 118, 6.5.2017, p. 20).

([31]) Commission Implementing Decision (EU) 2018/1876 of 29 November 2018 on the approval of the technology used in 12 Volt efficient alternators for use in conventional combustion engine powered light commercial vehicles as an innovative technology for reducing CO_2 emissions from light commercial vehicles pursuant to Regulation (EU) No 510/2011 of the European Parliament and of the Council (OJ L 306, 30.11.2018, p. 53).

([32]) Commission Implementing Decision (EU) 2019/313 of 21 February 2019 on the approval of the technology used in SEG Automotive Germany GmbH High efficient 48V motor generator (BRM) plus 48V/12V DC/DC converter for use in conventional combustion engine and certain hybrid powered light commercial vehicles as an innovative technology for reducing CO_2 emissions from light commercial vehicles pursuant to Regulation (EU) No 510/2011 of the European Parliament and of the Council (OJ L 51, 22.2.2019, p. 31).

([33]) Commission Implementing Decision (EU) 2019/314 of 21 February 2019 on the approval of the technology used in SEG Automotive Germany GmbH High efficient 48V motor generator (BRM) plus 48V/12V DC/DC converter for use in conventional combustion engine and certain hybrid powered passenger cars as an innovative technology for reducing CO_2 emissions from passenger cars pursuant to Regulation (EC) No 443/2009 of the European Parliament and of the Council (OJ L 51, 22.2.2019, p. 42).

([34]) Commission Implementing Decision (EU) 2020/728 of 29 May 2020 on the approval of the efficient generator function used in 12 volt motor-generators for use in certain passenger cars and light commercial vehicles as an innovative technology pursuant to Regulation (EU) 2019/631 of the European Parliament and of the Council (OJ L 170, 2.6.2020, p. 21).

([35]) Commission Implementing Decision (EU) 2020/1102 of 24 July 2020 on the approval of the technology used in a 48 Volt efficient motor-generator combined with a 48 Volt/12 Volt DC/DC converter for use in conventional combustion engine and certain hybrid electric passenger cars and light commercial vehicles as an innovative technology pursuant to Regulation (EU) 2019/631 of the European Parliament and of the Council and by reference to the New European Driving Cycle (NEDC) (OJ L 241, 27.7.2020, p. 38).

([36]) Commission Implementing Decision (EU) 2020/1222 of 24 August 2020 on the approval of efficient vehicle exterior lighting using light emitting diodes as an innovative technology for reducing CO_2 emissions from internal combustion engine powered light commercial vehicles with regard to NEDC conditions pursuant to Regulation (EU) 2019/631 of the European Parliament and of the Council (OJ L 279, 27.8.2020, p. 5).

HAS ADOPTED THIS DECISION:

Article 1

Innovative technology

The engine-on coasting function is approved as an innovative technology within the meaning of Article 11 of Regulation (EU) 2019/631, provided that the following conditions are met:

(a) the engine-on coasting function is fitted for use in passenger cars of category M_1 powered by an internal combustion engine, or in not off-vehicle charging hybrid electric vehicles of category M_1 for which uncorrected measured fuel consumption and CO_2 emission values may be used in accordance with Annex 8 to Regulation No 101 of the Economic Commission for Europe of the United Nations, and provided that the powertrain configuration is either P0 or P1, where P0 means that the electric machine is connected to the engine transmission belt, and P1 means that the electric machine is connected to the engine crankshaft;

(b) the vehicles fitted with the engine-on coasting function are equipped with automatic transmission or manual transmission with automated clutch;

(c) the engine-on coasting function is automatically activated in the predominant driving mode of the vehicle, i.e. the driving mode that is always selected when the engine is turned on regardless of the operating mode selected when the engine was previously shut down;

(d) it is not possible to deactivate, either by the driver or by external intervention, the engine-on coasting function when the engine is on in the predominant driving mode of the vehicle;

(e) the engine-on coasting function is not active when the velocity of the vehicle is less than 15 km/h.

Article 2

Application for certification of CO_2 savings

1. A manufacturer may apply to a type-approval authority for certification of the CO_2 savings from the use of the technology approved in accordance with Article 1 ('the innovative technology') by reference to this Decision.

2. The manufacturer shall ensure that the application for the certification is accompanied by a verification report from an independent and certified body confirming that the technology conforms to Article 1.

3. Where CO_2 savings have been certified in accordance with Article 3, the manufacturer shall ensure that the certified CO_2 savings and the eco-innovation code referred to in Article 4(1) are recorded in the certificate of conformity of the vehicles concerned.

Article 3

Certification of CO_2 savings

1. The type-approval authority shall ensure that CO_2 savings from the use of the innovative technology have been determined using the methodology in the Annex.

2. The type approval authority shall record the certified CO_2 savings determined in accordance with paragraph 1, and the eco-innovation code referred to in Article 4(1) in the relevant type-approval documentation.

4. The type-approval authority shall record all the elements considered for the certification in a test report and keep that together with the verification report referred to in Article 2(2), and shall make that information available to the Commission on request.

5. The type-approval authority shall only certify CO_2 savings from the use of the innovative technology if it finds that the technology conforms with Article 1, and if the CO_2 savings achieved are 1 g CO_2/km or higher, as specified in Article 9(1)(a) of Implementing Regulation (EU) No 725/2011.

Article 4

Eco-innovation code

1. The innovative technology approved by this Decision is attributed with the eco-innovation code 36.

2. The certified CO_2 savings recorded by reference to that eco-innovation code may only be taken into account for the calculation of the average specific emissions of CO_2 of manufacturers for the calendar year 2020.

Article 5

Repeal

This Implementing Decision and the following Implementing Decisions are repealed with effect from 1 January 2021: Implementing Decisions 2013/128/EU, 2013/341/EU, 2013/451/EU, 2013/529/EU, 2014/128/EU, 2014/465/EU, 2014/806/EU, (EU) 2015/158, (EU) 2015/206, (EU) 2015/279, (EU) 2015/295, (EU) 2015/1132, (EU) 2015/2280, (EU) 2016/160, (EU) 2016/265, (EU) 2016/588, (EU) 2016/362, (EU) 2016/587, (EU) 2016/1721, (EU) 2016/1926, (EU) 2017/785, (EU) 2017/1402, (EU) 2018/1876, (EU) 2018/2079, (EU) 2019/313, (EU) 2019/314, (EU) 2020/728, (EU) 2020/1102, (EU) 2020/1222.

From that date, CO_2 savings certified by reference to those Decisions shall not be taken into account for the calculation of the average specific emissions of manufacturers.

Article 6

Entry into force

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

Done at Brussels, 25 November 2020.

For the Commission
The President
Ursula VON DER LEYEN

ANNEX

METHODOLOGY TO DETERMINE THE CO_2 SAVINGS OF THE ENGINE-ON COASTING FUNCTION FOR INTERNAL COMBUSTION ENGINE VEHICLES AND CERTAIN NOT OFF-VEHICLE CHARGING HYBRID ELECTRIC VEHICLES

1. SYMBOLS, UNITS AND PARAMETERS

Latin symbols

CO_2 — Carbon dioxide

C_{CO_2} — CO_2 savings [g CO_2/km]

idle_corr — Correction factor for the idle fuel consumption

B_{MC} — CO_2 emissions of the baseline vehicle during the coasting corresponding manoeuvres under modified testing conditions [g CO_2/km]

B^i_{MC} — CO_2 emissions of the baseline vehicle during the i-th coasting corresponding manoeuvres under modified testing conditions [g CO_2/km]

B^i_{const} — CO_2 emissions of the baseline vehicle at constant speed k (i.e. 32, 35, 50, 70, 120 km/h) during the i-th constant speed event [g CO_2/km]

$B^i_{overrun}$ — CO_2 emissions of the baseline vehicle during the i-th overrun phase under modified testing conditions [g CO_2/km]

B^i_{Recu} — CO_2 emissions of the baseline vehicle during the i-th overrun phase under modified testing conditions due to the battery balance [g CO_2/km]

$dist^i_{overrun}$ — Distance driven during the i-th overrun event [km]

$dist^i_{coast}$ — Distance driven during the i-th coasting event [km]

ECE — Elementary urban driving cycle (part of the NEDC)

E_{MC} — CO_2 emissions of the eco-innovative vehicle under modified testing conditions [g CO_2/km]

E^i_{idle} — CO_2 emissions during the i-th idle phase [g CO_2/km]

$E^i_{synchro}$ — Engine synchronization CO_2 emissions during the i-th coasting event [g CO_2/km]

f_{const_k} — Measured fuel consumption at constant speed phase k (i.e. 32, 35, 50, 70, 120 km/h) [g/s]

EUDC — Extra-Urban Driving Cycle (part of the NEDC)

$f_{standstill}$ — Idle fuel consumption measured during vehicle standstill [g/s]

fuel_dens — Fuel density [kg/m^3]

f_{acc} — Fuel consumption to accelerate the engine from the idle speed to the transmission speed [l]

$F_{WLTP_{res,N}}$ — Driving resistance in 'neutral' measured under WLTP conditions for automatic and manual transmission [N] (Section 3.2)

$F_{WLTP_{res,D}}$ — Driving resistance during 'overrun' measured under WLTP conditions for automatic transmission [N] (Section 4.1)

$F_{NEDC_{res,D}}$ — Driving resistance during 'overrun' evaluated under NEDC conditions [N] (Section 4.1)

$F_{NEDC_{res,N}}$ — Driving resistance in NEDC as converted from WLTP conditions in neutral [N]

$F_{WLTP_{res,x}}$ — Driving resistance in WLTP conditions with the x-th gear engaged for manual transmission [N]

I_{eng} — Moment of inertia of engine (engine specific) [kgm²]

P^{i}_{Batt1} — Measured power of the primary battery during the i-th overrun event [W]

P^{i}_{Batt2} — Measured power of the secondary battery during the i-th overrun event [W]

RDC_{RW} — Relative coasting distance under real world conditions defined as the distance travelled with coasting active divided by total driving distance per trip [%]

RCD_{mNEDC} — Relative coasting distance under modified testing conditions defined as the distance travelled with coasting active divided by total driving distance of the mNEDC [%]

UF — Usage factor of the coasting technology defined as $UF = \frac{RCD_{RW}}{RCD_{mNEDC}}$

$S_{C_{CO_2}}$ — Uncertainty of the CO_2 savings [g CO_2/km]

$S_{E_{MC}}$ — Standard deviation of the arithmetic mean of the CO_2 emissions of the eco-innovative vehicle under modified testing conditions [g CO_2/km]

S_{UF} — Standard deviation of the arithmetic mean of the usage factor

t^{i}_{drag} — Engine drag time of the i-th overrun event [h]

t^{i}_{coast} — Duration of the i-th coasting event [s]

t^{const}_{min} — Minimum time for constant speed phases after acceleration or coasting deceleration [s]

t^{stop}_{min} — Minimum time after every coasting deceleration to a standstill or constant speed phase [s]

$T_{q_{acc,fric}}$ — Engine friction torque (engine specific) [Nm]

v_{min} — Minimum speed for coasting [km/h]

v_{max} — Maximum speed for coasting [km/h]

$v^{i}_{const_k}$ — Constant driving speed k (i.e. 32, 35, 50, 70, 120 km/h) during the i-th constant speed event [km/h]

Greek symbols

η_{DCDC}	— DC/DC Converter efficiency, which is set equal to 0,92
$\eta_{bat\_discharge}$	— Battery discharge efficiency, which is set equal to 0,94
$\eta_{alternator}$	— Alternator efficiency, which is set equal to 0,67
ΔRES_{drag}	— Difference between the driving resistance in 'neutral' gear position, during 'overrun' and measured under WLTP conditions [N]
ΔP_k^i	— Delta power due to WLTP driving resistance dyno settings occurring in the i-th constant speed event [W]
$\Delta F\left(v_{const_k}^i\right)_{WLTP-NEDC}$	— Difference of the vehicle driving resistance between the WLTP and NEDC occurring in the i-th constant speed event [N]
Δt_{acc}	— Time needed to accelerate the engine from idle speed to synchronisation speed [s]
$\Delta\gamma_{acc}$	— Delta rotational angle [rad]
$\Delta\omega_{acc}$	— Delta engine speed (from idle speed ω_{idle} to the synchronization speed ω_{sync}) [rad/s]

2. TEST VEHICLES

The test vehicles shall fulfil the following requirements:

(a) Eco-innovative vehicle: a vehicle with the innovative technology installed and active in default or predominant driving mode. The predominant driving mode is the driving mode that is always selected when the vehicle is switched on regardless of the operating mode selected when the vehicle was previously shut down. The engine-on coasting function shall not be deactivated by the driver in the predominant driving mode;

(b) Baseline vehicle: a vehicle that in all aspects is identical to the eco-innovative vehicle with the exception of the innovative technology, which is either not installed or deactivated in default or predominant driving mode; The baseline vehicle tested may be the eco-innovative vehicle on the condition that a short brake action is applied before the deceleration events so as to avoid the coasting events that would normally appear due to the coasting function installed in the eco-innovative vehicle as, in principle, the coasting function can be inhibited by pressing the brake pedal before the deceleration events. The brake action temporarily inhibits the coasting function until the subsequent driving event.

3. DEFINITION OF THE MODIFIED TESTING CONDITIONS

The steps defining the modified testing conditions are as follows:

1. Definition of the Road Loads;

2. Definition of the Coast Down Curve in engine-on coasting mode;

3. Generation of the modified NEDC speed profile (mNEDC);

4. Coasting corresponding manoeuvres for the baseline vehicle;

3.1. **Definition of the Road Loads**

The road loads of the baseline and eco-innovative vehicle shall be determined in accordance with the procedure set out in Sub-Annex 4 to Annex XXI to Regulation (EU) 2017/1151 and be converted into NEDC road loads for vehicle high and low in accordance with point 2.3.8 of Annex I to Commission Implementing Regulation (EU) 2017/1153 ([1]).

3.2. **Definition of the Coast Down Curve in engine-on coasting mode**

The coast down curve in engine-on coasting mode is defined as the coast down curve with the gear position in 'neutral', as determined during the type approval procedure in accordance with Sub-Annex 4 to Annex XXI to Regulation (EU) 2017/1151 and corrected to the corresponding NEDC coast down curve in accordance with point 2.3.8 of Annex I to Implementing Regulation (EU) 2017/1153.

3.3. **Generation of the modified NEDC speed profile (mNEDC)**

The speed profile of the mNEDC shall be generated in accordance with the following:

(a) The test sequence is composed of an urban cycle made of four elementary urban cycles and an extra-urban cycle;

(b) All acceleration ramps are identical to the NEDC speed profile;

(c) All constant speed levels are identical to the NEDC speed profile;

(d) The speed and time tolerances shall be in accordance with paragraph 1.4 of Annex 7 to UN/ECE Regulation No 101;

(e) The deviation from the NEDC profile shall be minimised and the overall distance must comply with the NEDC specified tolerances;

(f) The distance at the end of each deceleration phase of the mNEDC profile shall be equal to the distance at the end of each deceleration phase of the NEDC profile;

(g) During coasting phases the internal combustion engine (ICE) is decoupled and no active correction of the vehicle's speed trajectory is permitted;

(h) Lower speed limit for coasting v_{min}: The coasting mode has to be disabled at the lower speed limit for coasting (15 km/h) by engaging the brake;

(i) In technically justified cases and in agreement with the type approval authority, the manufacturer may select the speed v_{min} at a higher speed than 15 km/h;

(j) Minimum stop time: The minimum time after every coasting deceleration to a standstill or constant speed phase is 2 seconds;

(k) Minimum time for constant speed phases: The minimum time for constant speed phases after acceleration or coasting deceleration is 2 seconds. For technical reasons this value can be increased and it shall be recorded in the test report;

(l) The coasting mode can be enabled if the speed is below the maximum speed of the test cycle, i.e. 120 km/h

3.3.1. *Gearshift profile generation for vehicles with manual gearbox*

For vehicles with manual gearbox, the gearshift Tables 1 and 2 in Annex 4a of Regulation UNECE 83 shall be adapted on the basis of the following:

1. The gearshift selection during vehicle acceleration is as defined for the NEDC;

2. The timing for the downshifts of the modified NEDC differs from the one of the NEDC in order to avoid downshifts during coasting phases (e.g. anticipated before deceleration phases).

([1]) 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 2014/2010 (OJ L 175, 7.7.2017, p. 679).

The pre-defined shift points for the ECE and EUDC portion of the NEDC, as described in Table 1 and Table 2 of Annex 4a to Regulation UNECE 83, shall be modified in accordance with Table 1 and Table 2 shown below.

Table 1

Operation	Phase	Acceleration (m/s^2)	Speed (km/h)	Duration of each		Cumulative time (s)	Gear to be used
				Operation (s)	Phase (s)		
Idling	1	0	0	11	11	11	6s PM+5sK_1[1]
Acceleration	2	1,04	0-15	4	4	15	1
Steady speed	3	0	15	9	8	23	1
Deceleration	4	– 0,69	15-10	2	5	25	1
Deceleration, clutch disengaged		– 0,92	10-0	3		28	K_1 [1]
Idling	5	0	0	21	21	49	16s PM+5sK [1]
Acceleration	6	0,83	0-15	5	12	54	1
Gear change			15	2		56	
Acceleration		0,94	15-32	5		61	2
Steady speed	7	0	32	t_{const1}	t_{const1}	61+t_{const1}	2
Deceleration	8	coast down	[32-dv_1]	Δt_{cd1}	Δt_{cd1} + 8 -Δt_1 + 3	61+t_{const1}+Δt_{cd1}	2
Deceleration		– 0,75	[32-dv_1]-10	8-Δt_1		69+t_{const1}+Δt_{cd1}-Δt_1	2
Deceleration, clutch disengaged		– 0,92	10-0	3		72+t_{const1}+Δt_{cd1}-Δt_1	K_2[1]
Idling	9	0	0	21-Δt_1		117	16s-Δt_1PM+5sK_1[1]
Acceleration	10	0,83	0-15	5	26	122	1
Gear change			15	2		124	
Acceleration		0,62	15-35	9		133	2
Gear change			35	2		135	
Acceleration		0,52	35-50	8		143	3
Steady speed	11	0	50	t_{const2}	t_{const2}	t_{const2}	3
Deceleration		coast down	[50- dv_2]	Δt_{cd2}	Δt_{cd2}	t_{const2}+Δt_{cd2}	3
Deceleration	12	– 0,52	[50- dv_2]-35	8-Δt_2	8-Δt_2	t_{const2}+Δt_{cd2} + 8-Δt_2	3
Steady speed	13	0	35	t_{const3}	t_{const3}	t_{const2}+Δt_{cd2} + 8-Δt_2+t_{const3}	3
Gear change	14		35	2	12+Δt_{cd3}-Δt_3	t_{const2}+Δt_{cd2} + 10-Δt_2+t_{const3}	
Deceleration		coast down	[35- dv_3]	Δt_{cd3}		t_{const2}+Δt_{cd2} + 10-Δt_2+t_{const3}+Δt_{cd3}	2
Deceleration		– 0,99	[35- dv_3]-10	7-Δt_3		t_{const2}+Δt_{cd2} + 17-Δt_2+t_{const3}+Δt_{cd3}-Δt_3	2
Deceleration clutch disengaged		– 0,92	10-0	3		t_{const2}+Δt_{cd2} + 20-Δt_2+t_{const3}+Δt_{cd3}-Δt_3	K_2[1]
Idling	15	0	0	7-Δt_3	7-Δt_3	t_{const2}+Δt_{cd2} + 27-Δt_2+t_{const3}+Δt_{cd3}-2*Δt_3	7s-Δt_3PM[1]

Table 2

No of operation	Operation	Phase	Acceleration (m/s²)	Speed (km/h)	Duration of each		Cumulative time(s)	Gear to be used
					Operation (s)	Phase (s)		
1	Idling	1	0	0	20	20		K_1 (1)
2	Acceleration	2	0,83	0-15	5	41		1
3	Gear change			15	2			—
4	Acceleration		0,62	15-35	9			2
5	Gear change			35	2			—
6	Acceleration		0,52	35-50	8			3
7	Gear change			50	2			—
8	Acceleration		0,43	50-70	13			4
9	Steady speed	3	0	70	t_{const4}	t_{const4}		5
9'	Deceleration	3'	coastdown	70-dv_4 (**)	Δt_{cd4}	Δt_{cd4}		5
10	Deceleration	4	coastdown, (*)-0,69	dv_4 (**)-50	8-Δt_{cd4}	8-Δt_{cd4}		4
11	Steady speed	5	0	50	69	69		4
12	Acceleration	6	0,43	50-70	13	13		4
13	Steady speed	7	0	70	50	50		5
14	Acceleration	8	0,24	70-100	35	35		5
15	Steady speed (2)	9	0	100	30	30		5 (2)
16	Acceleration (2)	10	0,28	100-120	20	20		5 (2)
17	Steady speed (2)	11	0	120	t_{const5}	t_{const5}		5 (2)
17'	Deceleration (2)		coastdown	[120- dv_5]	Δt_{cd5}	Δt_{cd5}		5 (2)
18-end	**If $dv_5 \geq 80$**							
	Deceleration (2)	12	– 0,69	[120-dv_5]-80	16-Δt_5	34-Δt_5		5 (2)
	Deceleration (2)		– 1,04	80-50	8			5 (2)
	Deceleration, clutch disengaged		1,39	50-0	10			K_5 (1)
	Idling	13	0	0	20-Δt_5	20-Δt_5		PM (1)
	If $50 < dv_5 < 80$							
	Deceleration (2)		– 1,04	[120-dv_5]-50	8-Δt_5	18-Δt_5		5 (2)
	Deceleration, clutch disengaged		1,39	50-0	10			K_5 (1)
	Idling	13	0	0	20-Δt_5	20-Δt_5		PM (1)
	If $dv_5 \leq 50$							
	Deceleration, clutch disengaged		1,39	[120-dv_5]	10-Δt_5	10-Δt_5		K_5 (1)
	Idling	13	0	0	20-Δt_5	20-Δt_5		PM (1)

(1) PM = gearbox in neutral, clutch engaged. K_1, K_5 = first or second gear engaged, clutch disengaged.
(2) Additional gears can be used according to manufacturer recommendations if the vehicle is equipped with a transmission with more than five gears.
(*) Achieved velocity after 4 seconds with an acceleration of – 0,69 m/s2 is 60,064 km/h. This velocity is also used as gear shift indicator for modified NEDC cycle.
(**) dv4 ≥ 60,064 km/h.

For the definition of the terms in Table 1 and Table 2 please refer to UNECE Regulation 83.

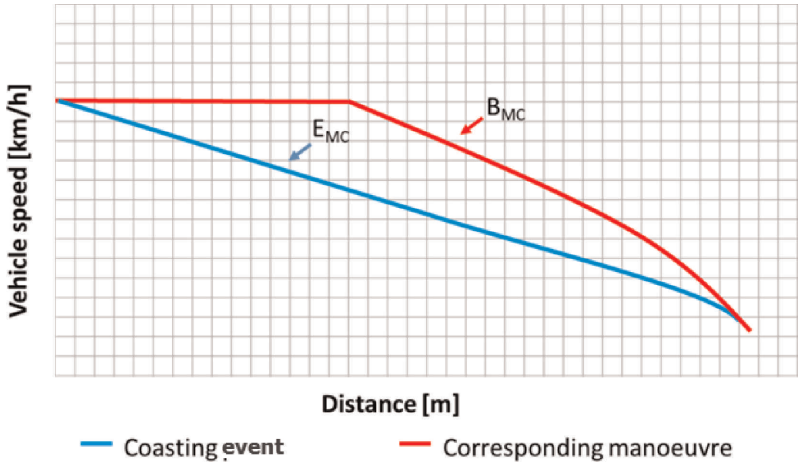
For vehicles with manual transmissions, coasting shall be interrupted during the deceleration from 70 km/h down to 50 km/h as gear shift is commanded from 5th to 4th gear. The gear shift shall interrupt the coasting and the vehicle shall follow the same pre-defined deceleration as in the NEDC until the vehicle reaches 50 km/h. In this case, only the coasting phase before the interruption will be considered in the calculation of the CO_2 savings resulting from the implementation of the coasting on function.

3.4. Coasting corresponding manoeuvres for the baseline vehicle

For each coasting event identified in the mNEDC for the eco-innovative vehicle, a corresponding manoeuvre shall be determined for the baseline vehicle. These manoeuvres shall be composed of a constant speed phase followed by a deceleration phase with engine in overrun conditions (i.e. the engine rotation is caused by the vehicle movement, the gas pedal is released and no fuel is injected), without braking, and they shall fulfil the speed tolerances and distances of the coasting manoeuvres as defined in UNECE Regulation 83. During these manoeuvres, the gearbox shall be engaged in case of automatic transmission, or the speed specific gear shall be engaged as set out in Section 3.3.1 in case of manual transmission.

Figure 1

Coasting event (blue line) of eco-innovative vehicle and coasting corresponding manoeuvre (red line) of baseline vehicle



In order to comply with points (a)-(l) of Section 3.3, the same distance must be covered under the NEDC and mNEDC. Since the distance covered by the baseline vehicle in overrun is shorter than the distance covered during coasting by the eco-innovative vehicle, due to the higher deceleration rate of the baseline vehicle, the difference in the distance to be covered by the baseline vehicle shall be supplemented by constant speed driving phases, where the constant speed driven shall be the speed of the baseline vehicle at the start of the coasting event prior to the engine overrun phases. In case the end speed of the coasting manoeuvre is not zero, the additional distances (Δs) shall be achieved in two sections at start speed and end speed respectively.

To determine the constant speed driving duration before the start of the coasting event $t_{v_{start}}$ and after the end of the coasting event $t_{v_{end}}$, the following system of linear equations (Formula 1) shall be used:

Formula 1

$$\begin{cases} \Delta s = s_{coast} - s_{drag} = v_{start} \cdot t_{v_{start}} + v_{end} \cdot t_{v_{end}} \\ \Delta t = t_{coast} - t_{drag} = t_{v_{start}} + t_{v_{end}} \\ t_{v_{start}} = \dfrac{\Delta s - v_{end} \cdot \Delta t}{v_{start} - v_{end}} \\ t_{v_{end}} = \dfrac{\Delta s - v_{start} \cdot \Delta t}{v_{end} - v_{start}} \end{cases}$$

where:

Δs is the additional distance driven at constant speed by the baseline vehicle in comparison with the eco-innovative vehicle [m]

Δt is the duration of the additional distance driven at constant speed by the baseline in comparison with the eco-innovative vehicle [s]

s_{coast} is the distance covered during coasting by the eco-innovative vehicle [m]

s_{drag} is the distance covered during overrun by the baseline vehicle [m]

v_{start} is the speed at the start of the manoeuvre (coasting or overrun) [m/s]

v_{end} is the speed at the end of the manoeuvre (coasting or overrun) [m/s]

t_{vstart} is the instant of time in which the overrun event begins [s]

t_{vend} is the instant of time in which the overrun event ends [s]

t_{coast} is the duration of the coasting event [s]

t_{drag} is the duration of the overrun event [s].

4. DETERMINATION OF THE ADDITIONAL PARAMETERS

The following tests shall be performed right after the WLTP Type I test in order to define the additional parameters required in the testing methodology:

— Coast down in overrun mode (valid for the baseline vehicle) to measure the driving resistance during overrun phases (Section 4.1);

— Constant speed test (valid for the baseline vehicle) to measure the constant speed fuel consumption. The test is based on a specific testing cycle composed by constant speed segments at 120, 70, 50, 35 and 32 km/h (Section 4.2);

— Idle test (valid for the eco-innovative vehicle) to measure the idle fuel consumption (Section 4.3);

— Engine synchronization energy determination (Section 4.4).

4.1. **Coast down in overrun mode (baseline vehicle)**

In order to measure the driving resistance in overrun mode, a coast down with the gearbox engaged shall be performed (see Figure 2). The test shall be repeated three times as a minimum and shall be performed after the WLTP type I test during the Type Approval with a maximum time lag of 15 minutes. The coast down curve shall be recorded at least three times in a row.

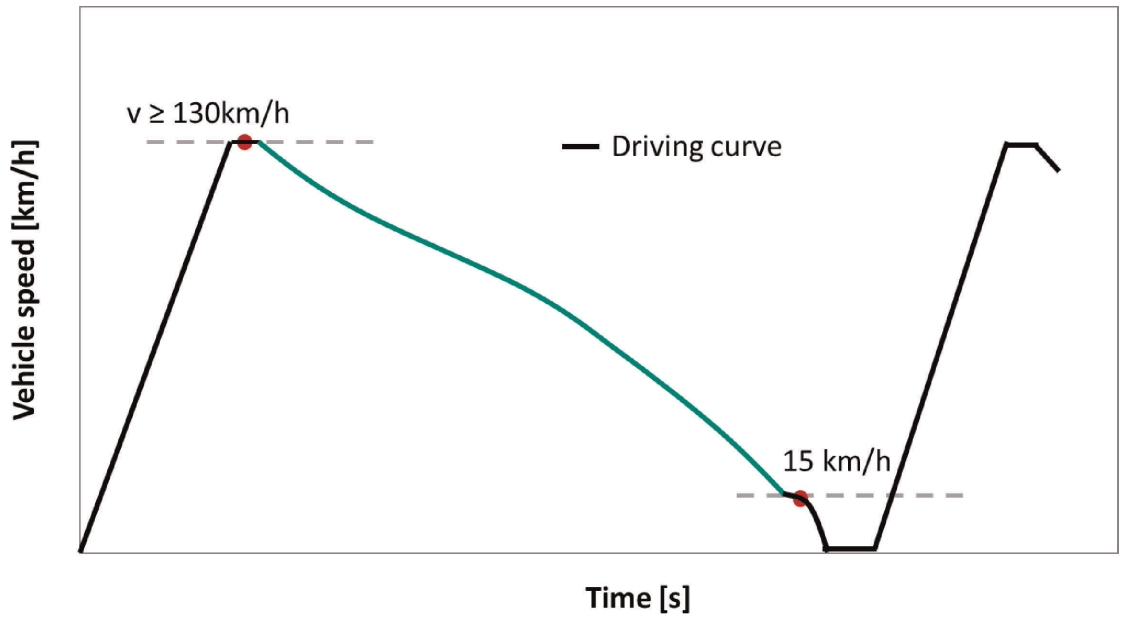
4.1.1. *Automatic transmission*

The vehicle can be accelerated by itself or by the dynamometer to a minimum speed of 130 km/h.

During each coast down, the driving resistance forces, the generator and battery current of all batteries shall be measured with steps of maximum 10 km/h.

Figure 2

Coast down with gearbox in position D on the vehicle dynamometer for the baseline vehicle (minimum 3 ×)



The driving resistance in overrun mode shall be converted from WLTP settings to NEDC settings in accordance with Formula 2:

Formula 2

$$\Delta RES_{drag} = F_{WLTP_{res,D}} - F_{WLTP_{res,N}}$$

$$F_{NEDC_{res,D}} = F_{NEDC_{res,N}} + \Delta RES_{drag}$$

where:

ΔRES_{drag} is the difference between the driving resistance in overrun condition and in neutral, measured under WLTP conditions [N]

$F_{WLTP_{res,N}}$ is the driving resistance measured as described in Section 3.2 [N]

$F_{WLTP_{res,D}}$ is the driving resistance in overrun condition, measured under WLTP conditions [N]

$F_{NEDC_{res,N}}$ is the driving resistance in NEDC as converted in accordance with point 2.3.8 of Annex I to Implementing Regulation (EU) 2017/1153, as described in Section 3.2 [N].

4.1.2. *Manual transmission*

For vehicles with manual transmission, the coast down shall be repeated at different vehicle speeds and gears, at least three times for each gear:

— Accelerate by using the engine to minimum 130 km/h and stabilize for 5s, then start the coast down in the highest gear and measure between 120-60 km/h;

— Accelerate by using the engine to 90 km/h and stabilize for 5s, then start the coast down in gear 5 and measure between 70-60 km/h;

— Accelerate by using the engine to 70 km/h and stabilize for 5s, then start the coast down in gear 3 and measure between 55-35 km/h;

— Accelerate by using the engine to 60 km/h and stabilize for 5s, then start the coast down in gear 2 and measure between 40-15 km/h.

During each coast down, the driving resistance forces and the generator and battery current [A] of all batteries shall be measured with steps of maximum 10 km/h.

The driving resistance in overrun mode shall be converted from WLTP settings to NEDC settings, in accordance with Formula 3, for each gear x:

Formula 3

$$\Delta RES_{drag} = (F_{WLTP_{res,1}}, F_{WLTP_{res,2}}, \ldots, F_{WLTP_{res,x}}) - F_{WLTP_{res,N}}$$

$$F_{NEDC_{res,D}} = F_{NEDC_{res,N}} + \Delta RES_{drag}$$

4.1.3. *Load balance of the battery in overrun mode*

The load balance of the battery/batteries during the overrun phases shall be calculated in accordance with Formula 4 or 5.

In case the vehicle is equipped with a primary and a secondary battery, Formula 4 applies:

Formula 4

$$\overline{Recu^i}\ [Wh] = t^i_{drag} \cdot \left(\overline{P^i_{Batt1}} + \overline{P^i_{Batt2}} \cdot \frac{1}{\eta_{DCDC}}\right)$$

where:

$\overline{Recu^i}$: Energy recuperated during the i-th overrun event, as arithmetic mean of the values obtained from each coast down test in overrun mode [Wh];

t^i_{drag} : Duration of the i-th overrun event [h];

$\overline{P^i_{Batt1}}$: Average (over the overrun test repetitions) measured power of the primary battery during the i-th overrun event [W];

$\overline{P^i_{Batt2}}$: Average (over the overrun test repetitions) measured power of the secondary battery during the i-th overrun event [W];

η_{DCDC}: DC/DC Converter efficiency, which is set equal to 0,92; if no DC/DC Converter is present, this value is set equal to 1.

In case only one battery (i.e. the 12V battery) is available, Formula 5 applies instead:

Formula 5

$$\overline{Recu^i}\ [Wh] = t^i_{drag} \cdot \overline{P^i_{Batt1}}$$

The recuperated energy is converted into CO_2 emissions by using Formula 6:

Formula 6

$$\overline{B^i_{Recu}}\left[\frac{gCO_2}{km}\right] = -\frac{\overline{Recu^i}}{1000 \cdot \eta_{bat\_discharge} \cdot \eta_{alternator}} \cdot V_{pe} \cdot 100 \cdot CF \cdot \frac{1}{dist^i_{overrun}}$$

where:

$\eta_{bat\_discharge}$: Battery discharge efficiency, which is 0,94;

$\eta_{alternator}$: Alternator efficiency, which is 0,67;

$dist^i_{overrun}$: Distance driven during the i-th overrun event [km];

V_{pe}: Consumption of effective power as specified in Table 3;

CF: Conversion factor as defined in Table 4.

Table 3

Consumption of effective power

Type of engine	Consumption of effective power (V_{pe}) l/kWh
Petrol	0,264
Petrol Turbo	0,280
Diesel	0,220

Table 4

Fuel conversion factor

Type of fuel	Conversion factor (CF) g CO_2/l
Petrol	2 330
Diesel	2 640

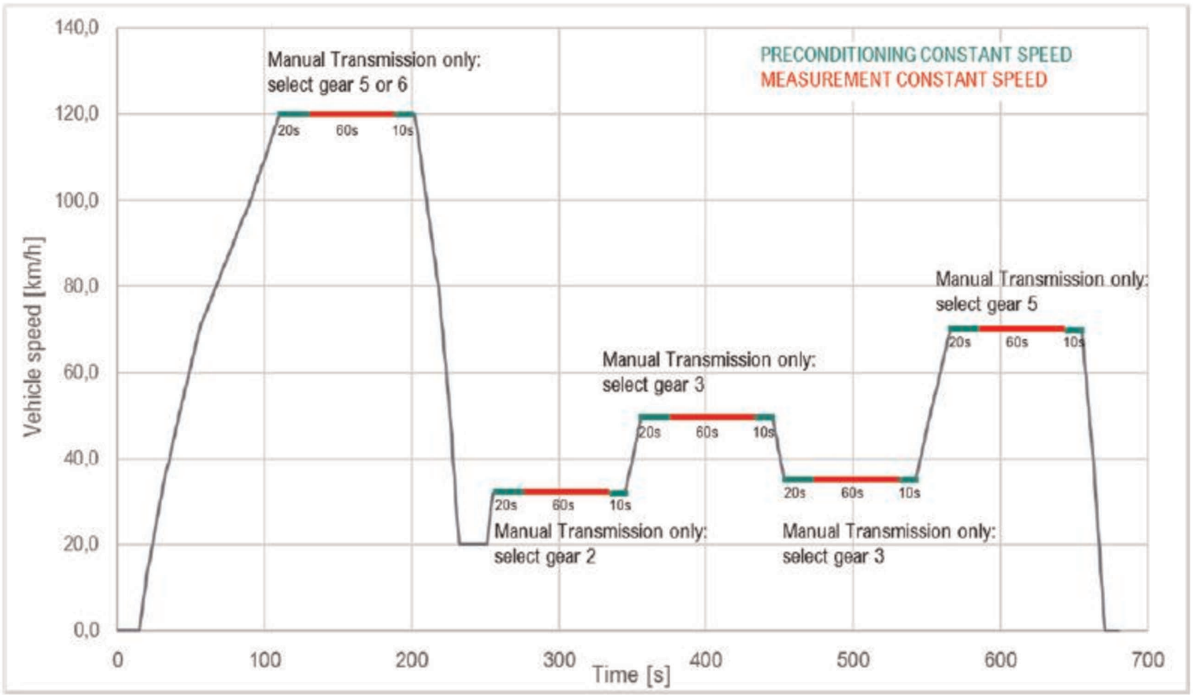
4.2. **Constant speed test**

The constant driving speed phase fuel consumption shall be measured on a chassis dynamometer by using the on-board-fuel and/or energy consumption monitoring device (OBFCM) meeting the requirements set out in Annex XXII to Regulation (EU) 2017/1151.

The measurement of the fuel consumption is based on a driving pattern which includes all the NEDC constant driving speed phases at 32, 35, 50, 70 and 120 km/h. To ensure equal NEDC shifting points and selected gears for manual transmission vehicles, the sequence of the constant driving speed phases shall be as specified in Figure 3.

Figure 3

Driving pattern which covers the relevant NEDC based constant driving speed phase



Each constant speed phase has a duration of 90 seconds, subdivided into 20 seconds for speed and emission stabilization, 60 seconds during which OBFCM measurement takes place and 10 seconds preparation time for the driver for the upcoming driving manoeuvre.

The speed and acceleration profiles are described in the Appendix to this Annex.

The constant speed test shall be performed after the Coast Down test in overrun mode is performed as set out in Section 4.1.

In order to obtain the NEDC constant speed fuel consumption, the results from the measurements carried out with the WLTP type approval dynamometer settings (vehicle road load and vehicle weight) have to be corrected to NEDC conditions as follows:

Formula 7

$$B^{i}_{const}\left[\frac{gCO_2}{km}\right] = \overline{f_{const_k}} \cdot \left(\frac{CF}{fuel\_dens} \cdot \frac{t^{i}_{const}}{dist^{i}_{const}}\right) + \Delta P^{i}_{k} \cdot \frac{V_{Pe} \cdot CF}{v^{i}_{const_k}}$$

Formula 8

$$\Delta P^{i}_{k}[kW] = \Delta F\left(v^{i}_{const_k}\right)_{WLTP-NEDC} \cdot v^{i}_{const_k}$$

where:

B^{i}_{const} : CO_2 emissions at constant speed k (i.e. 32, 35, 50, 70, 120 km/h) during the i-th constant speed event [g CO_2/km];

$\overline{f_{const_k}}$: Measured (WLTP) fuel consumption at constant speed k (i.e. 32, 35, 50, 70, 120 km/h) as arithmetic mean of the measurements [g/s];

t^i_{const} : Duration of the i-th constant speed event [s];

$dist^i_{const}$: Distance driven during the i-th constant speed event [km];

fuel_dens: Fuel density [kg/m³];

ΔP^i_k : Delta power due to WLTP driving resistance dyno settings occurring in the i-th constant speed event [kW];

$\Delta F(v^i_{const_k})_{WLTP-NEDC}$: Difference of vehicle driving resistance calculated between the WLTP and NEDC driving resistance dynamometer settings occurring in the i-th constant speed event as determined in Section 4.1 [N];

$v^i_{const_k}$: Constant driving speed k (i.e. 32, 35, 50, 70, 120 km/h) during the i-th constant speed event [km/h].

The generator and battery current of all batteries shall be measured and the battery SOC during each 60s measurement window shall be corrected in accordance with Appendix 2 to Sub-Annex 8 to Annex XXI to Regulation (EU) 2017/1151.

The fuel consumption during each constant speed phase k shall be determined as follows:

Formula 9

$$f_{const_k} = \overline{f_{const_k}} - \left| s_{f_{const_k}} \right|$$

Formula 10

$$s_{f_{const_k}} = \sqrt{\frac{\sum_{j=1}^{J} (f_{const_{k,j}} - \overline{f_{const_k}})^2}{J(J-1)}}$$

where:

J: Number of measurement points (J = 60) for each constant speed phase k (32, 35, 50, 70 and 120 km/h);

$f_{const_{k,j}}$: j-th fuel consumption measure at constant speed phase k (32, 35, 50, 70 and 120 km/h) [g/s];

$s_{f_{const_k}}$: Standard deviation of the fuel consumption at constant speed phase k (32, 35, 50, 70 and 120 km/h).

4.3. **Idle fuel consumption or idle speed test**

The idle fuel consumption during coasting can be directly measured with an OBFCM meeting the requirements set out in Annex XXII to Regulation (EU) 2017/1151, and this measured value can be used for the calculation of E^i_{idle}.

As an alternative, Formula 12 can be used to calculate E^i_{idle} in accordance with the following methodology:

The engine idle fuel consumption (g/s) shall be measured using an OBFCM meeting the requirements set out in Annex XXII to Regulation (EU) 2017/1151. The measurement shall be performed just after the Type 1 test when the engine is still warm and under the following conditions:

(a) the velocity of the vehicle is zero;

(b) the start-stop system is disengaged;

(c) the battery state of charge is at balance conditions.

The vehicle shall be left to idle for 3 minutes so that it stabilizes. The fuel consumption shall be measured during 2 minutes. The first minute shall be disregarded. The idle fuel consumption shall be calculated as the average fuel consumption of the vehicle during the second minute.

A manufacturer may request that the engine idle fuel consumption measurements are used also for other vehicles belonging to the same interpolation family, provided that the engines run with the same idle speed. The manufacturer shall demonstrate to the type approval authority or technical service that those conditions are met.

Where the idle fuel consumption differs between engine on coasting and idling at standstill, a correction factor shall be applied as determined in accordance with Formula 11:

Formula 11

$$\text{idle\_corr} = \frac{\overline{\text{Idle\_speed}}}{\overline{\text{stand\_speed}}}$$

where:

$\overline{\text{Idle\_speed}}$ mean engine idle speed during coasting determined in accordance with Formula 14 [rpm];

$\overline{\text{stand\_speed}}$ mean engine idle speed during stand-still determined in accordance with Formula 15 [rpm].

The mean engine idle speed during coasting is the arithmetic mean of the engine idle speeds measured via the OBD port during the deceleration from 130 km/h to 10 km/h, with steps of 10 km/h.

As an alternative, the ratio between the maximal possible engine speed during engine-on coasting and idle speed at standstill can be used.

In case the manufacturer can prove that the increase in engine idle speed that occurs during coasting on phases is lower than 5 % of the idle speed during standstill, idle_corr can be set equal to 1.

The corrected CO_2 emissions during each phase (E^i_{idle})[g CO_2/km], derived from the idle fuel consumption, shall be calculated in accordance with Formula 12:

Formula 12

$$E^i_{idle} = \left(\frac{\text{idle\_corr} \cdot \overline{f_{standstill}} \cdot CF}{\text{fuel\_dens}}\right) \cdot \left(\frac{t^i_{coast}}{dist^i_{coast}}\right)$$

where:

E^i_{idle} : CO_2 emissions during the i-th idle phase [gCO_2/km];

t^i_{coast} : duration of the i-th coasting event [s];

$dist^i_{coast}$: distance driven during the i-th coasting event [km];

$\overline{f_{standstill}}$: mean idle fuel consumption in standstill conditions [g/s], which is the arithmetic mean of 60 measurements.

The mean idle speed during coasting is measured in steps of 10 km/h, considering U measurements for each step (with a 1s resolution), and shall be calculated in accordance with Formula 13:

Formula 13

$$\overline{\text{idle\_speed}_h} = \frac{\sum_{u=1}^{U} \text{idle\_speed}_{h,u}}{U}$$

Therefore, the mean idle speed during coasting considering all H steps of 10 km/h shall be calculated in accordance with Formula 14:

Formula 14

$$\overline{\text{Idle\_speed}} = \frac{\sum_{h=1}^{H} \overline{\text{idle\_speed}_h}}{H}$$

The mean idle speed in standstill conditions shall be calculated in accordance with Formula 15:

Formula 15

$$\overline{\text{stand\_speed}} = \frac{\sum_{l=1}^{L} \text{stand\_speed}_l}{L}$$

where:

stand_speed_l	engine idle speed in standstill conditions during the l-th measurement;
L	number of measurement points.

4.4. **Engine synchronization energy determination**

The engine synchronization CO_2 emissions during the i-th coasting event $(E^i_{synchro})$ [g CO_2/km], shall be determined in accordance with Formula 16:

Formula 16

$$E^i_{synchro} = f_{acc} \cdot \frac{CF}{dist^i_{coast}}$$

where:

f_{acc}:	fuel consumption to accelerate the engine from the idle speed to the synchronization speed [l];
CF:	conversion factor as defined in Table 4 [g CO_2/l];
$dist^i_{coast}$:	distance driven during the i-th coasting event [km].

Manufacturers shall provide engine synchronization fuel consumption value [l] to the type approval authority/technical service determined in accordance with the following methodology:

4.4.1. *Calculation of fuel consumption to accelerate the engine from the idle speed to the synchronization speed*

When a coasting event is completed, an additional amount of energy is required (E_{acc}) to accelerate the engine to the synchronization speed.

The energy needed to accelerate the vehicle engine to synchronization speed, E_{acc}, is the sum of the energies associated with the acceleration and the friction work implemented in the vehicle and shall be calculated in accordance with Formula 17:

Formula 17

$$E_{acc} = E_{acc,kin} + E_{acc,fric}$$

where:

$E_{acc,kin}$:	Energy associated with the acceleration work implemented in the vehicle [kJ];
$E_{acc,fric}$:	Energy associated with the friction work implemented in the vehicle [kJ].

These energies shall be calculated in accordance with Formulas 18 and 19, respectively.

Formula 18

$$E_{acc,kin} = \frac{1}{2} \cdot I_{eng} \cdot \Delta\omega^2_{acc}$$

where:

I_{eng}: Moment of inertia of engine (engine specific) [kgm²];

$\Delta\omega_{acc}^2 = \omega_{sync} - \omega_{idle}$: Delta engine speed (from idle speed ω_{idle} to the target/synchronization speed ω_{sync}) [rad/s].

Formula 19

$$E_{acc,fric} = T_{q_{acc,fric}} \cdot \Delta\gamma_{acc}$$

where:

$T_{q_{acc,fric}}$: Engine friction torque (engine specific) [Nm];

$\Delta\gamma_{acc}$: Delta rotational angle [rad] as determined in accordance with Formula 20.

Formula 20

$$\Delta\gamma_{acceng} = (\omega_{idle} + 0{,}5 \bullet \Delta\omega_{acc}) \bullet \Delta t_{acc}$$

with Δt_{acc} as defined in Formula 21:

Formula 21:

$$\Delta t_{acc} = t_{sync} - t_{idle}$$

Finally, the amount of fuel [l] required to reach the synchronization speed, is calculated as follows:

Formula 22

$$_{acc} = (E_{acc,kin} + E_{acc,fric}) \bullet V_{Pe} \bullet 3{,}6$$

where:

V_{pe}: Consumption of effective power as specified in Table 3 [l/kWh].

5. DETERMINATION OF THE CO_2 EMISSIONS OF THE ECO-INNOVATIVE VEHICLE UNDER MODIFIED TESTING CONDITIONS (E_{MC})

For each coasting event i, the corresponding CO_2 emissions (E_{MC}^i) [g CO_2/km] of the eco-innovative vehicle shall be determined in accordance with Formula 23:

Formula 23

$$E_{MC}^i = E_{idle}^i + E_{synchro}^i$$

where:

E_{idle}^i: CO_2 emissions during the i-th idle phase as set out in point 4.3;

$E_{synchro}^i$: Engine synchronization CO_2 emissions during the i-th coasting event as set out in point 4.4.

The total CO_2 emissions of the eco-innovative vehicle during coasting events under modified testing conditions (E_{MC}) [g CO_2/km] shall be determined in accordance with Formula 24:

Formula 24

$$E_{MC} = \sum_{i=1}^{I} \left(E_{idle}^i + E_{Synchro}^i\right)$$

where

I: Total number of coasting events (for the eco-innovative vehicle) and corresponding driving manoeuvres (for the baseline vehicle);

i: i-th coasting event (for the eco-innovative vehicle) and corresponding driving manoeuvre (for the baseline vehicle).

6. DETERMINATION OF THE CO_2 EMISSIONS OF THE BASELINE VEHICLE UNDER MODIFIED CONDITIONS (B_{MC})

For each coasting corresponding manoeuvre i, as described in Section 3.4, the CO_2 emissions of the baseline vehicle under modified conditions (B_{MC}^i) [g CO_2/km] shall be determined in accordance with Formula 25:

Formula 25

$$B_{MC}^i = B_{const}^i + \overline{B_{Recu}^1}$$

The total CO_2 emissions of the baseline vehicle under modified conditions B_{MC} [g CO_2/km] shall be determined in accordance with Formula 26:

Formula 26

$$B_{MC} = \sum_{i=1}^{I} \overline{B_{MC}^1}$$

where:

$\overline{B_{Recu}^1}$ CO_2 emissions (arithmetic mean) of the baseline vehicle during the i-th overrun phase under modified testing conditions due to the battery balance [g CO_2/km] as defined with Formula 6;

B_{const}^i CO_2 emissions at constant speed k (i.e. 32, 35, 50, 70, 120 km/h) during the i-th constant speed event [g CO_2/km] as defined with Formula 7.

7. CALCULATION OF CO_2 SAVINGS

The CO_2 savings of the engine-on coasting function shall be determined in accordance with Formula 27:

Formula 27

$$C_{CO_2} = (B_{MC} - E_{MC}) \cdot UF_{MC}$$

where

C_{CO_2}: CO_2 savings [g CO_2/km];

B_{MC}: CO_2 emissions of the baseline vehicle during the manoeuvres corresponding with coasting events under modified testing conditions [g CO_2/km];

E_{MC}: CO_2 emissions of the eco-innovative vehicle during coasting events under modified testing conditions [g CO_2/km];

UF_{MC}: Usage factor of the coasting technology under modified conditions, which is 0,52 for vehicles equipped with automatic transmission and 0,48 for vehicles equipped with manual transmission with an automated clutch.

8. CALCULATION OF THE UNCERTAINTY

The uncertainty of the CO_2 savings ($s_{C_{CO_2}}$) shall not exceed 0,5 g CO_2/km.

This uncertainty of the CO_2 savings shall be calculated as follows:

Formula 28

$$s_{C_{CO_2}} = \sqrt{UF_{MC}^2 \cdot \left(s_{B_{MC}} - s_{E_{MC}}\right)^2 + (B_{MC} - E_{MC})^2 \cdot s_{UF}^2}$$

where

$s_{B_{MC}}$: Standard deviation of the arithmetic mean of the CO_2 emissions of the baseline vehicle during the manoeuvres corresponding with coasting events under modified testing conditions [g CO_2/km], determined in accordance with Formula 29;

$s_{E_{MC}}$: Standard deviation of the arithmetic mean of the CO_2 emissions of the eco-innovative vehicle during coasting events under modified testing conditions [g CO_2/km] determined in accordance with Formulas 30 to 34;

s_{UF}: Standard deviation of the arithmetic mean of the usage factor, which is 0,027.

$s_{B_{MC}}$ is determined as follows:

Formula 29

$$s_{B_{MC}} = \sqrt{\sum_{i=1}^{I}\left(t_{drag}^{i} \cdot s_{\overline{P_{Batt1}^{i}}}\right)^2 + \sum_{i=1}^{I}\left(\frac{t_{drag}^{i}}{\eta_{DCDC}} \cdot s_{\overline{P_{Batt2}^{i}}}\right)^2}$$

where:

$$s_{\overline{P_{Batt1}^{i}}} = \frac{\sum_{n\_ov=1}^{N\_ov} P_{Batt1,n\_ov}^{i} - \overline{P_{Batt1}^{i}}}{N\_ov}$$

and

$$s_{\overline{P_{Batt2}^{i}}} = \frac{\sum_{n\_ov=1}^{N\_ov} P_{Batt2,n\_ov}^{i} - \overline{P_{Batt2}^{i}}}{N\_ov}$$

$s_{E_{MC}}$ is determined as follows, depending on the value of f_{idle}:

If $f_{idle} = f_{idle\_meas}$:

Formula 30

$$s_{E_{MC}} = s_{f_{idle\_meas}} \cdot \left(\frac{CF}{fuel\_dens} \cdot \frac{t_{coast}^{i}}{dist_{coast}^{i}}\right)$$

If $f_{idle} = f_{standstill}$:

Formula 31

$$s_{E_{MC}} = \left(\frac{\sum_{l=1}^{L} f_{standstill_l} - \overline{f_{standstill}}}{L}\right) \cdot \left(\frac{CF}{fuel\_dens} \cdot \frac{t_{coast}^{i}}{dist_{coast}^{i}}\right)$$

If $f_{idle} = idle\_corr \bullet f_{standstill}$:

Formula 32

$$s_{E_{MC}} = \sum_{h=1}^{H} s_{idle\_speed_h} \cdot \frac{\overline{f_{standstill}}}{stand_{speed}} \cdot \left(\frac{CF}{fuel\_dens} \cdot \frac{t_{coast}^{i}}{dist_{coast}^{i}}\right) + \frac{1}{(stand_{speed})^2} \cdot s_{stand_{speed}} \cdot \overline{f_{standstill}} \cdot \left(\frac{CF}{fuel\_dens} \cdot \frac{t_{coast}^{i}}{dist_{coast}^{i}}\right) + s_{\overline{f_{standstill}}} \cdot \frac{\overline{idle\_speed}}{\overline{stand\_speed}} \cdot \left(\frac{CF}{fuel\_dens} \cdot \frac{t_{coast}^{i}}{dist_{coast}^{i}}\right)$$

where:

Formula 33

$$s_{idle\_speed_h} = \frac{\sum_{h=1}^{H} idle\_speed_h - \overline{idle\_speed_h}}{H}$$

and:

Formula 34

$$s_{stand\_speed} = \frac{\sum_{l=1}^{L} stand\_speed_l - \overline{stand\_speed}}{L}$$

9. CERTIFICATION OF CO_2 SAVINGS BY THE TYPE APPROVAL AUTHORITY

The type approval authority shall, for each vehicle version fitted with the engine-on coasting function, certify the CO_2 savings in accordance with Article 11 of Implementing Regulation (EU) No 725/2011, by taking the lowest of the CO_2 savings determined respectively for vehicle low and vehicle high of the interpolation family to which the vehicle version belongs.

In determining the CO_2 savings and assessing them against the minimum savings threshold of 1 g CO_2/km, the uncertainty of the CO_2 savings determined in accordance with Section 8 shall be taken into account as set out in Section 10.

The uncertainty of the CO_2 savings shall be calculated for both vehicle low and vehicle high of the interpolation family. In case that in one of those vehicles, the criteria set out in sections 8 or 10 are not fulfilled, the type approval authority shall not certify savings for any of the vehicles belonging in the respective interpolation family.

10. ASSESSMENT AGAINST THE MINIMUM THRESHOLD

Taking into account the uncertainty determined in accordance with section 8, the CO_2 savings shall exceed the minimum threshold of 1 g CO_2/km specified in Article 9(1) of Implementing Regulation (EU) No 725/2011, as follows:

Formula 35

$$C_{CO_2} - s_{C_{CO_2}} \geq MT$$

where

MT: Minimum threshold (1 g CO_2/km);

C_{CO_2}: CO_2 savings [g CO_2/km];

$s_{C_{CO_2}}$: uncertainty of the CO_2 savings [g CO_2/km].

Where the minimum threshold is met in accordance with Formula 35, the second subparagraph of Article 11(2) of Implementing Regulation (EU) No 725/2011 shall apply.

Appendix 1

Cycle for constant speed fuel consumption measurement

Time	Speed	Acceleration *	Gear for manual transmission
[s]	[km/h]	[m/s²]	[-]
0	0,0	0,00	Neutral
1	0,0	0,00	Neutral
2	0,0	0,00	Neutral
3	0,0	0,00	Neutral
4	0,0	0,00	Neutral
5	0,0	0,00	Neutral
6	0,0	0,00	Neutral
7	0,0	0,00	Neutral
8	0,0	0,00	Neutral
9	0,0	0,00	Neutral
10	0,0	0,00	Neutral
11	0,0	0,00	Neutral
12	0,0	0,00	Neutral
13	0,0	0,00	Neutral
14	0,0	0,00	Clutch
15	0,0	0,69	1
16	2,5	0,69	1
17	5,0	0,69	1
18	7,5	0,69	1
19	9,9	0,69	1
20	12,4	0,69	1
21	14,9	0,51	1
22	16,7	0,51	2
23	18,6	0,51	2
24	20,4	0,51	2
25	22,2	0,51	2
26	24,1	0,51	2

Time	Speed	Acceleration *	Gear for manual transmission
27	25,9	0,51	2
28	27,8	0,51	2
29	29,6	0,51	2
30	31,4	0,51	2
31	33,3	0,51	2
32	35,1	0,42	2
33	36,6	0,42	3
34	38,1	0,42	3
35	39,6	0,42	3
36	41,1	0,42	3
37	42,7	0,42	3
38	44,2	0,42	3
39	45,7	0,42	3
40	47,2	0,42	3
41	48,7	0,42	3
42	50,2	0,40	3
43	51,7	0,40	4
44	53,1	0,40	4
45	54,5	0,40	4
46	56,0	0,40	4
47	57,4	0,40	4
48	58,9	0,40	4
49	60,3	0,40	4
50	61,7	0,40	4
51	63,2	0,40	4
52	64,6	0,40	4
53	66,1	0,40	4
54	67,5	0,40	4
55	68,9	0,40	4
56	70,4	0,24	5

Time	Speed	Acceleration *	Gear for manual transmission
57	71,2	0,24	5
58	72,1	0,24	5
59	73,0	0,24	5
60	73,8	0,24	5
61	74,7	0,24	5
62	75,6	0,24	5
63	76,4	0,24	5
64	77,3	0,24	5
65	78,2	0,24	5
66	79,0	0,24	5
67	79,9	0,24	5
68	80,7	0,24	5
69	81,6	0,24	5
70	82,5	0,24	5
71	83,3	0,24	5
72	84,2	0,24	5
73	85,1	0,24	5
74	85,9	0,24	5
75	86,8	0,24	5
76	87,7	0,24	5
77	88,5	0,24	5
78	89,4	0,24	5
79	90,3	0,24	5
80	91,1	0,24	5
81	92,0	0,24	5
82	92,8	0,24	5
83	93,7	0,24	5
84	94,6	0,24	5
85	95,4	0,24	5
86	96,3	0,24	5

Time	Speed	Acceleration *	Gear for manual transmission
87	97,2	0,24	5
88	98,0	0,24	5
89	98,9	0,24	5
90	99,8	0,24	5
91	100,6	0,28	5/6
92	101,6	0,28	5/6
93	102,6	0,28	5/6
94	103,6	0,28	5/6
95	104,7	0,28	5/6
96	105,7	0,28	5/6
97	106,7	0,28	5/6
98	107,7	0,28	5/6
99	108,7	0,28	5/6
100	109,7	0,28	5/6
101	110,7	0,28	5/6
102	111,7	0,28	5/6
103	112,7	0,28	5/6
104	113,7	0,28	5/6
105	114,7	0,28	5/6
106	115,7	0,28	5/6
107	116,7	0,28	5/6
108	117,8	0,28	5/6
109	118,8	0,28	5/6
110	119,8	0,00	5/6
111	120,0	0,00	5/6
112	120,0	0,00	5/6
113	120,0	0,00	5/6
114	120,0	0,00	5/6
115	120,0	0,00	5/6
116	120,0	0,00	5/6

Time	Speed	Acceleration *	Gear for manual transmission
117	120,0	0,00	5/6
118	120,0	0,00	5/6
119	120,0	0,00	5/6
120	120,0	0,00	5/6
121	120,0	0,00	5/6
122	120,0	0,00	5/6
123	120,0	0,00	5/6
124	120,0	0,00	5/6
125	120,0	0,00	5/6
126	120,0	0,00	5/6
127	120,0	0,00	5/6
128	120,0	0,00	5/6
129	120,0	0,00	5/6
130	120,0	0,00	5/6
131	120,0	0,00	5/6
132	120,0	0,00	5/6
133	120,0	0,00	5/6
134	120,0	0,00	5/6
135	120,0	0,00	5/6
136	120,0	0,00	5/6
137	120,0	0,00	5/6
138	120,0	0,00	5/6
139	120,0	0,00	5/6
140	120,0	0,00	5/6
141	120,0	0,00	5/6
142	120,0	0,00	5/6
143	120,0	0,00	5/6
144	120,0	0,00	5/6
145	120,0	0,00	5/6
146	120,0	0,00	5/6

Time	Speed	Acceleration *	Gear for manual transmission
147	120,0	0,00	5/6
148	120,0	0,00	5/6
149	120,0	0,00	5/6
150	120,0	0,00	5/6
151	120,0	0,00	5/6
152	120,0	0,00	5/6
153	120,0	0,00	5/6
154	120,0	0,00	5/6
155	120,0	0,00	5/6
156	120,0	0,00	5/6
157	120,0	0,00	5/6
158	120,0	0,00	5/6
159	120,0	0,00	5/6
160	120,0	0,00	5/6
161	120,0	0,00	5/6
162	120,0	0,00	5/6
163	120,0	0,00	5/6
164	120,0	0,00	5/6
165	120,0	0,00	5/6
166	120,0	0,00	5/6
167	120,0	0,00	5/6
168	120,0	0,00	5/6
169	120,0	0,00	5/6
170	120,0	0,00	5/6
171	120,0	0,00	5/6
172	120,0	0,00	5/6
173	120,0	0,00	5/6
174	120,0	0,00	5/6
175	120,0	0,00	5/6
176	120,0	0,00	5/6

Time	Speed	Acceleration *	Gear for manual transmission
177	120,0	0,00	5/6
178	120,0	0,00	5/6
179	120,0	0,00	5/6
180	120,0	0,00	5/6
181	120,0	0,00	5/6
182	120,0	0,00	5/6
183	120,0	0,00	5/6
184	120,0	0,00	5/6
185	120,0	0,00	5/6
186	120,0	0,00	5/6
187	120,0	0,00	5/6
188	120,0	0,00	5/6
189	120,0	0,00	5/6
190	120,0	0,00	5/6
191	120,0	0,00	5/6
192	120,0	0,00	5/6
193	120,0	0,00	5/6
194	120,0	0,00	5/6
195	120,0	0,00	5/6
196	120,0	0,00	5/6
197	120,0	0,00	5/6
198	120,0	0,00	5/6
199	120,0	0,00	5/6
200	120,0	0,00	5/6
201	120,0	0,00	5/6
202	120,0	– 0,69	5/6
203	117,5	– 0,69	5/6
204	115,0	– 0,69	5/6
205	112,5	– 0,69	5/6
206	110,1	– 0,69	5/6

Time	Speed	Acceleration *	Gear for manual transmission
207	107,6	– 0,69	5/6
208	105,1	– 0,69	5/6
209	102,6	– 0,69	5/6
210	100,1	– 0,69	5/6
211	97,6	– 0,69	5/6
212	95,2	– 0,69	5/6
213	92,7	– 0,69	5/6
214	90,2	– 0,69	5/6
215	87,7	– 0,69	5/6
216	85,2	– 0,69	5/6
217	82,7	– 0,69	5/6
218	80,3	– 1,04	5/6
219	76,5	– 1,04	5/6
220	72,8	– 1,04	5/6
221	69,0	– 1,04	5/6
222	65,3	– 1,04	5/6
223	61,5	– 1,04	5/6
224	57,8	– 1,04	5/6
225	54,0	– 1,04	5/6
226	50,3	– 1,39	Clutch
227	45,3	– 1,39	Clutch
228	40,3	– 1,39	Clutch
229	35,3	– 1,39	Clutch
230	30,3	– 1,39	Clutch
231	25,3	– 1,39	Clutch
232	20,3	0,00	2
233	20,0	0,00	2
234	20,0	0,00	2
235	20,0	0,00	2
236	20,0	0,00	2

Time	Speed	Acceleration *	Gear for manual transmission
237	20,0	0,00	2
238	20,0	0,00	2
239	20,0	0,00	2
240	20,0	0,00	2
241	20,0	0,00	2
242	20,0	0,00	2
243	20,0	0,00	2
244	20,0	0,00	2
245	20,0	0,00	2
246	20,0	0,00	2
247	20,0	0,00	2
248	20,0	0,00	2
249	20,0	0,00	2
250	20,0	0,00	2
251	20,0	0,79	2
252	22,8	0,79	2
253	25,7	0,79	2
254	28,5	0,79	2
255	31,4	0,79	2
256	32,0	0,00	2
257	32,0	0,00	2
258	32,0	0,00	2
259	32,0	0,00	2
260	32,0	0,00	2
261	32,0	0,00	2
262	32,0	0,00	2
263	32,0	0,00	2
264	32,0	0,00	2
265	32,0	0,00	2
266	32,0	0,00	2

Time	Speed	Acceleration *	Gear for manual transmission
267	32,0	0,00	2
268	32,0	0,00	2
269	32,0	0,00	2
270	32,0	0,00	2
271	32,0	0,00	2
272	32,0	0,00	2
273	32,0	0,00	2
274	32,0	0,00	2
275	32,0	0,00	2
276	32,0	0,00	2
277	32,0	0,00	2
278	32,0	0,00	2
279	32,0	0,00	2
280	32,0	0,00	2
281	32,0	0,00	2
282	32,0	0,00	2
283	32,0	0,00	2
284	32,0	0,00	2
285	32,0	0,00	2
286	32,0	0,00	2
287	32,0	0,00	2
288	32,0	0,00	2
289	32,0	0,00	2
290	32,0	0,00	2
291	32,0	0,00	2
292	32,0	0,00	2
293	32,0	0,00	2
294	32,0	0,00	2
295	32,0	0,00	2
296	32,0	0,00	2

Time	Speed	Acceleration *	Gear for manual transmission
297	32,0	0,00	2
298	32,0	0,00	2
299	32,0	0,00	2
300	32,0	0,00	2
301	32,0	0,00	2
302	32,0	0,00	2
303	32,0	0,00	2
304	32,0	0,00	2
305	32,0	0,00	2
306	32,0	0,00	2
307	32,0	0,00	2
308	32,0	0,00	2
309	32,0	0,00	2
310	32,0	0,00	2
311	32,0	0,00	2
312	32,0	0,00	2
313	32,0	0,00	2
314	32,0	0,00	2
315	32,0	0,00	2
316	32,0	0,00	2
317	32,0	0,00	2
318	32,0	0,00	2
319	32,0	0,00	2
320	32,0	0,00	2
321	32,0	0,00	2
322	32,0	0,00	2
323	32,0	0,00	2
324	32,0	0,00	2
325	32,0	0,00	2
326	32,0	0,00	2

Time	Speed	Acceleration *	Gear for manual transmission
327	32,0	0,00	2
328	32,0	0,00	2
329	32,0	0,00	2
330	32,0	0,00	2
331	32,0	0,00	2
332	32,0	0,00	2
333	32,0	0,00	2
334	32,0	0,00	2
335	32,0	0,00	2
336	32,0	0,00	2
337	32,0	0,00	2
338	32,0	0,00	2
339	32,0	0,00	2
340	32,0	0,00	2
341	32,0	0,00	2
342	32,0	0,00	2
343	32,0	0,00	2
344	32,0	0,00	2
345	32,0	0,46	2
346	33,7	0,46	2
347	35,3	0,46	3
348	37,0	0,46	3
349	38,6	0,46	3
350	40,3	0,46	3
351	41,9	0,46	3
352	43,6	0,46	3
353	45,2	0,46	3
354	46,9	0,46	3
355	48,6	0,46	3
356	50,0	0,00	3

Time	Speed	Acceleration *	Gear for manual transmission
357	50,0	0,00	3
358	50,0	0,00	3
359	50,0	0,00	3
360	50,0	0,00	3
361	50,0	0,00	3
362	50,0	0,00	3
363	50,0	0,00	3
364	50,0	0,00	3
365	50,0	0,00	3
366	50,0	0,00	3
367	50,0	0,00	3
368	50,0	0,00	3
369	50,0	0,00	3
370	50,0	0,00	3
371	50,0	0,00	3
372	50,0	0,00	3
373	50,0	0,00	3
374	50,0	0,00	3
375	50,0	0,00	3
376	50,0	0,00	3
377	50,0	0,00	3
378	50,0	0,00	3
379	50,0	0,00	3
380	50,0	0,00	3
381	50,0	0,00	3
382	50,0	0,00	3
383	50,0	0,00	3
384	50,0	0,00	3
385	50,0	0,00	3
386	50,0	0,00	3

Time	Speed	Acceleration *	Gear for manual transmission
387	50,0	0,00	3
388	50,0	0,00	3
389	50,0	0,00	3
390	50,0	0,00	3
391	50,0	0,00	3
392	50,0	0,00	3
393	50,0	0,00	3
394	50,0	0,00	3
395	50,0	0,00	3
396	50,0	0,00	3
397	50,0	0,00	3
398	50,0	0,00	3
399	50,0	0,00	3
400	50,0	0,00	3
401	50,0	0,00	3
402	50,0	0,00	3
403	50,0	0,00	3
404	50,0	0,00	3
405	50,0	0,00	3
406	50,0	0,00	3
407	50,0	0,00	3
408	50,0	0,00	3
409	50,0	0,00	3
410	50,0	0,00	3
411	50,0	0,00	3
412	50,0	0,00	3
413	50,0	0,00	3
414	50,0	0,00	3
415	50,0	0,00	3
416	50,0	0,00	3

Time	Speed	Acceleration *	Gear for manual transmission
417	50,0	0,00	3
418	50,0	0,00	3
419	50,0	0,00	3
420	50,0	0,00	3
421	50,0	0,00	3
422	50,0	0,00	3
423	50,0	0,00	3
424	50,0	0,00	3
425	50,0	0,00	3
426	50,0	0,00	3
427	50,0	0,00	3
428	50,0	0,00	3
429	50,0	0,00	3
430	50,0	0,00	3
431	50,0	0,00	3
432	50,0	0,00	3
433	50,0	0,00	3
434	50,0	0,00	3
435	50,0	0,00	3
436	50,0	0,00	3
437	50,0	0,00	3
438	50,0	0,00	3
439	50,0	0,00	3
440	50,0	0,00	3
441	50,0	0,00	3
442	50,0	0,00	3
443	50,0	0,00	3
444	50,0	0,00	3
445	50,0	– 0,52	3
446	48,1	– 0,52	3

Time	Speed	Acceleration *	Gear for manual transmission
447	46,3	– 0,52	3
448	44,4	– 0,52	3
449	42,5	– 0,52	3
450	40,6	– 0,52	3
451	38,8	– 0,52	3
452	36,9	– 0,52	3
453	35,0	0,00	3
454	35,0	0,00	3
455	35,0	0,00	3
456	35,0	0,00	3
457	35,0	0,00	3
458	35,0	0,00	3
459	35,0	0,00	3
460	35,0	0,00	3
461	35,0	0,00	3
462	35,0	0,00	3
463	35,0	0,00	3
464	35,0	0,00	3
465	35,0	0,00	3
466	35,0	0,00	3
467	35,0	0,00	3
468	35,0	0,00	3
469	35,0	0,00	3
470	35,0	0,00	3
471	35,0	0,00	3
472	35,0	0,00	3
473	35,0	0,00	3
474	35,0	0,00	3
475	35,0	0,00	3
476	35,0	0,00	3

Time	Speed	Acceleration *	Gear for manual transmission
477	35,0	0,00	3
478	35,0	0,00	3
479	35,0	0,00	3
480	35,0	0,00	3
481	35,0	0,00	3
482	35,0	0,00	3
483	35,0	0,00	3
484	35,0	0,00	3
485	35,0	0,00	3
486	35,0	0,00	3
487	35,0	0,00	3
488	35,0	0,00	3
489	35,0	0,00	3
490	35,0	0,00	3
491	35,0	0,00	3
492	35,0	0,00	3
493	35,0	0,00	3
494	35,0	0,00	3
495	35,0	0,00	3
496	35,0	0,00	3
497	35,0	0,00	3
498	35,0	0,00	3
499	35,0	0,00	3
500	35,0	0,00	3
501	35,0	0,00	3
502	35,0	0,00	3
503	35,0	0,00	3
504	35,0	0,00	3
505	35,0	0,00	3
506	35,0	0,00	3

Time	Speed	Acceleration *	Gear for manual transmission
507	35,0	0,00	3
508	35,0	0,00	3
509	35,0	0,00	3
510	35,0	0,00	3
511	35,0	0,00	3
512	35,0	0,00	3
513	35,0	0,00	3
514	35,0	0,00	3
515	35,0	0,00	3
516	35,0	0,00	3
517	35,0	0,00	3
518	35,0	0,00	3
519	35,0	0,00	3
520	35,0	0,00	3
521	35,0	0,00	3
522	35,0	0,00	3
523	35,0	0,00	3
524	35,0	0,00	3
525	35,0	0,00	3
526	35,0	0,00	3
527	35,0	0,00	3
528	35,0	0,00	3
529	35,0	0,00	3
530	35,0	0,00	3
531	35,0	0,00	3
532	35,0	0,00	3
533	35,0	0,00	3
534	35,0	0,00	3
535	35,0	0,00	3
536	35,0	0,00	3

Time	Speed	Acceleration *	Gear for manual transmission
537	35,0	0,00	3
538	35,0	0,00	3
539	35,0	0,00	3
540	35,0	0,00	3
541	35,0	0,00	3
542	35,0	0,42	3
543	36,5	0,42	3
544	38,0	0,42	3
545	39,5	0,42	3
546	41,0	0,42	3
547	42,6	0,42	3
548	44,1	0,42	3
549	45,6	0,42	3
550	47,1	0,42	3
551	48,6	0,42	3
552	50,1	0,40	3
553	51,6	0,40	4
554	53,0	0,40	4
555	54,4	0,40	4
556	55,9	0,40	4
557	57,3	0,40	4
558	58,8	0,40	4
559	60,2	0,40	4
560	61,6	0,40	4
561	63,1	0,40	4
562	64,5	0,40	4
563	66,0	0,40	4
564	67,4	0,40	4
565	68,8	0,40	4
566	70,0	0,00	5

Time	Speed	Acceleration *	Gear for manual transmission
567	70,0	0,00	5
568	70,0	0,00	5
569	70,0	0,00	5
570	70,0	0,00	5
571	70,0	0,00	5
572	70,0	0,00	5
573	70,0	0,00	5
574	70,0	0,00	5
575	70,0	0,00	5
576	70,0	0,00	5
577	70,0	0,00	5
578	70,0	0,00	5
579	70,0	0,00	5
580	70,0	0,00	5
581	70,0	0,00	5
582	70,0	0,00	5
583	70,0	0,00	5
584	70,0	0,00	5
585	70,0	0,00	5
586	70,0	0,00	5
587	70,0	0,00	5
588	70,0	0,00	5
589	70,0	0,00	5
590	70,0	0,00	5
591	70,0	0,00	5
592	70,0	0,00	5
593	70,0	0,00	5
594	70,0	0,00	5
595	70,0	0,00	5
596	70,0	0,00	5

Time	Speed	Acceleration *	Gear for manual transmission
597	70,0	0,00	5
598	70,0	0,00	5
599	70,0	0,00	5
600	70,0	0,00	5
601	70,0	0,00	5
602	70,0	0,00	5
603	70,0	0,00	5
604	70,0	0,00	5
605	70,0	0,00	5
606	70,0	0,00	5
607	70,0	0,00	5
608	70,0	0,00	5
609	70,0	0,00	5
610	70,0	0,00	5
611	70,0	0,00	5
612	70,0	0,00	5
613	70,0	0,00	5
614	70,0	0,00	5
615	70,0	0,00	5
616	70,0	0,00	5
617	70,0	0,00	5
618	70,0	0,00	5
619	70,0	0,00	5
620	70,0	0,00	5
621	70,0	0,00	5
622	70,0	0,00	5
623	70,0	0,00	5
624	70,0	0,00	5
625	70,0	0,00	5
626	70,0	0,00	5

Time	Speed	Acceleration *	Gear for manual transmission
627	70,0	0,00	5
628	70,0	0,00	5
629	70,0	0,00	5
630	70,0	0,00	5
631	70,0	0,00	5
632	70,0	0,00	5
633	70,0	0,00	5
634	70,0	0,00	5
635	70,0	0,00	5
636	70,0	0,00	5
637	70,0	0,00	5
638	70,0	0,00	5
639	70,0	0,00	5
640	70,0	0,00	5
641	70,0	0,00	5
642	70,0	0,00	5
643	70,0	0,00	5
644	70,0	0,00	5
645	70,0	0,00	5
646	70,0	0,00	5
647	70,0	0,00	5
648	70,0	0,00	5
649	70,0	0,00	5
650	70,0	0,00	5
651	70,0	0,00	5
652	70,0	0,00	5
653	70,0	0,00	5
654	70,0	0,00	5
655	70,0	– 1,04	5
656	66,3	– 1,04	5

Time	Speed	Acceleration *	Gear for manual transmission
657	62,5	– 1,04	5
658	58,8	– 1,04	5
659	55,0	– 1,04	5
660	51,3	– 1,04	5
661	47,5	– 1,04	Clutch
662	43,8	– 1,39	Clutch
663	38,8	– 1,39	Clutch
664	33,8	– 1,39	Clutch
665	28,8	– 1,39	Clutch
666	23,8	– 1,39	Clutch
667	18,8	– 1,39	Clutch
668	13,8	– 1,39	Clutch
669	8,8	– 1,39	Clutch
670	3,8	– 1,05	Clutch
671	0,0	0,00	Clutch
672	0,0	0,00	Neutral
673	0,0	0,00	Neutral
674	0,0	0,00	Neutral
675	0,0	0,00	Neutral
676	0,0	0,00	Neutral
677	0,0	0,00	Neutral
678	0,0	0,00	Neutral
679	0,0	0,00	Neutral
680	0,0	0,00	Neutral