

**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****(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<sub>2</sub> emission standards for new passenger cars and for new light commercial vehicles, and repealing Regulations (EC) No 443/2009 and (EU) No 510/2011 <sup>(1)</sup>, and in particular Article 11(4) thereof,

Whereas:

- (1) On 20 September 2019, the manufacturers Bayerische Motoren Werke AG, Daimler AG, FCA Italy S.p.A, Honda Motor Europe Ltd, Hyundai Motor Europe Technical Center GmbH, Jaguar Land Rover LTD, Automobile Citroen, Automobile Peugeot, PSA Automobiles SA, Renault, SEG Automotive Germany GmbH, Volkswagen AG, Volkswagen AG Nutzfahrzeuge and the supplier Valeo Electrification Systems jointly made a request as provided for by Article 12a of Commission Implementing Regulation (EU) No 725/2011 <sup>(2)</sup> to amend Commission Implementing Decision (EU) 2017/785 <sup>(3)</sup> in order to extend the approval of the innovative technology to its use in certain not-off-vehicle charging hybrid electric vehicles (NOVC-HEVs) of category M<sub>1</sub> and passenger cars capable of running on certain alternative fuels.
- (2) On 1 October 2019, the manufacturers Daimler AG, FCA Italy S.p.A, Hyundai Motor Europe Technical Center GmbH, Jaguar Land Rover LTD, Mitsubishi Electric Corporation, Opel Automobile GmbH-PSA, Automobile Citroen, Automobile Peugeot, PSA Automobiles SA, Renault, SEG Automotive Germany GmbH, Volkswagen AG, Volkswagen AG Nutzfahrzeuge and the supplier Valeo Electrification Systems submitted a joint application for the approval, in accordance with Article 11 of Regulation (EU) 2019/631, as an innovative technology, of the efficient generator function in 12 volt motor-generators for use in certain light commercial vehicles, including certain NOVC-HEVs and light commercial vehicles capable of running on certain alternative fuels.
- (3) A 12 volt motor-generator may operate as either an electric motor converting electrical energy into mechanical energy, or a generator converting mechanical energy into electrical energy, i.e. similarly as an alternator. The technology subject to the amendment request and the application is defined as an efficient generator function of the 12 volt motor-generator.
- (4) Considering that the amendment request and the approval application refer to the same innovative technology and that the same conditions apply for its use in the vehicle categories concerned, it is appropriate to address both the amendment request and the approval application in one single decision.
- (5) The amendment request and the approval application have been assessed in accordance with Article 11 of Regulation (EU) 2019/631, Implementing Regulation (EU) No 725/2011 and Commission Implementing Regulation (EU) No 427/2014 <sup>(4)</sup> as well as the Technical Guidelines for the preparation of applications for the

<sup>(1)</sup> OJ L 111, 25.4.2019, p. 13.

<sup>(2)</sup> 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<sub>2</sub> 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).

<sup>(3)</sup> 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 innovative technology for reducing CO<sub>2</sub> 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).

<sup>(4)</sup> Commission Implementing Regulation (EU) No 427/2014 of 25 April 2014 establishing a procedure for the approval and certification of innovative technologies for reducing CO<sub>2</sub> emissions from light commercial vehicles pursuant to Regulation (EU) No 510/2011 of the European Parliament and of the Council (OJ L 125, 26.4.2014, p. 57).

approval of innovative technologies pursuant to Regulation (EC) No 443/2009 of the European Parliament and of the Council <sup>(5)</sup> (July 2018 version) <sup>(6)</sup>. Both the request and the application fulfilled the formal requirements; in accordance with Article 11(3) of Regulation (EU) 2019/631, they were notably accompanied by a verification report undertaken by an independent and certified body.

- (6) The efficient generator function of a 12 volt motor-generator has already been approved for use in conventional combustion engine powered passenger cars by Implementing Decision (EU) 2017/785 as an innovative technology capable of reducing CO<sub>2</sub> emissions in a way that is only partially covered by the measurements performed as part of the emission test under the New European Driving Cycle set out in Commission Regulation (EC) No 692/2008 <sup>(7)</sup>. The assessment shows that the approved eco-innovation is capable of reducing CO<sub>2</sub> emissions under the same conditions also for other vehicle categories.
- (7) More precisely, the applicants have demonstrated that the efficient generator function of a 12 volt motor-generator is capable of reducing CO<sub>2</sub> emissions in conventional combustion engine powered light commercial vehicles in the same way as for passenger cars with the same kind of powertrain.
- (8) With regard to NOVC-HEVs of categories M<sub>1</sub> and N<sub>1</sub> for which uncorrected measured fuel consumption and CO<sub>2</sub> emission values may be used in accordance with point 5.3.2 of Annex 8 to Regulation UN/ECE No 101 <sup>(8)</sup>, it is appropriate to consider them equivalent for the purpose of this Decision to conventional combustion engine-powered M<sub>1</sub> and N<sub>1</sub> vehicles.
- (9) The applicants have demonstrated that the testing methodology set out in Implementing Decision (EU) 2017/785 for testing CO<sub>2</sub> savings from the use of the efficient generator function in 12 volt motor-generators in conventional combustion engine powered passenger cars is appropriate for determining such savings from the use of the technology in light commercial vehicles as well as for certain M<sub>1</sub> and N<sub>1</sub> NOVC-HEVs.
- (10) The applicants have requested that, due to the increasing share of passenger cars and light commercial vehicles capable of running on liquefied petroleum gas (LPG), compressed natural gas (CNG) or E85, the scope of this Decision should include also such vehicles, and that consequently some factors in the testing methodology should be adjusted accordingly.
- (11) Considering the limited availability of E85 on the Union market as a whole, it is, however, not appropriate to distinguish this fuel from petrol for the purpose of the testing methodology.
- (12) With regard to the addition to the testing methodology of a run-in procedure for the motor-generator, the application does not set out with sufficient precision the details for how such run-ins should be performed nor how the run-in effect should be taken into account. Moreover, it is already integral to the testing methodology set out in Implementing Decision (EU) 2017/785 that such effects may be taken into account, where necessary, by the requirement that the efficiency of the generator function of the motor-generator must be measured at least five times. As the efficiency of the generator function of the motor-generator is determined on the basis of the average of the measurement results, any run-in effects, positive or negative, may therefore be adequately taken into account in the final efficiency determination, where necessary by increasing the number of measurements. Against that background, it is not appropriate to complement the testing methodology with an additional specific run-in procedure such as that proposed in the applications
- (13) Taking into account the above considerations, the testing methodology provided for in Implementing Decision (EU) 2017/785, with the addition of some fuel-specific factors, should also be considered appropriate for determining the CO<sub>2</sub> savings from the innovative technology fitted in N<sub>1</sub> vehicles powered by internal combustion engines, NOVC-HEV M<sub>1</sub> and N<sub>1</sub> vehicles as well as M<sub>1</sub> and N<sub>1</sub> vehicles capable of running on certain alternative fuels.

<sup>(5)</sup> Regulation (EC) No 443/2009 of the European Parliament and of the Council of 23 April 2009 setting emission performance standards for new passenger cars as part of the Community's integrated approach to reduce CO<sub>2</sub> emissions from light-duty vehicles (OJ L 140, 5.6.2009, p. 1).

<sup>(6)</sup> <https://circabc.europa.eu/w/browse/f3927eae-29f8-4950-b3b3-d2e700598b52>

<sup>(7)</sup> 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).

<sup>(8)</sup> 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<sub>1</sub> and N<sub>1</sub> 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).

- (14) Manufacturers should have the possibility to apply to a type-approval authority for the certification of CO<sub>2</sub> 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 set out in this Decision.
- (15) In order to facilitate a wider deployment of the innovative technology in new vehicles, a manufacturer should also have the possibility to submit a single application for the certification of the CO<sub>2</sub> savings from the efficient generator functions used in several 12 volt motor generators. It is, however, appropriate to ensure that, where that possibility is used, a mechanism is applied that incentivises the deployment of only those motor generators that offer the highest efficiency.
- (16) It is the responsibility of the type-approval authority to verify thoroughly that the conditions for certifying the CO<sub>2</sub> 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.
- (17) For the purpose of determining the general eco-innovation code to be used in the relevant type-approval documents in accordance with Annexes I, VIII and IX to Directive 2007/46/EC of the European Parliament and of the Council <sup>(9)</sup>, it is necessary to attribute an individual code to the innovative technology.
- (18) From 2021, manufacturers' compliance with their specific CO<sub>2</sub> emission targets is to be established on the basis of the CO<sub>2</sub> emissions determined in accordance with the Worldwide Harmonised Light Vehicle Test Procedure (WLTP) set out in Commission Regulation (EU) 2017/1151 <sup>(10)</sup>. CO<sub>2</sub> savings from the innovative technology certified by reference to this Decision may therefore be taken into account for the calculation of manufacturers' average specific CO<sub>2</sub> emissions only for the calendar year 2020,

HAS ADOPTED THIS DECISION:

#### Article 1

### Innovative technology

The efficient generator function used in a 12 volt motor-generator, as referred to in Implementing Decision (EU) 2017/785, is approved as an innovative technology within the meaning of Article 11 of Regulation (EU) 2019/631, taking into account that it is only partially covered by the standard test procedure set out in Regulation (EC) No 692/2008, and provided that the following conditions are met:

- (a) the innovative technology is fitted in light commercial vehicles (N<sub>1</sub>) powered by internal combustion engines running on petrol, diesel, liquefied petroleum gas (LPG), compressed natural gas (CNG) or E-85, or in not-off-vehicle charging hybrid electric vehicles (NOVC-HEVs) of the category M<sub>1</sub> or N<sub>1</sub> that comply with point (3) of paragraph 5.3.2 of Annex 8 to Regulation No 101 of the Economic Commission for Europe of the United Nations;
- (b) the efficiency of the generator function, determined in accordance with the methodology set out in the Annex, is at least:
  - (i) 73,8 % for petrol- or E85-fuelled vehicles, other than turbo-charged;
  - (ii) 73,4 % for turbo-charged petrol- or E85-fuelled vehicles;
  - (iii) 74,2 % for diesel-fuelled vehicles;

<sup>(9)</sup> Directive 2007/46/EC of the European Parliament and 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 (Framework Directive) (OJ L 263, 9.10.2007, p. 1).

<sup>(10)</sup> 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).

- (iv) 74,6 % for LPG-fuelled vehicles other than turbo-charged;
- (v) 74,1 % for turbo-charged LPG-fuelled vehicles;
- (vi) 76,3 % for CNG-fuelled vehicles other than turbo-charged;
- (vii) 75,7 % for turbo-charged CNG-fuelled vehicles.

#### Article 2

##### **Baseline technology**

The baseline technology shall be an alternator with a mass of maximum 7 kg and an efficiency of 67 %.

#### Article 3

##### **Application for certification of CO<sub>2</sub> savings**

1. A manufacturer may apply to a type-approval authority for certification of the CO<sub>2</sub> savings from the use of the technology approved in accordance with Article 1 ('the innovative technology') in one or several 12 volt motor-generators 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 conditions set out in Article 1 have been met.
3. Where savings have been certified in accordance with Article 3, the manufacturer shall ensure that the certified CO<sub>2</sub> savings and the eco-innovation code referred to in Article 5(1) are recorded in the certificate of conformity of the vehicles concerned.

#### Article 4

##### **Certification of CO<sub>2</sub> savings**

1. The type-approval authority shall ensure that CO<sub>2</sub> savings achieved from the use of the innovative technology have been determined using the methodology set out in the Annex.
2. Where a manufacturer applies for the certification of the CO<sub>2</sub> savings from the use of the innovative technology in more than one 12 volt motor-generator in relation to one vehicle version, the type-approval authority shall determine which of the 12 volt motor-generators tested delivers the lowest CO<sub>2</sub> savings. That value shall be used for the purpose of paragraph 4.
3. Where the innovative technology is fitted in a bi-fuel or flex-fuel vehicle, the approval authority shall record the CO<sub>2</sub> savings as follows:
  - (a) for bi-fuel vehicles using petrol and gaseous fuels, the CO<sub>2</sub> savings value with regard to LPG or CNG fuels;
  - (b) for flex-fuel vehicles using petrol and E85, the CO<sub>2</sub> savings value with regard to petrol.
4. The type approval authority shall record the certified CO<sub>2</sub> savings determined in accordance with paragraph 1 and 2, and the eco-innovation code referred to in Article 5(1) in the relevant type-approval documentation.
5. 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 3(2), and shall make that information available to the Commission on request.
6. The type-approval authority shall only certify CO<sub>2</sub> savings, if it finds that the innovative technology complies with the conditions set out in Article 1, and if the CO<sub>2</sub> savings achieved are 1 g CO<sub>2</sub>/km or higher, as specified in Article 9(1)(a) of Implementing Regulation (EU) No 725/2011 in the case of passenger cars, or as specified in Article 9(1)(a) of Implementing Regulation (EU) No 427/2014 in the case of light commercial vehicles.

*Article 5***Eco-innovation code**

1. The innovative technology approved by this Decision is attributed with the eco-innovation code 30.
2. The certified CO<sub>2</sub> savings recorded by reference to that eco-innovation code may only be taken into account for the calculation of the average specific emissions of manufacturers for the calendar year 2020.

*Article 6***Entry into force**

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

Done at Brussels, 29 May 2020.

*For the Commission*  
*The President*  
Ursula VON DER LEYEN

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## ANNEX

**METHODOLOGY TO DETERMINE THE CO<sub>2</sub> SAVINGS OF THE EFFICIENT GENERATOR FUNCTION  
IN 12 VOLT MOTOR-GENERATORS FOR USE IN CERTAIN PASSENGER CARS AND LIGHT COMMERCIAL  
VEHICLES**

## 1. INTRODUCTION

In order to determine the CO<sub>2</sub> emission savings that can be attributed to the efficient generator function of a 12 volt motor-generator, hereinafter ‘the innovative technology’, for use in certain passenger cars (M<sub>1</sub>) and light commercial vehicles (N<sub>1</sub>) meeting the conditions set out in Article 1, it is necessary to establish the following:

- (1) the testing conditions;
- (2) the test equipment;
- (3) the determination of the peak power output;
- (4) the calculation of the CO<sub>2</sub> savings;
- (5) the calculation of the statistical margin of the CO<sub>2</sub> savings.

## 2. SYMBOLS, PARAMETERS AND UNITS

*Symbols*

$C_{CO_2}$	—	CO <sub>2</sub> savings [g CO <sub>2</sub> /km]
CO <sub>2</sub>	—	Carbon dioxide
CF	—	Conversion factor as defined in Table 3
H	—	Frequency as defined in Table 1
I	—	Current intensity at which the measurement shall be carried out [A]
M	—	Number of measurements of the sample
M	—	Torque [Nm]
N	—	Rotational frequency [min <sup>-1</sup> ] as defined in Table 1
P	—	Power [W]
$s_{\eta_{MG}}$	—	Standard deviation of the efficiency of the generator function of the 12 V motor-generator (hereinafter ‘the motor-generator efficiency’) [%]
$s_{\overline{\eta_{MG}}}$	—	Standard deviation of the motor-generator efficiency mean [%]
$s_{C_{CO_2}}$	—	Standard deviation of the total CO <sub>2</sub> savings [g CO <sub>2</sub> /km]
U	—	Test voltage at which the measurement shall be carried out [V]
v	—	Mean driving speed of the New European Driving Cycle (NEDC) [km/h]
$V_{pe}$	—	Consumption of effective power as defined in Table 2
$\frac{\partial C_{CO_2}}{\partial \eta_{MG}}$	—	Sensitivity of calculated CO <sub>2</sub> savings related to the motor-generator efficiency
$\Delta$	—	Difference
$\eta_B$	—	Baseline alternator efficiency [%]
$\eta_{MG}$	—	Motor-generator efficiency [%]
$\overline{\eta_{MG_i}}$	—	Mean of the motor-generator efficiency at operating point i [%]

*Subscripts*

Index (i) refers to operating point

Index (j) refers to measurement of the sample

MG	—	Motor-generator
M	—	Mechanical
RW	—	Real-world conditions
TA	—	Type approval conditions
B	—	Baseline

## 3. DETERMINATION OF THE EFFICIENCY

The motor-generator efficiency shall be determined in accordance with ISO 8854:2012, with the exception of the elements specified in this point.

Evidence shall be provided to the type-approval authority that the speed ranges of the 12 volt motor-generator are consistent with those set out in Table 1. The measurements shall be conducted at different operating points, as set out in Table 1. The current intensity of the motor-generator shall be defined as half of the rated current for all operating points. For each speed the voltage and the output current of the motor-generator shall be kept constant at 14,3 volt.

Table 1

Operating point i	Holding time [s]	Rotational frequency $n_i$ [ $\text{min}^{-1}$ ]	Frequency $h_i$
1	1 200	1 800	0,25
2	1 200	3 000	0,40
3	600	6 000	0,25
4	300	10 000	0,10

The efficiency at each operating point shall be calculated in accordance with the following Formula 1.

*Formula 1*

$$\eta_{MG_i} = \frac{60 \cdot U_i \cdot I_i}{2\pi \cdot M_i \cdot n_i} \cdot 100$$

All efficiency measurements are to be performed consecutively at least five (5) times. The average of the measurements at each operation point ( $\overline{\eta_{MG_i}}$ ) shall be calculated.

The motor-generator efficiency ( $\eta_{MG}$ ) shall be calculated in accordance with the following Formula 2.

*Formula 2*

$$\eta_{MG} = \sum_{i=1}^4 h_i \cdot \overline{\eta_{MG_i}}$$

The motor-generator leads to saved mechanical power under real-world conditions ( $\Delta P_{mRW}$ ) and under type-approval conditions ( $\Delta P_{mTA}$ ). The difference between these two values ( $\Delta P_m$ ) is calculated as set out in Formula 3.

Formula 3

$$\Delta P_m = \Delta P_{mRW} - \Delta P_{mTA}$$

Where  $\Delta P_{mRW}$  shall be calculated in accordance with Formula 4 and  $\Delta P_{mTA}$  in accordance with Formula 5.

Formula 4

$$\Delta P_{mRW} = \frac{P_{RW}}{\eta_B} - \frac{P_{RW}}{\eta_{MG}}$$

Formula 5

$$\Delta P_{mTA} = \frac{P_{TA}}{\eta_B} - \frac{P_{TA}}{\eta_{MG}}$$

Where

$P_{RW}$ : Power requirement under 'real-world' conditions [W], which is 750 W

$P_{TA}$ : Power requirement under type-approval conditions [W], which is 350 W

$\eta_B$ : Efficiency of the baseline alternator [%], which is 67 %

#### 4. CALCULATION OF THE CO<sub>2</sub> SAVINGS

The CO<sub>2</sub> savings of the generator function in a 12 volt motor-generator shall be calculated in accordance with Formula 6.

Formula 6

$$C_{CO_2} = \Delta P_m \cdot \frac{V_{pe} \cdot CF}{v}$$

Where,

$v$ : Mean driving speed of the NEDC (km/h), which is 33,58 km/h

$V_{pe}$ : Consumption of effective power specified in Table 2

$CF$ : Conversion factor as defined in Table 3

Table 2

#### Consumption of effective power

Type of engine	Consumption of effective power ( $V_{pe}$ ) [l/kWh]
Petrol/E85	0,264
Petrol/E85 Turbo	0,280
Diesel	0,220
LPG	0,342
LPG Turbo	0,363
	Consumption of effective power ( $V_{pe}$ ) [m <sup>3</sup> /kWh]
CNG (G20)	0,259
CNG (G20) Turbo	0,275



Table 3

**Fuel conversion factor**

Type of fuel	Conversion factor (CF) [g CO <sub>2</sub> /l]
Petrol/E85	2 330
Diesel	2 640
LPG	1 629
	Conversion factor (CF) [g CO <sub>2</sub> /m <sup>3</sup> ]
CNG (G20)	1 795

## 5. CALCULATION OF THE STATISTICAL ERROR

The statistical errors in the results of the testing methodology caused by the measurements shall be quantified. For each operating point the standard deviation shall be calculated in accordance with Formula 7.

Formula 7

$$s_{\bar{\eta}_{MGi}} = \frac{s_{\eta_{MGi}}}{\sqrt{m}} = \sqrt{\frac{\sum_{j=1}^m (\eta_{MGij} - \bar{\eta}_{MGi})^2}{m(m-1)}}$$

The standard deviation of the value of the 12 volt motor-generator efficiency ( $s_{\eta_{MG}}$ ) shall be calculated in accordance with Formula 8.

Formula 8

$$s_{\eta_{MG}} = \sqrt{\sum_{i=1}^4 (h_i \cdot s_{\eta_{MGi}})^2}$$

The standard deviation of the motor-generator efficiency ( $s_{\eta_{MG}}$ ) leads to an error in the CO<sub>2</sub> savings ( $s_{C_{CO_2}}$ ). That error is calculated in accordance with Formula 9.

Formula 9

$$s_{C_{CO_2}} = \sqrt{\left(\frac{\partial C_{CO_2}}{\partial \eta_{MG}} \cdot s_{\eta_{MG}}\right)^2} = \frac{(P_{RW} - P_{TA})}{\eta_{MG}^2} \cdot \frac{V_{Pe} \cdot CF}{v} \cdot s_{\eta_{MG}}$$

## 6. STATISTICAL SIGNIFICANCE

It has to be demonstrated for each type, variant and version of a vehicle fitted with the innovative technology that the error in CO<sub>2</sub> savings calculated in accordance with Formula 9 is not greater than the difference between the total CO<sub>2</sub> savings and the minimum savings threshold specified in Article 9(1)(a) of Implementing Regulations (EU) No 725/2011 and (EU) No 427/2014 (see Formula 10).

Formula 10

$$MT < C_{CO_2} - s_{C_{CO_2}} - \Delta CO_{2m}$$

Where,

MT: minimum threshold [g CO<sub>2</sub>/km]

C<sub>CO<sub>2</sub></sub>: total CO<sub>2</sub> saving [g CO<sub>2</sub>/km]

S<sub>C<sub>CO<sub>2</sub></sub></sub>: standard deviation of the total CO<sub>2</sub> saving [g CO<sub>2</sub>/km]

ΔCO<sub>2m</sub>: CO<sub>2</sub> correction coefficient due to the positive mass difference (Δm) between the motor-generator and the baseline alternator, calculated in accordance with Table 4

Table 4

**CO<sub>2</sub> correction coefficient due to the extra mass**

Type of fuel	CO <sub>2</sub> correction coefficient (ΔCO <sub>2m</sub> )
Petrol/E85	0,0277 · Δm
Diesel	0,0383 · Δm
LPG	0,0251 · Δm
CNG	0,0209 · Δm

In this Table, Δm is the extra mass due to the installation of the efficient 12 volt motor-generator. The extra mass is the positive difference between the mass of the efficient 12 volt motor-generator and the mass of the baseline alternator. The mass of the baseline alternator is 7 kg. The extra mass is to be verified and confirmed in the verification report to be submitted to the type-approval authority together with the application for certification.

7. THE 12 VOLT MOTOR-GENERATOR WITH AN EFFICIENT GENERATOR FUNCTION TO BE FITTED IN PASSENGER CARS AND LIGHT COMMERCIAL VEHICLES

The type-approval authority is to certify the CO<sub>2</sub> savings based on the measurements of the 12 volt motor-generator and the baseline alternator using the testing methodology set out in this Annex. Where the CO<sub>2</sub> emission savings are below the threshold specified in Article 9(1)(a) of Implementing Regulations (EU) No 725/2011 or (EU) No 427/2014, the second subparagraph of Article 11(2) of those Regulations shall apply.