

**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<sub>2</sub> emissions from passenger cars pursuant to Regulation (EC) No 443/2009 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 (EC) No 443/2009 of the European Parliament and of the Council of 23 April 2009 setting emissions 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 <sup>(1)</sup>, and in particular Article 12(4) thereof,Having regard to 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 <sup>(2)</sup>, and in particular Article 10(2) thereof,

Whereas:

- (1) The application submitted by the supplier Valeo Electrical Systems on 21 July 2016 for the approval of the efficient generator function of the 12 V i-StARS belt-driven starter-alternator as an eco-innovation has been assessed in accordance with Article 12 of Regulation (EC) No 443/2009, Implementing Regulation (EU) No 725/2011 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 <sup>(3)</sup>.
- (2) The information provided in the application demonstrates that the conditions and the criteria referred to in Article 12 of Regulation (EC) No 443/2009 and in Articles 2 and 4 of Implementing Regulation (EU) No 725/2011 have been met. Moreover, the application is supported by a verification report established by an independent and certified body in accordance with Article 7 of that Regulation. As a consequence, the efficient generator function of the 12 V i-StARS belt-driven starter-alternator proposed by the applicant should be approved as an eco-innovation.
- (3) Based on the information provided with the current application and with Commission Implementing Decision (EU) 2016/265 <sup>(4)</sup>, taking into account the experience gained from the assessment of applications concerning technologies that contribute to improving the efficiency of alternators in the framework of Commission Implementing Decisions 2013/341/EU <sup>(5)</sup>, 2014/465/EU <sup>(6)</sup>, (EU) 2015/158 <sup>(7)</sup>, (EU) 2015/295 <sup>(8)</sup>, (EU) 2015/2280 <sup>(9)</sup>, and (EU) 2016/588 <sup>(10)</sup>, it has been satisfactorily and conclusively demonstrated that a 12 V motor-generator that has a maximum mass of 7 kg and a minimum efficiency of the generator function meets the criteria referred to in Article 12(2) of Regulation (EC) No 443/2009 and provides a reduction in CO<sub>2</sub> emissions of at least 1 g CO<sub>2</sub>/km in accordance with Article 9 of Implementing Regulation (EU) No 725/2011. For a 12 V motor generator that has a mass exceeding 7 kg, it is necessary to apply a mass correction coefficient when calculating if the 1 g CO<sub>2</sub>/km reduction threshold is met.
- (4) It is therefore appropriate to generally acknowledge and, in accordance with Article 12(4) of Regulation (EC) No 443/2009, attest the capacity of this innovative technology to reduce CO<sub>2</sub> emissions and provide a generic testing methodology for the certification of the CO<sub>2</sub> savings from the use of the generator function of efficient 12 V motor-generators.

- (5) The manufacturer should, in order to have the CO<sub>2</sub> savings from efficient 12 V motor-generators certified, provide a verification report from an independent and certified body confirming the compliance of the motor-generator with the conditions specified in this Decision together with the application for certification to the type approval authority.
- (6) If the type approval authority finds that the motor-generator presented by the manufacturer does not satisfy the conditions for certification as specified in this Decision, the application for certification of the savings should be rejected.
- (7) It is appropriate to determine the reduction in CO<sub>2</sub> emissions from efficient 12 V motor-generators using the testing methodology set out in the Annex.
- (8) In order to determine the CO<sub>2</sub> savings it is necessary to define the baseline technology against which the efficiency of the efficient 12 V motor-generator should be compared as provided for in Articles 5 and 8 of Implementing Regulation (EU) No 725/2011. On the basis of the experience gained, it is appropriate to consider a 12 V alternator with 67 % efficiency as the baseline technology.
- (9) The savings from the efficient 12 V motor-generator may be partially demonstrated in the test referred to in Annex XII to Commission Regulation (EC) No 692/2008 <sup>(11)</sup>. The final total savings for the purpose of the certification of a vehicle fitted with the innovative technology in accordance with Article 11 of Implementing Regulation (EU) No 725/2011 should therefore be determined in accordance with the second subparagraph of Article 8(2) of that Implementing Regulation.
- (10) In order to facilitate a wider deployment of efficient 12 V motor-generators in new vehicles, a manufacturer should also have the possibility to apply for the certification of the CO<sub>2</sub> savings from several different 12 V motor-generators by a single certification application. It is however appropriate to ensure that where this possibility is used a mechanism is applied that incentivises the deployment of only those 12 V motor-generators that offer the highest efficiency.
- (11) For the purposes 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>(12)</sup>, the individual code to be used for the innovative technology should be specified,

HAS ADOPTED THIS DECISION:

#### *Article 1*

#### **Approval**

The efficient generator function of the 12 V motor-generator, i.e. of the i-STARS belt-driven starter-alternator, as described in the application by Valeo Electrical Systems, is approved as an innovative technology within the meaning of Article 12 of Regulation (EC) No 443/2009.

#### *Article 2*

#### **Definitions**

For the purpose of this Decision efficient 12 V motor-generator means the efficient generator function of a 12 V motor-generator.

*Article 3***Application for certification of CO<sub>2</sub> savings**

1. The manufacturer may apply for certification of the CO<sub>2</sub> savings from one or several efficient 12 V motor-generators intended for use in conventional combustion-engine-powered M1 vehicles, provided that each motor-generator complies with the following conditions:

- (a) where the mass of the efficient 12 V motor-generator does not exceed the mass of the baseline alternator of 7 kg and the efficiency of the generator function, determined in accordance with the Annex, is at least:
  - (i) 73,8 % for petrol-fuelled vehicles;
  - (ii) 73,4 % for petrol turbo-fuelled vehicles;
  - (iii) 74,2 % for diesel-fuelled vehicles;

or,

- (b) where the mass of the 12 V motor generator exceeds the mass of the baseline alternator as specified in point (a), the extra mass is taken into account in accordance with Formula 10 set out in the Annex and meets the minimum reduction threshold of 1 g CO<sub>2</sub>/km, specified in Article 9(1) of Implementing Regulation (EU) No 725/2011.

The extra mass shall be verified and confirmed in the verification report to be submitted to the type approval authority together with the application for certifications.

2. An application for the certification of the savings from one or several efficient 12 V motor generators shall be accompanied by a verification report from an independent and certified body certifying that the efficient 12 V motor-generator(s) comply with the conditions set out in paragraph 1, and verifying and confirming the mass of the 12 V motor-generators.

3. The type approval authority shall reject the application for certification if it finds that the efficient 12 V motor-generator(s) do not comply with the conditions set out in paragraph 1.

*Article 4***Certification of CO<sub>2</sub> savings**

1. The reduction in CO<sub>2</sub> emissions from the use of the efficient 12 V motor-generators referred to in Article 2(1) shall be 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 more than one efficient 12 V motor-generator in relation to one vehicle version, the type approval authority shall determine which of the motor-generators tested delivers the lowest CO<sub>2</sub> savings, and record the lowest value in the relevant type approval documentation. That value shall be indicated in the certificate of conformity in accordance with Article 11(2) of Implementing Regulation (EU) No 725/2011.

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

The eco-innovation code No 22 shall be entered into the type approval documentation where reference is made to this Decision in accordance with Article 11(1) of Implementing Regulation (EU) No 725/2011.

## 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, 5 May 2017.

For the Commission  
Miguel ARIAS CAÑETE  
Member of the Commission

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<sup>(1)</sup> OJ L 140, 5.6.2009, p. 1.

<sup>(2)</sup> OJ L 194, 26.7.2011, p. 19.

<sup>(3)</sup> <https://circabc.europa.eu/w/browse/f3927eae-29f8-4950-b3b3-d2e700598b52>

<sup>(4)</sup> 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<sub>2</sub> 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).

<sup>(5)</sup> 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<sub>2</sub> 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).

<sup>(6)</sup> 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<sub>2</sub> 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).

<sup>(7)</sup> 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<sub>2</sub> 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) ((EU) 2015/158 covers two applications).

<sup>(8)</sup> 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<sub>2</sub> 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).

<sup>(9)</sup> Save item 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<sub>2</sub> 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).

<sup>(10)</sup> Save item 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<sub>2</sub> 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).

<sup>(11)</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>(12)</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).

## ANNEX

**METHODOLOGY TO DETERMINE THE CO<sub>2</sub> SAVINGS OF EFFICIENT 12 V MOTOR-GENERATORS FOR  
CONVENTIONAL COMBUSTION ENGINE POWERED M1 VEHICLES**

**1. Introduction**

In order to determine the CO<sub>2</sub> emission reductions that can be attributed to the generator function of a 12 V motor generator, hereinafter referred to as an efficient 12 V motor generator or motor generator, for use in an M1 vehicle powered by a combustion engine, 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**

*Latin symbols*

$C_{CO_2}$	— CO <sub>2</sub> savings [g CO <sub>2</sub> /km]
CO <sub>2</sub>	— Carbon dioxide
CF	— Conversion factor (l/100 km) — (g CO <sub>2</sub> /km) [g CO <sub>2</sub> /l] 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 motor generator efficiency [%]
$\overline{s_{\eta_{MG}}}$	— 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 [l/kWh] as defined in Table 2
$\frac{\partial C_{CO_2}}{\partial \eta_{MG}}$	— Sensitivity of calculated CO <sub>2</sub> savings related to the efficiency of the motor generator

*Greek symbols*

- $\Delta$  — 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. Measurements and determination of the efficiency

The efficiency of the 12 V motor generator 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 efficient 12 V 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 efficient 12 V motor generator current intensity shall be defined as half of the rated current for all operating points. For each speed the voltage and the output current of the alternator shall be kept constant at 14,3 V.

Table 1

#### Operating points

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 operating point ( $\overline{\eta_{MG_i}}$ ) shall be calculated.

The efficiency of the motor generator ( $\eta_{MG}$ ) 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 type approval conditions ( $\Delta P_{mTA}$ ) as set out in Formula 3.

Formula 3

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

Where the saved mechanical power under real-world conditions ( $\Delta P_{mRW}$ ) shall be calculated in accordance with Formula 4 and the saved mechanical power under type-approval conditions ( $\Delta P_{mTA}$ ) in accordance with the following 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 750W

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

$\eta_B$ : 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 efficient 12 V motor generator shall be calculated in accordance with the following 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<sub>pe</sub>: Consumption of effective power specified in Table 2

Table 2

##### Consumption of effective power

Type of engine	Consumption of effective power (V <sub>pe</sub> ) [l/kWh]
Petrol	0,264
Petrol Turbo	0,280
Diesel	0,220

CF: Conversion factor (l/100 km) — (g CO<sub>2</sub>/km) [g CO<sub>2</sub>/l] as defined in Table 3

Table 3

##### Fuel conversion factor

Type of fuel	Conversion factor (l/100 km) — (g CO <sub>2</sub> /km) (CF) [g CO <sub>2</sub> /l]
Petrol	2 330
Diesel	2 640

#### 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 the following Formula 7:

Formula 7

$$s_{\overline{\eta_{MGi}}} = \frac{s_{\eta_{MGi}}}{\sqrt{m}} = \sqrt{\frac{\sum_{j=1}^m (\eta_{MGj} - \overline{\eta_{MGi}})^2}{m(m-1)}}$$

The standard deviation of the efficiency value of the efficient 12 V motor generator ( $s_{\eta_{MG}}$ ) shall be calculated in accordance with the following Formula 8:

Formula 8

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

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 the following 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 efficient 12 V motor generator that the error in the 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) of Implementing Regulation (EU) No 725/2011 (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]

$C_{CO_2}$ : total CO<sub>2</sub> saving [g CO<sub>2</sub>/km]

$s_{C_{CO_2}}$ : standard deviation of the total CO<sub>2</sub> saving [gCO<sub>2</sub>/km]

$\Delta CO_{2m}$ : CO<sub>2</sub> correction coefficient due to the positive mass difference between the efficient 12 V motor generator and the baseline alternator. For  $\Delta CO_{2m}$  the data in Table 4 is to be used.

Table 4

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

Type of fuel	CO <sub>2</sub> correction coefficient due to the positive mass difference ( $\Delta CO_{2m}$ ) [g CO <sub>2</sub> /km]
Petrol	0,0277 · $\Delta m$
Diesel	0,0383 · $\Delta m$

$\Delta m$  (in Table 4) is the extra mass due to the installation of the motor generator. It is the positive difference between the mass of the efficient 12 V motor generator and the mass of 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 certifications.

#### **7. The efficient 12 V motor generator to be fitted in vehicles**

The type approval authority is to certify the CO<sub>2</sub> savings based on measurements of the 12 V motor generator and the baseline alternator using the test methodology set out in this Annex. Where the CO<sub>2</sub> emission savings are below the threshold specified in Article 9(1) of Implementing Regulation (EU) No 725/2011 the second subparagraph of Article 11(2) of that Regulation shall apply.

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