

# DECISIONS

## COMMISSION IMPLEMENTING DECISION (EU) 2020/174

of 6 February 2020

**on the approval of the technology used in 12 Volt efficient alternators 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 12 April 2019, the manufacturers Toyota Motor Europe NV/SA, Opel Automobile GmbH – PSA, FCA Italy S.p. A., Automobile Citroën, Automobile Peugeot, PSA Automobiles SA, Mitsubishi Electric Corporation, Audi AG, Ford Werke GmbH, Jaguar Land Rover Ltd, Hyundai Motor Europe Technical Center GmbH, Bayerische Motoren Werke AG, Renault SA, Honda Motor Europe Ltd, Volkswagen AG, Volkswagen Nutzfahrzeuge, Daimler AG, Denso Corporation and SEG Automotive Germany GmbH submitted a joint application ('the application') for the approval as an innovative technology of the technology used in 12 Volt efficient alternators for use in passenger cars and light commercial vehicles with internal combustion engine powertrains.
- (2) The application has been assessed in accordance with Article 11 of Regulation (EU) 2019/631, Commission Implementing Regulations (EU) No 725/2011 <sup>(2)</sup> and (EU) 427/2014 <sup>(3)</sup> and the Technical Guidelines for the preparation of applications for the approval of innovative technologies pursuant to Regulation (EC) No 443/2009 of the European Parliament and of the Council <sup>(4)</sup> (July 2018 version). In accordance with Article 11(3) of Regulation (EU) 2019/631, the application was accompanied by a verification report undertaken by an independent and certified body.
- (3) The technology used in 12 Volt efficient alternators converting mechanical energy into electrical energy with a certain conversion efficiency rate has already been approved for use in passenger cars by Commission

<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 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).

<sup>(4)</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) <https://circabc.europa.eu/w/browse/f3927eae-29f8-4950-b3b3-d2e700598b52>

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> and for use in light commercial vehicles by Commission Implementing Decision (EU) 2018/1876 <sup>(11)</sup> (jointly referred to as 'past approval Implementing Decisions') as an innovative technology capable of reducing CO<sub>2</sub> emissions in a way that is not covered by the measurements performed as part of the emissions test under the New European Driving Cycle set out in Commission Regulation (EC) No 692/2008 <sup>(12)</sup>.

- (4) The application, however, refers to the new standard test procedure, the Worldwide Harmonised Light Vehicle Test Procedure (WLTP) set out in Commission Regulation (EU) 2017/1151 <sup>(13)</sup>, and it is demonstrated that also the measurements performed as part of the emissions test under the WLTP do not cover the CO<sub>2</sub> savings resulting from the technology used in 12 Volt efficient alternators.
- (5) Based on the experience gained from the assessment of applications concerning technologies that contribute to improving the efficiency of alternators in the framework of the past approval Implementing Decisions as well as on the reports and other information provided with the application, it has been satisfactorily and conclusively demonstrated that the technology used in 12 Volt efficient alternators meets the criteria specified in Article 11(2) of Regulation (EU) 2019/631 and the eligibility criteria specified in Article 9(1)(b) of Implementing Regulations (EU) No 725/2011 and (EU) No 427/2014.
- (6) The application sets out a methodology for testing CO<sub>2</sub> savings from the use of the technology in 12 Volt alternators in passenger cars and light commercial vehicles. In addition to referring to the WLTP, that methodology differs from the testing methodology set out in the past approval Implementing Decisions, principally by the definition of the power consumption, the definition of the average speed and the use of a run-in procedure.
- (7) It is appropriate to adjust the definitions of the power consumption and the average speed in order to take into account the WLTP. However, regarding the addition to the testing methodology of a run-in procedure for the alternator, the application does not set out with sufficient precision the details for how such run-ins should be performed nor how the run-in effects should be taken into account. Moreover, it is already integral to the existing testing methodology set out in the past approval Implementing Decisions that such effects may be taken into

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<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).

<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> 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> 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 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<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 306, 30.11.2018, p. 53).

<sup>(12)</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>(13)</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).

account, where necessary, by the requirement that the efficiency of the alternator must be measured at least five times. As the efficiency of alternators 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 application.

- (8) It is also appropriate to maintain the conversion efficiency rates at the same levels as those already approved by the past approval Implementing Decisions taking into account that no evidence has been provided to support that alternators with a lower conversion efficiency rate meet the market penetration requirement set out in Article 2(2)(a) of Implementing Regulations (EU) No 725/2011 and (EU) No 427/2014.
- (9) Taking into account the above considerations, the adjusted testing methodology should be considered appropriate for determining the CO<sub>2</sub> savings from the innovative technology in question.
- (10) 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 technology in 12 Volt efficient alternators that meets the conditions laid down in this Decision. 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 technology used in the 12 Volt efficient alternator 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.
- (11) In order to facilitate a wider deployment of 12 Volt efficient alternators 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 several 12 Volt efficient alternators. It is, however, appropriate to ensure that, where that possibility is used, a mechanism is applied that incentivises the deployment of only those alternators that offer the highest efficiency.
- (12) It is the responsibility of the type-approval authority to thoroughly verify that the conditions for certifying the CO<sub>2</sub> savings from use of an innovative technology as specified in this Decision are met. Where the certification is granted, the 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.
- (13) 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>(14)</sup>, it is necessary to attribute an individual code to the innovative technology.
- (14) From 2021, manufacturers' compliance with their specific CO<sub>2</sub> emissions targets is to be established on the basis of CO<sub>2</sub> emissions determined in accordance with the WLTP. 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 from the calendar year 2021 onwards,

HAS ADOPTED THIS DECISION:

#### *Article 1*

#### **Innovative technology**

The technology used in 12 Volt efficient alternators intended for the conversion of mechanical energy into electrical energy is approved as an innovative technology within the meaning of Article 11 of Regulation (EU) 2019/631, taking into account that it is not covered by the standard test procedure set out in Regulation (EU) 2017/1151 and provided that the innovative technology conforms to the following conditions:

- (a) it is fitted in internal combustion engine powered passenger cars (M1) and light commercial vehicles (N1);

<sup>(14)</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).

- (b) it is used solely to charge the vehicle battery and to power the electrical system of the vehicle when its combustion engine is running;
- (c) it has an efficiency, i.e. a conversion rate from mechanical into electric power, of at least:
  - (i) 73,8 % for petrol-fuelled vehicles other than turbo-charged;
  - (ii) 73,4 % for turbo-charged petrol-fuelled vehicles;
  - (iii) 74,2 % for diesel-fuelled vehicles.

#### *Article 2*

### **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 technology') in one or several 12 Volt efficient alternators 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 the 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 4(1) are recorded in the certificates of conformity of the vehicles concerned.

#### *Article 3*

### **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 technology in more than one 12 Volt efficient alternator in relation to one vehicle version, the type-approval authority shall determine which of the 12 Volt efficient alternators tested delivers the lowest CO<sub>2</sub> savings. That value shall be used for the purposes of paragraph 3.
3. The type-approval authority shall record the certified CO<sub>2</sub> savings determined in accordance with paragraph 1 or 2 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<sub>2</sub> savings, if it finds that the technology used in the 12 Volt efficient alternator or alternators comply with the conditions set out in Article 1, and if the CO<sub>2</sub> savings achieved are 0,5 g CO<sub>2</sub>/km or higher as specified in Article 9(1)(b) of Implementing Regulation (EU) No 725/2011 in the case of passenger cars or of Implementing Regulation (EU) No 427/2014 in the case of light commercial vehicles.

#### *Article 4*

### **Eco-innovation code**

1. The innovative technology approved by this Decision is attributed with the eco-innovation code No 29.
2. The certified CO<sub>2</sub> savings recorded by reference to that eco-innovation code may be taken into account for the calculation of the average specific emissions of manufacturers starting from the calendar year 2021.

*Article 5***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, 6 February 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 a 12 V efficient alternator in passenger cars and light commercial vehicles with internal combustion engine powertrain (fulfilling the conditions specified in Article 1 by reference to the Worldwide Harmonized Light Vehicle Test Procedure)**

## 1. INTRODUCTION

In order to determine the CO<sub>2</sub> savings that can be attributed to the use of a 12 V efficient alternator in a passenger car and light commercial vehicle with internal combustion engine powertrain, it is necessary to specify the following:

- (1) the testing conditions;
- (2) the test equipment;
- (3) the procedure to determine the total efficiency;
- (4) the procedure to determine the CO<sub>2</sub> savings;
- (5) the procedure to determine the uncertainty 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) [gCO <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]
$s_{\eta_{EI}}$	-	Standard deviation of the eco-innovative alternator efficiency [%]
$\overline{s_{\eta_{EI}}}$	-	Standard deviation of the eco-innovative alternator 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 Worldwide harmonised Light-duty vehicles Test Cycle (WLTC) [km/h]
$V_{Pe}$	-	Consumption of effective power [l/kWh] as defined in Table 2
$\frac{\partial C_{CO_2}}{\partial \eta_{EI}}$	-	Sensitivity of calculated CO <sub>2</sub> savings related to the efficiency of the eco-innovative alternator

*Greek symbols*

$\Delta$	-	Difference
$\eta$	-	Baseline alternator efficiency [%]
$\eta_{EI}$	-	Efficient alternator efficiency [%]
$\overline{\eta_{EI_i}}$	-	Mean of the eco-innovative alternator efficiency at operating point i [%]

*Subscripts*

Index (i) refers to operating point

Index (j) refers to measurement of the sample

EI	-	Eco-innovative
m	-	Mechanical
RW	-	Real-world conditions
TA	-	Type-approval conditions
B	-	Baseline

## 3. TEST CONDITIONS

The testing conditions shall fulfil the requirements specified in ISO 8854:2012 <sup>(1)</sup>.

## 4. TEST EQUIPMENT

The test equipment shall be in accordance with the specifications set out in ISO 8854:2012.

## 5. MEASUREMENTS AND DETERMINATION OF THE EFFICIENCY

The efficiency of the 12 V efficient alternator shall be determined in accordance with ISO 8854:2012, with the exception of the elements specified in the present paragraph.

The measurements shall be conducted at different operating points *i*, as defined in Table 1. The alternator current intensity is defined as half of the rated current for all operating points. For each speed the voltage and the output current of the alternator are to be kept constant, the voltage at 14,3 V.

Table 1

Operating point <i>i</i>	Holding time [s]	Rotational frequency <i>n<sub>i</sub></i> [min <sup>-1</sup> ]	Frequency <i>h<sub>i</sub></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 shall be calculated in accordance with Formula 1.

*Formula 1*

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

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

The efficiency of the eco-innovative alternator ( $\eta_{EI}$ ) shall be calculated in accordance with Formula 2

<sup>(1)</sup> ISO 8854:2012 Road vehicles – Alternators with regulators – Test methods and general requirements Reference number ISO 8854:2012, published on 1 June 2012.

Formula 2

$$\eta_{EI} = \sum_{i=1}^4 h_i \cdot \overline{\eta_{EI_i}}$$

The efficient alternator leads to saved mechanical power under real-world conditions ( $\Delta P_{mRW}$ ) and type approval conditions ( $\Delta P_{mTA}$ ) as defined in Formula 3.

Formula 3

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

where the saved mechanical power under real-world conditions ( $\Delta P_{mRW}$ ) is calculated in accordance with Formula 4 and the saved mechanical power under type-approval conditions ( $\Delta P_{mTA}$ ) in accordance with Formula 5.

Formula 4

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

Formula 5

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

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%

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

The CO<sub>2</sub> savings of the efficient alternator are to be calculated 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 WLTC [km/h], which is 46,60 km/h

$V_{Pe}$ : Consumption of effective power specified in the following Table 2:

Table 2

### 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



CF: Factor specified in the following Table 3:

Table 3

**Fuel conversion factor**

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

7. 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

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

The standard deviation of the efficiency value of the efficient alternator ( $s_{\eta_{EI}}$ ) shall be calculated in accordance with Formula 8:

Formula 8

$$s_{\eta_{EI}} = \sqrt{\sum_{i=1}^4 (h_i \cdot s_{\overline{\eta_{EI_i}}})^2}$$

The standard deviation of the alternator efficiency ( $s_{\eta_{EI}}$ ) leads to an error in the CO<sub>2</sub> savings ( $s_{C_{CO_2}}$ ). That error shall be calculated in accordance with Formula 9:

Formula 9

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

8. STATISTICAL SIGNIFICANCE

It has to be demonstrated for each type, variant and version of a vehicle fitted with the efficient alternator 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 Regulation (EU) No 725/2011 (see Formula 10).

Formula 10

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

Where:

MT: Minimum threshold [gCO<sub>2</sub>/km]

C<sub>CO<sub>2</sub></sub>: Total CO<sub>2</sub> saving [gCO<sub>2</sub>/km]

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

ΔCO<sub>2m</sub>: CO<sub>2</sub> correction coefficient due to the positive mass difference between the efficient alternator and the baseline alternator. ΔCO<sub>2m</sub> shall be calculated following Table 4:

Table 4

CO <sub>2</sub> correction coefficient due to the extra mass	
Petrol (ΔCO <sub>2mP</sub> ) [g CO <sub>2</sub> /km kg]	0,0277•Δm
Diesel (ΔCO <sub>2mD</sub> ) [g CO <sub>2</sub> /km kg]	0,0383•Δm

In Table 4, 'Δm' is the extra mass due to the installation of the efficient alternator. It is the positive difference between the mass of the efficient alternator and the mass of baseline alternator. The mass of the baseline alternator is 7 kg. On the evaluation of the extra mass the manufacturer must hand over verified documentation to the type-approval authority.

#### 9. TEST AND EVALUATION REPORT

The report shall include:

- Model and mass of the tested alternators
- Description of the bench
- Test results (measured values)
- Calculated results and corresponding formulae.

#### 10. THE EFFICIENT ALTERNATOR TO BE FITTED IN VEHICLES

The type-approval authority shall certify the CO<sub>2</sub> savings based on measurements of the efficient alternator 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), the second subparagraph of Article 11(2) of Regulation (EU) No 725/2011 shall apply.