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► **B****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 CO₂ emissions from passenger cars pursuant to Regulation (EC) No 443/2009 of the European Parliament and of the Council

(Text with EEA relevance)

(OJ L 101, 16.4.2016, p. 17)

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		No	page	date
► <u>M1</u>	Commission Implementing Decision (EU) 2019/1861 of 31 October 2019	L 286	15	7.11.2019
► <u>M2</u>	Commission Implementing Decision (EU) 2020/1168 of 6 August 2020	L 258	27	7.8.2020

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*Article 1***Approval**

The technology used in the Mazda light emitting diodes (LED) lighting and in the Honda LED lighting is approved as an innovative technology within the meaning of Article 12 of Regulation (EC) No 443/2009.

*Article 2***Application for certification of CO₂ savings****▼M2**

1. The manufacturer may apply for the certification of CO₂ savings from one or several exterior LED lighting intended for use in internal combustion engine M₁ vehicles or in not off-vehicle charging hybrid electric M₁ vehicles (NOVC-HEVs) 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, including such vehicles that are capable of running on liquefied petroleum gas (LPG), compressed natural gas (CNG) or E85 in addition to petrol or diesel, or a combination of those fuels, and provided that the vehicles are fitted with one or a combination of the following LED lights:

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- (a) low beam headlamp;
- (b) high beam headlamp;
- (c) front position lamp;
- (d) front fog lamp;
- (e) rear fog lamp;
- (f) front turn signal lamp;
- (g) rear turn signal lamp;
- (h) licence plate lamp;
- (i) reversing lamp.

The LED light or the combination of LED lights forming the efficient exterior LED lighting shall as a minimum provide the CO₂ reduction specified in ►**M2** Article 9(1)(a) ◄ of Regulation (EU) No 725/2011.

2. An application for the certification of the savings from one or several efficient exterior LED lighting shall be accompanied by an independent verification report certifying that that or those LED lighting complies with the conditions set out in paragraph 1.

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3. The type approval authority shall reject the application for certification if it finds that one or several exterior LED lighting do not comply with the conditions set out in paragraph 1.

*Article 3***Certification of CO₂ savings**

1. The reduction in CO₂ emissions from the use of efficient exterior LED lighting 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 CO₂ savings from more than one efficient exterior LED lighting referred to in Article 2(1) in relation to one vehicle version, the type approval authority shall determine which of the efficient exterior LED lighting tested delivers the lowest CO₂ 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.

▼M2

3. Where the efficient exterior vehicle LED lights are fitted in a bi-fuel or flex-fuel vehicle, the approval authority shall record the CO₂ savings as follows:

- (a) for a bi-fuel vehicle using petrol and gaseous fuels, the CO₂ savings value with regard to LPG or CNG;
- (b) for a flex-fuel vehicle using petrol and E85, the CO₂ savings value with regard to petrol.

4. The certified CO₂ savings recorded by reference to eco-innovation code No 19 may only be taken into account for the calculation of the average specific emissions of manufacturers until 31 December 2020.

▼B*Article 4***Eco-innovation code**

The eco-innovation code No 19 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 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*.

▼ B*ANNEX***METHODOLOGY TO DETERMINE THE CO₂ SAVINGS OF EXTERIOR VEHICLE LIGHTING USING LIGHT EMITTING DIODES (LED).****1. INTRODUCTION**

In order to determine the CO₂ emission reductions that can be attributed to a package of efficient exterior LED lights consisting of an appropriate combination of vehicle lights referred to in Article 2 for the use in an M₁ vehicle, it is necessary to establish the following:

- (1) testing conditions;
- (2) test equipment;
- (3) determination of the power savings;
- (4) calculation of the CO₂ savings;
- (5) calculation of the statistical error.

2. SYMBOLS, PARAMETERS AND UNITS**Latin symbols**

C_{CO_2} — CO₂ savings [g CO₂/km]

CO₂ — Carbon dioxide

▼ M2

CF — Conversion factor as defined in Table 3

▼ B

m — Number of efficient exterior LED lights composing the package

n — Number of measurements of the sample

P — Power consumption of the vehicle light [W]

$S_{P_{EI}}$ — Standard deviation of the LED light power consumption [W]

$\overline{S_{P_{EI}}}$ — Standard deviation of the LED light power consumption mean [W]

$S_{C_{CO_2}}$ — Standard deviation of the total CO₂ savings [g CO₂/km]

UF — Usage factor [-] as defined in Table 4

v — Mean driving speed of the New European Driving Cycle (NEDC) [km/h]

▼ M2

V_{Pe} — Consumption of effective power as defined in Table 2

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$\frac{\partial C_{CO_2}}{\partial P_{EI}}$ — Sensitivity of calculated CO₂ savings related to the LED light power consumption

Greek symbols

Δ — Difference

η_A — Alternator efficiency [%]

▼ B**Subscripts**

Index (i) refers to vehicle lights

Index (j) refers to measurement of the sample

EI — Eco-innovative

RW — Real-world conditions

TA — Type approval conditions

B — Baseline

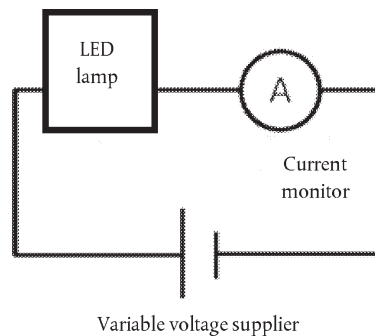
3. TESTING CONDITIONS

The testing conditions shall fulfil the requirements of Regulation UN/ECE No 112 ⁽¹⁾ on Uniform provisions concerning the approval of motor vehicle headlamps emitting an asymmetrical passing beam or a driving beam or both and equipped with filament lamps and/or light-emitting diode (LED) modules. The power consumption shall be determined in accordance with point 6.1.4 of Regulation UN/ECE No 112 and points 3.2.1 and 3.2.2 of Annex 10 to that Regulation.

4. TEST EQUIPMENT

The following equipment is to be used, as shown in the figure:

- a power supply unit (i.e. variable voltage supplier);
- two digital multimeters, one for measuring the DC-current, and the other for measuring the DC-voltage. In the figure, a possible test set-up is shown, when the DC-voltage meter is integrated in the power supply unit.



Test set-up

5. MEASUREMENTS AND DETERMINATION OF THE POWER SAVINGS

For each efficient exterior LED light included in the package the measurement of the current shall be performed as shown in the figure at a voltage of 13,2 V. LED module(s) operated by an electronic light source control gear, shall be measured as specified by the applicant.

The manufacturer may request that other measurements of the current shall be done at other additional voltages. In that case, the manufacturer must hand over verified documentation on the necessity to perform these other measurements to the type-approval authority. The measurements of the currents at each of those additional voltages are to be performed consecutively at least five (5) times. The exact installed voltages and the measured current is to be recorded in four decimals.

⁽¹⁾ E/ECE/324/Rev.2/Add.111/Rev.3 — E/ECE/TRANS/505/Rev.2/Add.111/Rev.3, 9 January 2013

▼ B

The power consumption has to be determined by multiplying the installed voltage with the measured current. The average of the power consumption for each efficient exterior LED light ($\overline{P_{ELi}}$) has to be calculated. Each value must be expressed in 4 decimals. When a stepper motor or electronic controller is used for the supply of the electricity to the LED lamps, then the electric load of this component part is to be excluded from the measurement.

The resulting power savings of each efficient exterior LED light (ΔP_i) are to be calculated with the following formula:

Formula 1

$$\Delta P_i = P_{B_i} - \overline{P_{ELi}}$$

where the power consumption of the corresponding baseline vehicle light is defined by Table 1.

Table 1

Power requirements for different baseline vehicle lights

Vehicle light	Total electric power (P_B) [W]
Low beam headlamp	137
High beam headlamp	150
Front position	12
License plate	12
Front fog lamp	124
Rear fog lamp	26
Front turn signal lamp	13
Rear turn signal lamp	13
Reversing lamp	52

6. CALCULATION OF THE CO₂ SAVINGS

The total CO₂ savings of the lighting package are to be calculated by Formula 2.

Formula 2

$$C_{CO_2} = \left(\sum_{i=1}^m \Delta P_i \cdot UF_i \right) \cdot \frac{V_{PE} \cdot CF}{\eta_A \cdot v}$$

where

v : Mean driving speed of the NEDC [km/h], which is 33,58 km/h

η_A : Alternator efficiency [%], which is 67 %

▼ M2

V_{Pe} : Consumption of effective power as defined in Table 2

▼ **M2**

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 ³ /kWh]
CNG (G20)	0,259
CNG (G20) Turbo	0,275

CF : Conversion factor as defined in Table 3

Table 3

Fuel conversion factor (CF)

Type of fuel	Conversion factor (CF) [gCO ₂ /l]
Petrol/E85	2 330
Diesel	2 640
LPG	1 629
	Conversion factor (CF) [gCO ₂ /m ³]
CNG (G20)	1 795

▼ **B**

UF : Usage factor of the vehicle light [-] as defined in Table 4

Table 4

Usage factor for different vehicle lights

Vehicle light	Usage factor (UF) [-]
Low beam headlamp	0,33
High beam headlamp	0,03
Front position	0,36
License plate	0,36
Front fog lamp	0,01
Rear fog lamp	0,01
Front turn signal lamp	0,15
Rear turn signal lamp	0,15
Reversing lamp	0,01

▼B**7. CALCULATION OF THE STATISTICAL ERROR**

The statistical errors in the outcomes of the testing methodology caused by the measurements are to be quantified. For each efficient exterior LED light included in the package the standard deviation is calculated as defined by Formula 3.

Formula 3

$$S_{\overline{P_{El_i}}} = \frac{S_{P_{El_i}}}{\sqrt{n}} = \sqrt{\frac{\sum_{j=1}^n (P_{El_j} - \overline{P_{El_i}})^2}{n(n-1)}}$$

where:

n: Number of measurements of the sample, which is at least 5

The standard deviation of the power consumption of each efficient exterior LED light ($S_{\overline{P_{El_i}}}$) leads to an error in the CO₂ savings ($S_{C_{CO_2}}$). This error is to be calculated by means of Formula 4

Formula 4

$$S_{C_{CO_2}} = \sqrt{\sum_{i=1}^m \left(\frac{\partial C_{CO_2}}{\partial P_{El_i}} \cdot S_{\overline{P_{El_i}}} \right)^2} = \sqrt{\sum_{i=1}^m \left(U_{Fi} \cdot S_{\overline{P_{El_i}}} \right)^2} \cdot \frac{V_{Pe} \cdot CF}{\eta_A \cdot v}$$

8. STATISTICAL SIGNIFICANCE

It has to be demonstrated for each type, variant and version of a vehicle fitted with the combination of the efficient exterior LED lights that the error in the CO₂ savings calculated with Formula 4 is not greater than the difference between the total CO₂ savings and the minimum savings threshold specified in Article 9(1) of Implementing Regulation (EU) No 725/2011 (see Formula 5).

Formula 5

$$MT \leq C_{CO_2} - S_{C_{CO_2}}$$

where:

MT: Minimum threshold [gCO₂/km], which is 1 gCO₂/km

Where the total CO₂ emission savings of the of the package of the efficient exterior LED lights, as a result of the calculation using Formula 5, 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.