Commission Implementing Decision 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 CO2 emissions from passenger cars pursuant to Regulation (EC) No 443/2009 of the European Parliament and of the Council (Text with EEA relevance) (2013/128/EU)

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ANNEX

Methodology for determining the reduction in CO_2 emissions due to the use of LED lights in the low beam headlamps, the high beam headlamps, and the licence plate lamps

1. INTRODUCTION

In order to determine the CO_2 reductions that can be attributed to the use of LEDs in the low beam headlamps, the high beam headlamps, and the licence plate lamps fitted to M1 vehicles the following are to be established:

(a) the electric power consumption of the LED lights used in the lighting functions in question;

(b) the savings in electric power consumption compared to the base line technology, i.e. halogen lights;

(c) the reduction in CO_2 emissions due to the savings in the electric power consumption.

2. DETERMINATION OF THE ELECTRIC POWER CONSUMPTION OF THE LEDS

The electric power consumption of the LEDs for each of the lighting functions concerned is to be determined as the multiplication of the battery voltage and the electric current of each lighting unit with the number of lights of each lighting unit, according to the formula:

$$PLED = U \times I \times n$$

;

PLED : electric power consumption of an LED lighting function (W);
U : battery voltage (V) This value can be measured with a multimeter;
I : electric current (A). This value can be measured with a multimeter;
n : number of lights in function.

The measurement of the power consumption of the LEDs may be done separate from the NEDC hot test (see point 4 of this Annex).

3. DETERMINATION OF THE SAVINGS IN ELECTRIC POWER CONSUMPTION DUE TO THE USE OF LEDS

The savings in electric power consumption due to the LEDs are to be determined by comparing the electric power consumption of the baseline technology with that of the LEDs for each of the relevant lighting functions.

The total savings resulting from the comparison are to be multiplied by a usage factor representing the time during which the LEDs are fully activated.

The values specified in the table are to be applied for the electric power consumption of the base line technology and for the usage factors.

Lighting Function	Total electric power consumption of the base line technology (halogen lights) (W)[a]	Usage factor (%)[b]

a Electric energy consumption as determined in the Technical Guidelines for the preparation of applications for the approval of innovative technologies pursuant to Regulation (EC) No 443/2009, 'the Technical Guidelines'.

b The usage factors as determined in the Technical Guidelines.

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Low beam lamp	137	33
High beam lamp	150	3
Licence plate lamp	12	36

a Electric energy consumption as determined in the Technical Guidelines for the preparation of applications for the approval of innovative technologies pursuant to Regulation (EC) No 443/2009, 'the Technical Guidelines'.

b The usage factors as determined in the Technical Guidelines.

4. DETERMINATION OF THE REDUCTION IN CO_2 EMISSIONS DUE TO THE SAVINGS IN THE ELECTRIC POWER CONSUMPTION

In order to quantify the impact of the electric power consumption on the CO_2 emissions the vehicle is to be tested on a chassis dynamometer by running a hot start NEDC test as specified in Annex 4a to Regulation No 83 of the Economic Commission for Europe of the United Nations (UN/ECE) — Uniform provisions concerning the approval of vehicles with regard to the emission of pollutants according to engine fuel requirements[(1)].

In order to ensure repeatability of the measurement, the power of the additional electrical load must be significantly higher than the potential electrical power saving of the LEDs (the saving is less than 40 W). An additional load causing an extra electrical power production of the alternator of ~750 W is to be therefore selected.

In total 10 hot start NEDC tests are to be performed of which five with and five without the additional load of ~750 Watt. In order to minimise the variability of the test results, the oil temperature, ambient temperature, and the time between the experiments are to be monitored and kept constant at the start of the test.

For these variables and for the road load setting the following specifications are to be followed:

— the road load setting of the chassis dynamometer is to be determined according to the procedure for the calibration of the dynamometer as defined in Annex 7 to Regulation No 83 (UN/ECE);

— the engine is to be warmed up at the start of the test, i.e. the oil temperature shall be 92 °C < T < 96 °C;

— the ambient temperature is to be 22,0 °C < T < 23,8 °C;

— the time between the tests is not to exceed 45 minutes.

The following measurements are to be performed:

— the electric output of the alternator measured with the additional electric load of ~750 W (5 tests) (potentiometer) and without the additional load (5 tests);

— CO_2 emissions.

5. DETERMINATION OF THE CO_2 EMISSIONS REDUCTIONS AND THE DETERMINATION OF THE STATISTICAL SIGNIFICANCE

The difference between the average CO_2 emissions resulting from the ten tests performed in accordance with point 4 is to be multiplied with the average electric power savings determined in accordance with point 3 divided by the difference between the average electric power consumption resulting from the two tests performed with and without the additional electric load, i.e.:

$$C_{iCO_2} = (M_{iC} - M_{iNC}) \times \frac{\Delta P_M}{P_{iC} - P_{iNC}}$$

C_{iCO_2} : CO_2 saving of the LED lights (g/km)

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M_{iC}	:	CO_2 mass emissions with additional electric load (g/km)
M_{iNC}	:	CO_2 mass emissions without additional electric load (g/km)
ΔP_M	:	average electrical power saving by using LED (W)
P_{iC}	:	average electrical power consumption with additional consumer (W)
P_{iNC}	:	average electrical power consumption without additional consumer (W)

The statistical significance of the measured effects is to be determined by calculating the standard deviation of the measured CO_2 values (with and without the additional load) and by comparing the difference of the measured CO_2 values (with and without the additional load) with the standard deviation. The difference of the measured CO_2 values is to be more than 3 times the standard deviation.

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(**1**) OJ L 42, 15.2.2012, p. 1.

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