DECISIONS

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_2 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_2 emissions from light-duty vehicles ([1]), and in particular Article 12(4) thereof,

Whereas:

(1) On 27 May 2015 the supplier Mitsubishi Electric Corporation (MELCO), represented in the Union by Mitsubishi Electric Automotive Europe B.V. (the 'Applicant'), submitted an application for the approval of its second innovative technology: the MELCO motor generator. The completeness of the application was assessed in accordance with Article 4 of Commission Implementing Regulation (EU) No 725/2011 ([2]). The application was found to be complete and the period granted to the Commission for its assessment of the application, pursuant to Article 10(2) of that Regulation, started on 28 May 2015.

(2) The application 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 ([3]) (the 'Technical Guidelines'). The information provided in the application demonstrates that the conditions and 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.

(3) The MELCO motor generator has a generator function similar to a regular alternator. As compared to a baseline alternator, it reduces stator copper loss by way of an ultra-high fill-factor stator manufactured by an ultra-high density wire winding method and by way of a new 2-way cooling structure. It also reduces stator iron loss by way of a thin and high-grade electromagnetic steel stator core. Finally, it reduces rectification loss by way of a new Metal-Oxide-Semiconductor Field-Effect-Transistor module.

(4) The Applicant has demonstrated that a motor generator of the kind described in the application was fitted in 3 % or less of all new passenger cars registered in the reference year 2009 in accordance with Article 2(2)(a) of Implementing Regulation (EU) No 725/2011.

(5) In order to determine the CO_2 savings that the innovative technology will deliver when fitted to a vehicle, it is necessary to define the baseline technology against which the efficiency of the innovative technology should be compared, as provided for in Articles 5 and 8 of Implementing Regulation (EU) No 725/2011. In accordance with the simplified approach chosen by the Applicant and described in the Technical Guidelines, it is appropriate to consider a 12 V alternator with 67 % efficiency as the baseline technology, as designated by the Applicant.

(6) The Applicant has provided a methodology for testing and calculating the CO_2 reductions which includes formulae that are consistent with the formulae described in the Technical Guidelines for the simplified approach with regard to efficient alternators. In order to accurately determine the statistical significance the formula should

([1]) OJ L 140, 5.6.2009, p. 1.

([2]) 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_2 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).

([3]) https://circabc.europa.eu/d/a/workspace/SpacesStore/42c4a33e-6fd7-44aa-adac-f28620bd436f/Technical%20Guidelines%20February%202013.pdf

however also take into account the need to evaluate the mass of the motor generator as compared to the mass of the baseline alternator (i.e. 7 kg). In order to ensure that the same weighting factors and speed points are used, the manufacturer should, for the purpose of certifying the savings, provide evidence that the speed ranges of the MELCO motor generator are consistent with those applicable to alternators. Such methodology will provide results that are verifiable, repeatable and comparable and it is capable of demonstrating in a realistic manner the CO_2 emissions benefits of the innovative technology with strong statistical significance in accordance with Article 6 of Implementing Regulation (EU) No 725/2011.

(7) Against that background, the Applicant has demonstrated satisfactorily that the emission reduction achieved by the innovative technology is at least 1 g CO_2/km.

(8) The savings of the innovative technology may be partially demonstrated on the standard test cycle, and 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.

(9) The verification report established by the accredited technical service UTAC, which is an independent and certified body, supports the findings set out in the application.

(10) Therefore, no objections should be raised as regards the approval of the innovative technology in question.

(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 [1], the individual code to be used for the innovative technology approved by this Decision should be specified,

HAS ADOPTED THIS DECISION:

Article 1

1. The MELCO motor generator as described in the application submitted by Mitsubishi Electric Automotive Europe B.V., representing Mitsubishi Electric Corporation (MELCO) in the Union, intended for use in vehicles of category M_1 is approved as an innovative technology within the meaning of Article 12 of Regulation (EC) No 443/2009.

2. The CO_2 emissions reduction from the use of the motor generator referred to in paragraph 1 shall be determined using the methodology set out in the Annex.

3. The code of the eco-innovation to be entered into type approval documentation for the innovative technology approved by this Decision shall be '16'.

Article 2

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, 25 February 2016.

For the Commission

The President

Jean-Claude JUNCKER

[1] Directive 2007/46/EC of the European Parliament and of 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

1. INTRODUCTION

In order to determine the CO_2 savings that can be attributed to the use of the motor generator in an M_1 vehicle, it is necessary to specify the following:

(1) the testing conditions;

(2) the test equipment;

(3) the determination of the efficiency of the innovative technology and the baseline technology;

(4) the calculation of the CO_2 savings;

(5) the calculation of the statistical error and significance of the results.

2. SYMBOLS, PARAMETERS AND UNITS

Latin symbols

C_{CO_2} — CO_2 savings [g CO_2/km]

CO_2 — Carbon dioxide

CF — Conversion factor (l/100 km) — (g CO_2/km) [gCO_2/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^{-1}] as defined in Table 1

P — Power [W]

$s_{\eta_{MG}}$ — Standard deviation of 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_2 savings [g CO_2/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_2 savings related to the efficiency of the motor generator

Greek symbols

Δ — Difference

η_B — Baseline alternator efficiency [%]

η_{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. TEST CONDITIONS

The testing conditions shall fulfil the requirements specified in ISO 8854:2012 ([1]).

4. TEST EQUIPMENT

The test equipment shall be in accordance with the specifications set out in ISO 8854:2012 ([1]).

5. MEASUREMENTS AND DETERMINATION OF THE EFFICIENCY

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

Evidence shall be provided to the type approval authority that the speed ranges of the motor generator are consistent with those described below. The measurements shall be conducted at different operating points i, as defined in Table 1. The motor generator 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 motor generator are to be kept constant, the voltage at 14,3 V.

Table 1

Operating points

Operating point i	Holding time [s]	Rotational frequency n_i [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

([1]) ISO 8854:2012 Road vehicles — Alternators with regulators — Test methods and general requirements Reference number ISO 8854:2012, published on 1 June 2012.

The efficiency shall be calculated in accordance with 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 ($\overline{\eta_{MG_i}}$) has to be calculated.

The efficiency of the motor generator (η_{MG}) shall be calculated in accordance with 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 (ΔP_{mRW}) and type approval conditions (ΔP_{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 (ΔP_{mRW}) is calculated in accordance with Formula 4 and the saved mechanical power under type-approval conditions (ΔP_{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

η_B: Efficiency of the baseline alternator [%], which is 67 %

6. CALCULATION OF THE CO_2 SAVINGS

The CO_2 savings of the motor generator are to be calculated with the following formula.

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 [l/kWh] as defined 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: Conversion factor (l/100 km) — (g CO_2/km) [gCO_2/l] as defined in the following Table 3

Table 3

Fuel conversion factor

Type of fuel	Conversion factor (l/100 km) — (g CO_2/km) (CF) [gCO_2/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 are to be quantified. For each operating point the standard deviation is calculated as defined by the following formula:

Formula 7

$$s_{\overline{\eta_{MG_i}}} = \frac{s_{\eta_{EI_i}}}{\sqrt{m}} = \sqrt{\frac{\sum_{j=i}^{m} \left(\eta_{MG_{i_j}} - \overline{\eta_{MG_i}}\right)^2}{m(m-1)}}$$

The standard deviation of the efficiency value of the motor generator ($s_{\eta_{MG}}$) is calculated in accordance with Formula 8:

Formula 8

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

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

Formula 9

$$s_{C_{co_2}} = \sqrt{\left(\frac{\partial C_{CO_2}}{\partial \eta_{MG}} \cdot s_{\eta_{MG}}\right)^2} = \frac{(P_{RW} - P_{TA})}{\eta_{MG}^2} \cdot \frac{V_{Pe} \cdot CF}{v} \cdot s_{\eta_{MG}}$$

8. STATISTICAL SIGNIFICANCE

It has to be demonstrated for each type, variant and version of a vehicle fitted with the motor generator that the error in the CO_2 savings calculated in accordance with Formula 9 is not greater than the difference between the total CO_2 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_2/km], which is 1 gCO_2/km

ΔCO_{2m}: CO_2 correction coefficient due to the positive mass difference between the motor generator and the baseline alternator. For ΔCO_{2m} the data in Table 4 is to be used.

Table 4

CO_2 correction coefficient due to the extra mass

Type of fuel	CO_2 correction coefficient due to the extra mass (ΔCO_{2m}) [g CO_2/km]
Petrol	0,0277 · Δm
Diesel	0,0383 · Δm

In Table 4 Δm is the extra mass due to the installation of the motor generator. It is the positive difference between the mass of the motor generator and the mass of the baseline alternator. The mass of the baseline alternator is 7 kg.

9. THE MOTOR GENERATOR TO BE FITTED IN VEHICLES

The type approval authority is to certify the CO_2 savings based on measurements of the motor generator and the baseline alternator using the test methodology set out in this Annex. Where the CO_2 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.